OVERVIEW OF THE CME GROUP FEEDER CATTLE FUTURES CONTRACT

Justin Bina and Ted C. Schroeder[1]
Kansas State University, Department of Agricultural Economics – June 2019

The CME Group feeder cattle futures contract plays several important roles in the feeder cattle market. The contract contributes greatly to price discovery in a decentralized and heterogeneous feeder cattle cash market. That is, feeder futures help determine a market-clearing price for an asset with geographically dispersed supply and demand. In addition, the contract is the primary alternative for price risk management in the feeder cattle market. As such, assessing the effectiveness of the contract as a risk management tool is important for market users.

This study addresses the performance of the feeder cattle futures contract. In particular, trade volume, volatility, and price discovery performance are assessed both across time and in comparison to other agricultural derivatives. In addition, we analyze the representativeness of the CME Feeder Cattle Index—a cash-settled commodity index which determines the futures contract final settlement price at termination of trading. Our research aims to provide a better understanding of the performance of the CME Group feeder cattle futures contract and to determine whether the contract remains an effective instrument for managing price risk.

Contract Specifications

Basic contract and trading specifications for CME Group feeder cattle futures are depicted in Table 1. Additional information can be found online at cmegroup.com.

Table 1. **Feeder Cattle Futures Contract Specifications**

Contract Unit	50,000 pounds (≈23 metric tons)
Price Quotation	cents per pound
Trading Hours	M–F: 8:30am to 1:05pm CT
Minimum Price Fluctuation/Tick Size	$0.00025 per pound ($12.50 per contract)
Daily Price Limits	$0.045 per pound above or below the previous day's settlement price. All contract months expand to $0.0675 per pound on the following business day should either of the first two listed contract months settle at limit.
Contract Months	(8) January, March, April, May, August, September, October, November
Settlement Method	Financially settled to the CME Feeder Cattle Index
Termination of Trading	Last Thursday of the contract month with exceptions for November and other months

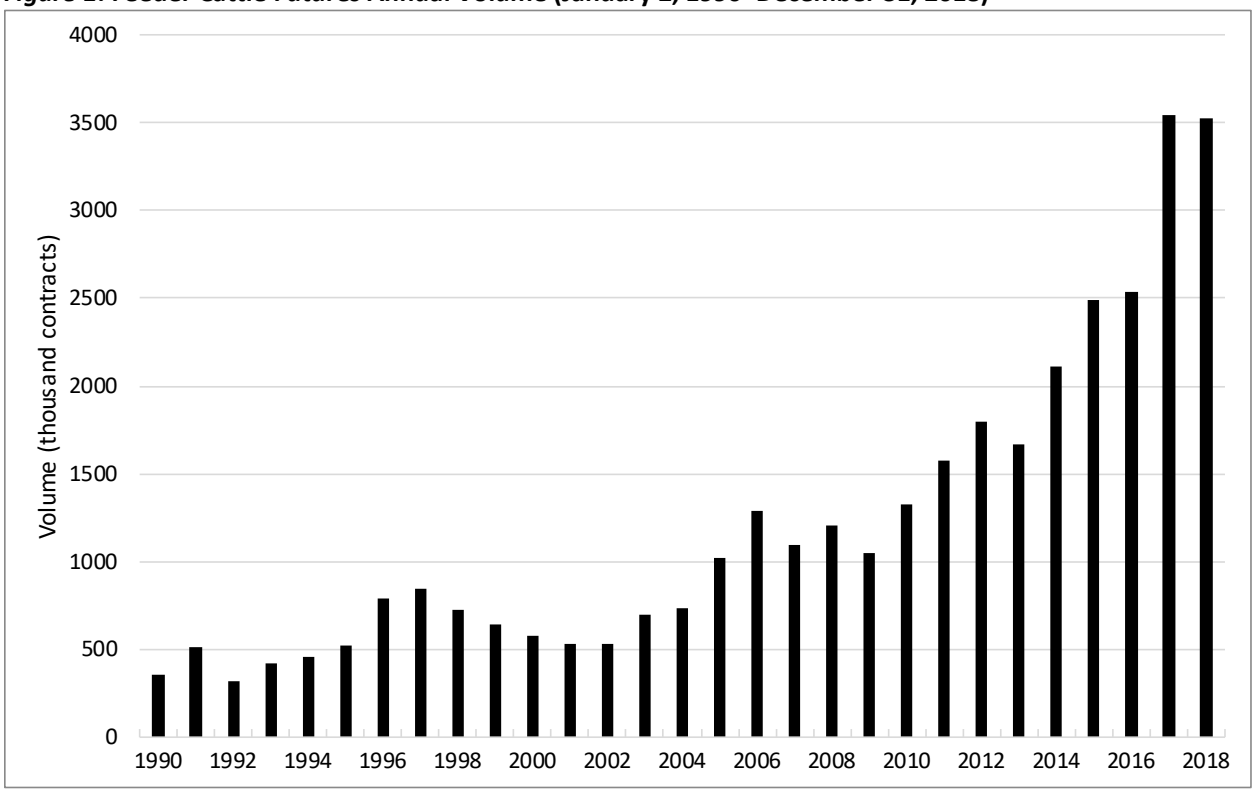
Source: CME Group

[1] Bina is a graduate research assistant and Schroeder is a professor. Contact Ted Schroeder, tcs@ksu.edu.

Evaluating Trade Volume

Feeder Cattle Futures Volume. To assess CME Group feeder cattle futures contract trade volume over time we first analyzed annual trading volume data for the entire contract. Trade volumes for all contract months of feeder cattle futures were obtained from Bloomberg from January 2, 1990 to December 31, 2018. This time frame represents an era of only cash settlement on the feeder futures contract, which was changed from a physically delivered contract in 1986. Figure 1 depicts annual volume for the contract from 1990 through 2018.

***Figure 1*. Feeder Cattle Futures Annual Volume (January 2, 1990–December 31, 2018)**

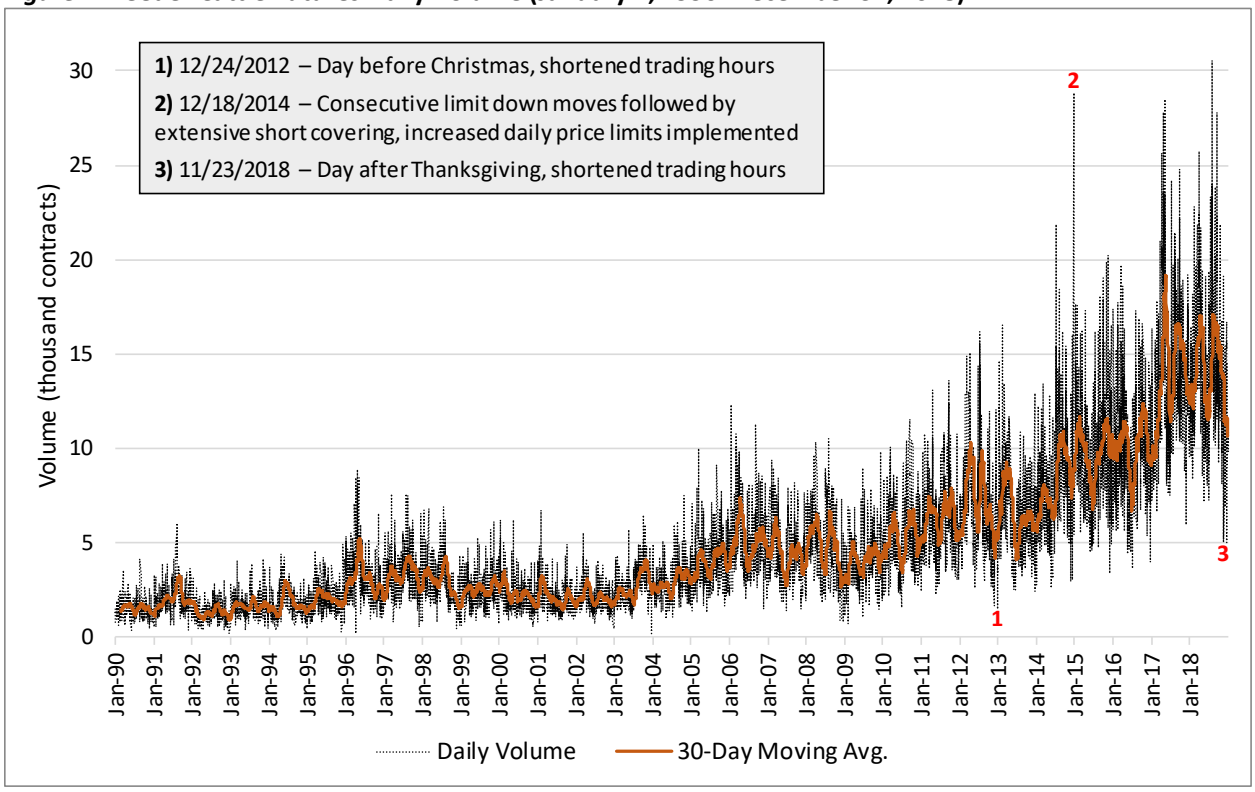


Source: Bloomberg

Annual volume steadily increased since about 2002, coinciding with the growth of electronic trading that has affected all commodities. Record feeder cattle futures volume was achieved in 2017, exceeding 3.5 million contracts traded for the year. Elevated levels of volume continued through 2018, remaining above 3.5 million contracts, though slightly lower than 2017.

We also examine daily feeder cattle trade volumes since 1990, shown in Figure 2. Outliers, or days of especially high (or low) volume, are at times attributable to the release of market reports, major economic headlines, or simply shortened trading hours due to an upcoming holiday. In addition, futures price movements that break through technical resistance and support levels usually result in the liquidation of long positions or covering of short positions, increasing trade volume. A 30-day moving average was included to depict how aggregated daily volume of all feeder contracts trading has changed across time.

Figure 2. **Feeder Cattle Futures Daily Volume (January 2, 1990–December 31, 2018)**

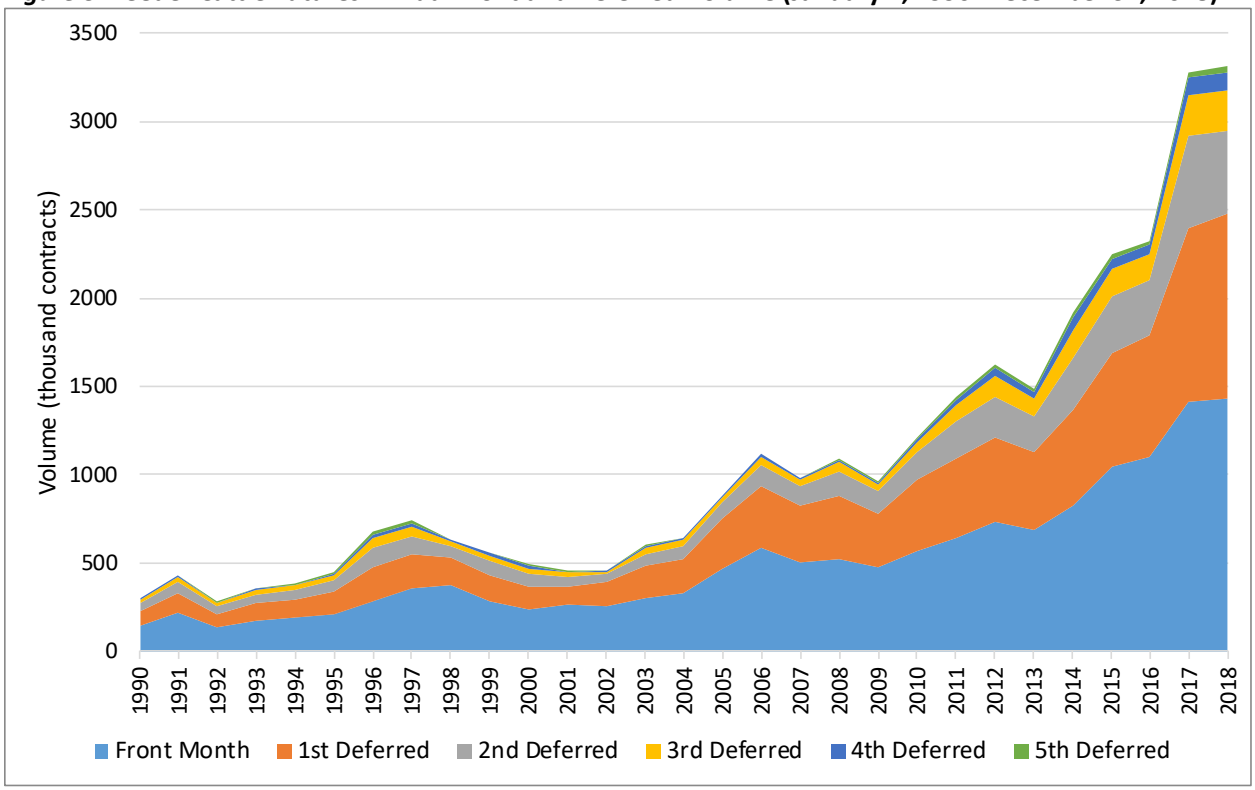


Source: Bloomberg

Daily feeder cattle futures trading volume experienced little change from 1990 to about 2004, hovering around 2,000 contracts traded daily. This changed around 2004–2005 as daily volumes began generally increasing year over year. Since 2014, daily volume has increased significantly, currently averaging between 10,000 and 15,000 contracts traded per day.

Trade volume can also be disaggregated into front month and deferred contract volume. Here we define the time period in which a specific contract is the front month as ending on the last day of the month prior to the contract month. For instance, the last day the March 2018 contract would be considered the front month would be on February 28, 2018. On March 1, the front month rolls over into the April 2018 contract. Our definition allows for the measurement of volume on a constant, rolling front month basis that does not include trade activity for the last few weeks of a contract leading up to expiration; a time period characterized by trade volume rolling out of the expiring contract and a poor representation of a liquid front month. Following the same method, we define the 1st deferred contract as the contract succeeding the front month, the 2nd deferred contract as the contract succeeded the 1st deferred, and so on—all on a constant, rolling basis. Yearly front and deferred contract volumes for feeder cattle are shown in Figure 3.

Figure 3. **Feeder Cattle Futures Annual Front and Deferred Volume (January 2, 1990–December 31, 2018)**



Source: Bloomberg

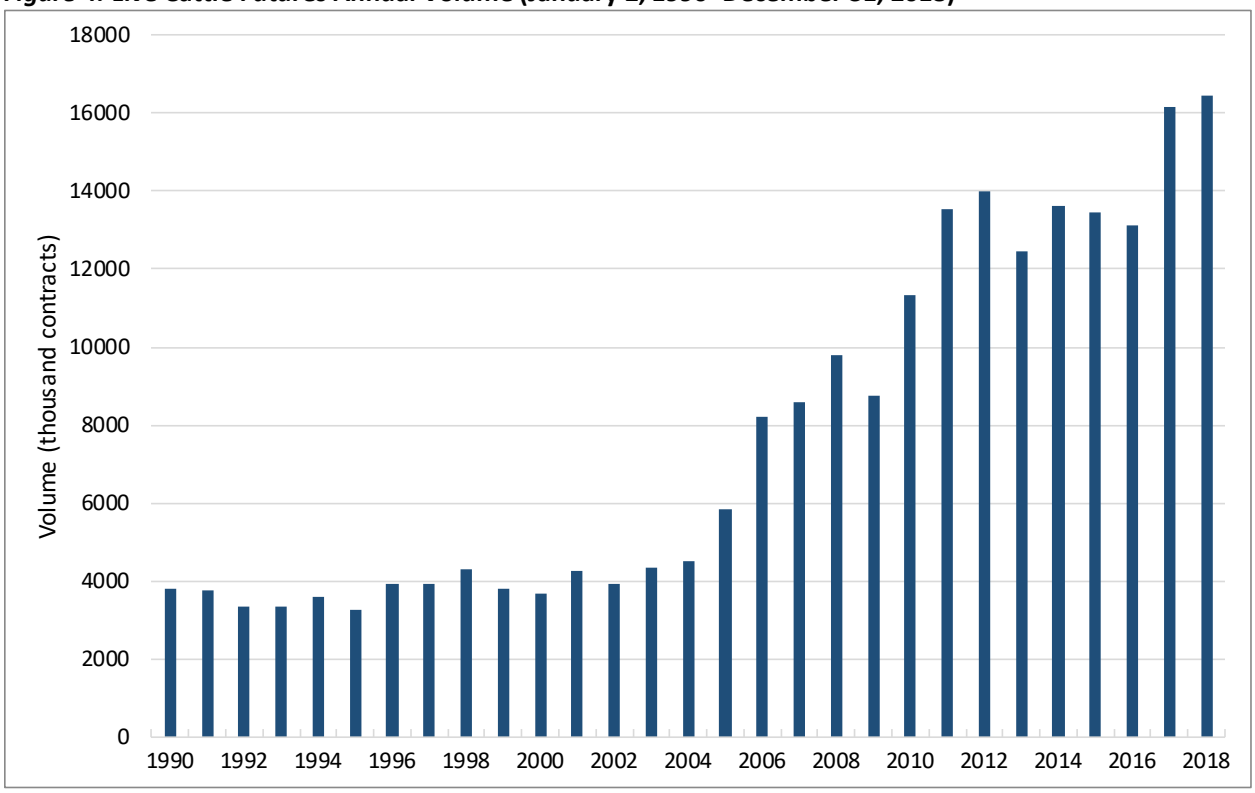
Again, we observe overall trade volume for feeder cattle futures steadily increased since around 2002. Distinguishing between front and deferred contracts, volumes for all contracts, regardless of position on the forward curve, have increased steadily. Though growing trade activity is more apparent for the front month, 1st deferred, and 2nd deferred contracts, all contracts have experienced relatively stable levels as a percentage of overall volume. Front month volume has averaged around 43% of overall volume since 1990 and was slightly above 40% during 2017 and 2018. First-deferred contract volume averages around 25% of the total, increasing from 22% of overall volume in 1990 to about 30% in 2018. Second, 3rd, 4th, and 5th deferred contract volumes have remained steady as a percentage of overall feeder cattle futures trade volume at about 12%, 5%, 2%, and 1%, respectively.

Breaking trade volume down according to its position on the forward curve, we can make observations on thinness of trade and the ability to take futures positions on further-out expirations. Trade volume drops off considerably from the front month to the 1st deferred contract, and from the 1st deferred contract to the more deferred contracts. This implies as traders attempt to take positions in more distant deferred contracts, they will progressively represent more of the prevailing market trade—realizing less liquidity and perhaps having more difficulty getting orders filled without economically important slippage. Trade volume in feeder cattle is noticeably more thin for expirations past the 1st deferred contract, which can affect costs of trade (bid/ask spreads) and the ability to freely enter into and exit out of positions. However, the extent to which the feeder cattle futures contract is

"thinly traded" or "illiquid", especially for deferred expirations, can be placed in more perspective by comparing it to similar products, such as live cattle futures.

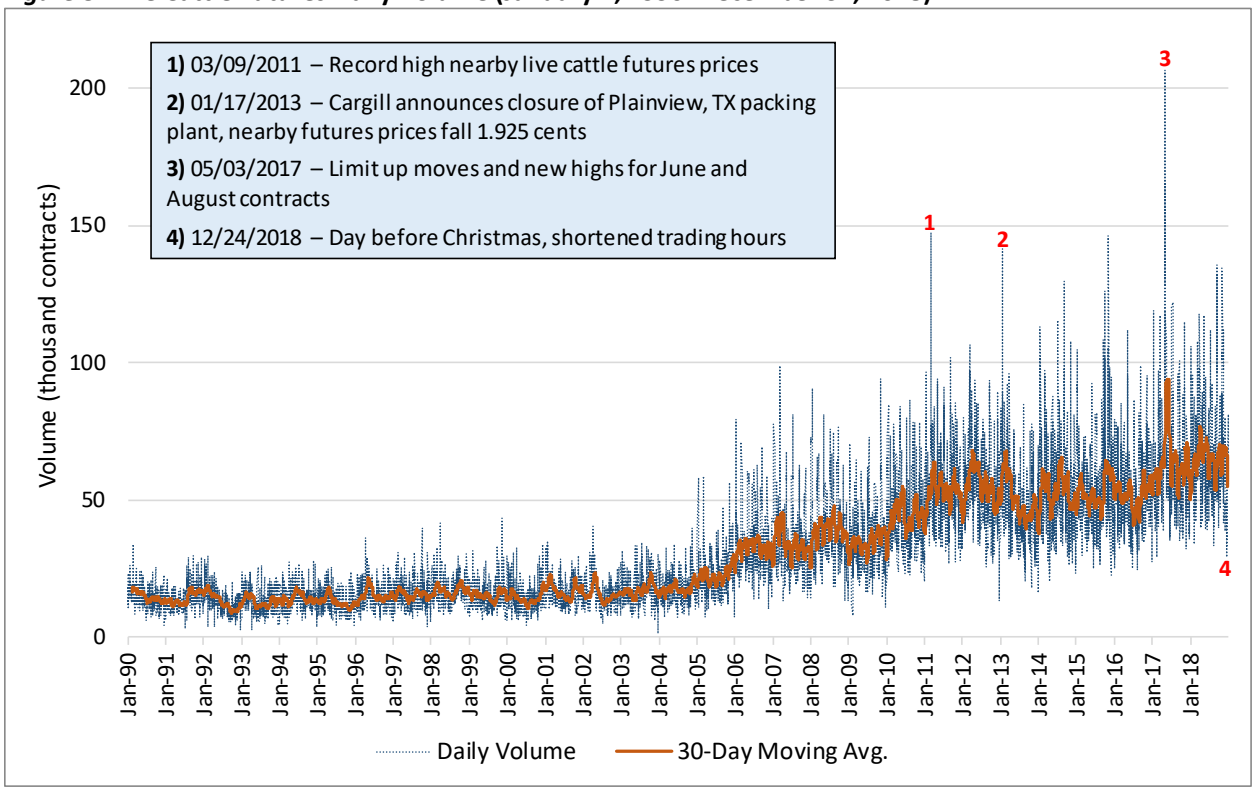
Live Cattle Futures Volume. Trade volume data for live cattle futures was obtained in a similar fashion as feeder cattle. Daily trade volumes for all contract months of live cattle futures were obtained from Bloomberg from January 2, 1990 to December 31, 2018. Figures 4 and 5 depict annual live cattle volume and daily volume, respectively.

Figure 4. **Live Cattle Futures Annual Volume (January 2, 1990–December 31, 2018)**



Source: Bloomberg

Figure 5. **Live Cattle Futures Daily Volume (January 2, 1990–December 31, 2018)**

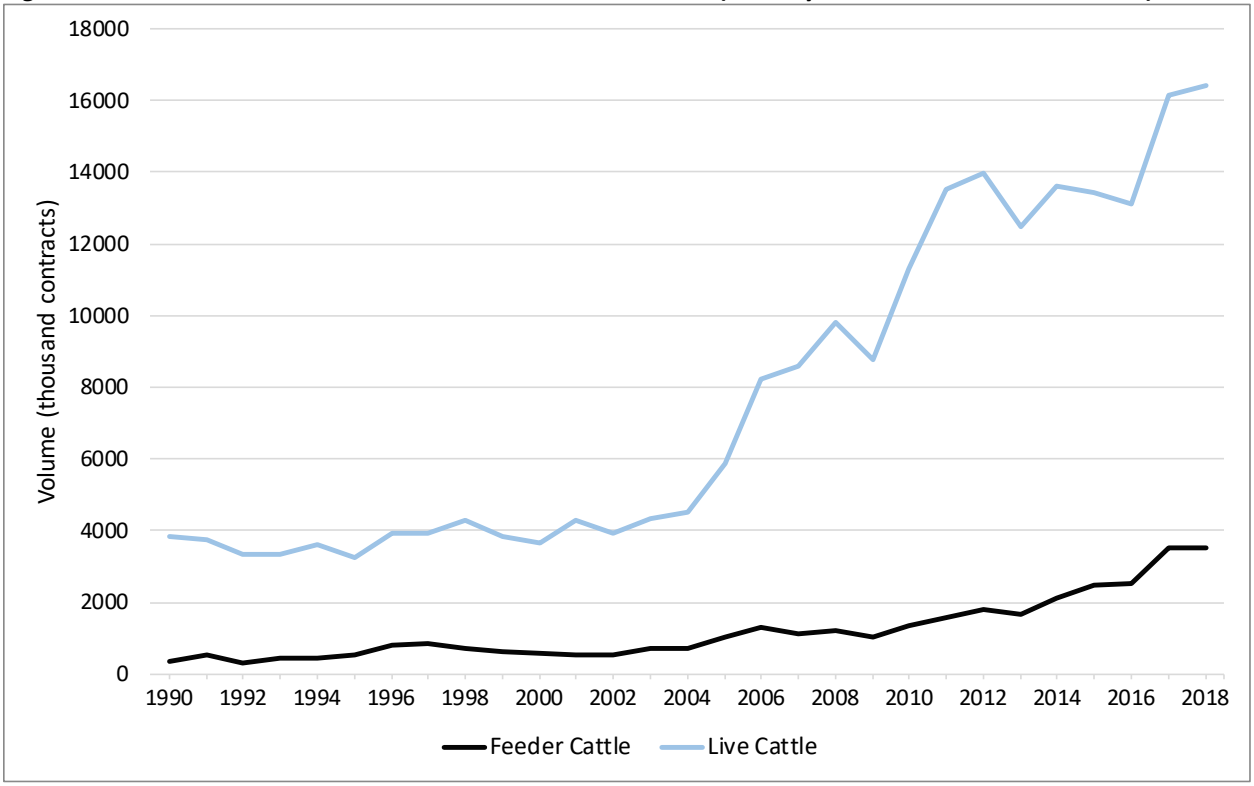


Source: Bloomberg

The live cattle futures contract maintained annual volumes of slightly under 4 million contracts and average daily volume of around 14,000 contracts until 2004–2005. The last decade and a half has experienced steady growth in live cattle futures activity, with 2017 and 2018 seeing record volumes exceeding 16 million contracts traded each year and average daily volumes of about 65,000.

Feeder vs Live Comparison. To evaluate the relative thinness of feeder cattle futures trading, we compare annual volumes of the feeder cattle and live cattle futures contracts from 1990 through 2018. Figure 6 displays this relationship.

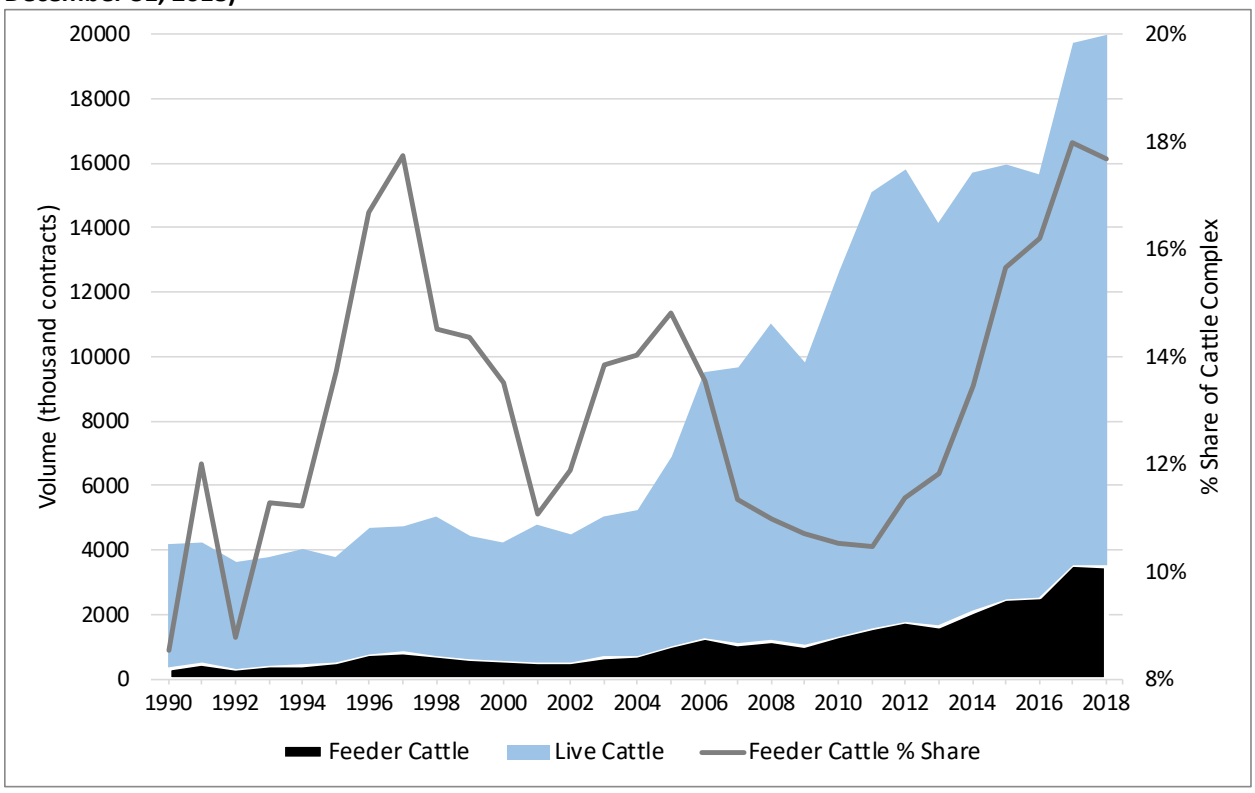
Figure 6. **Feeder Cattle vs. Live Cattle Futures Annual Volume (January 2, 1990–December 31, 2018)**



Source: Bloomberg

Upward trends in volume are apparent for both feeder cattle and live cattle, but the rates of increase in volumes are quite different across the two livestock products. Live cattle futures volume has increased at a much greater pace than feeder cattle futures. From 1990 through 2018, total trade volume for all expirations of live cattle is measured at just over 223 million contracts, while all feeder cattle expirations have experienced volume of about 35 million contracts over the same time period. Live cattle futures volume has been almost 6.4 times larger than feeder cattle futures. Another measure of feeder cattle futures relative thinness of trade can be viewed in Figure 7, where annual futures trade volume for the entire cattle complex (feeder and live cattle) is graphed along with feeder cattle's percentage share of the overall cattle complex.

Figure 7. **Cattle Complex Futures Annual Volume and Feeder Cattle Percentage of Volume (January 2, 1990–December 31, 2018)**



Source: Bloomberg

Feeder cattle share of the entire cattle complex's trade volume does not show a clear pattern across time, though it has been increasing since about 2011 and is just under 18% through the end of 2018. While comparing feeder cattle and live cattle futures trade volumes cannot give a definitive answer on whether feeder cattle are thinly traded, it does show that, in comparison to a similar livestock product, feeder cattle have witnessed much less trade activity across time. The relative thinness of trade in feeder cattle is even more noticeable when observing volumes on some of CME Group's other agricultural products—such as corn, soybeans, and the wheat complex. Discussions with industry participants about their use of and success with feeder cattle futures must be had to better determine if the contract can be considered "thinly traded" or "illiquid."

Evaluating Volatility

CME Group feeder cattle futures contract has, in recent years, been subject to industry concerns over volatility. These concerns took root in an era of record high feeder cattle futures prices in 2014–2015, followed by a drastic downturn in prices in late 2015. Producers and other industry participants held strong views on what was to blame for the volatile conditions—namely high frequency trading (a subset of computerized algorithmic trading). While prices have been relatively stable in 2017–2018, industry concerns remain. Figure 8 depicts nearby futures

settlement prices for feeder cattle obtained from Bloomberg. The nearby contract is simply defined as the contract month nearest expiration, most representative of current spot prices.

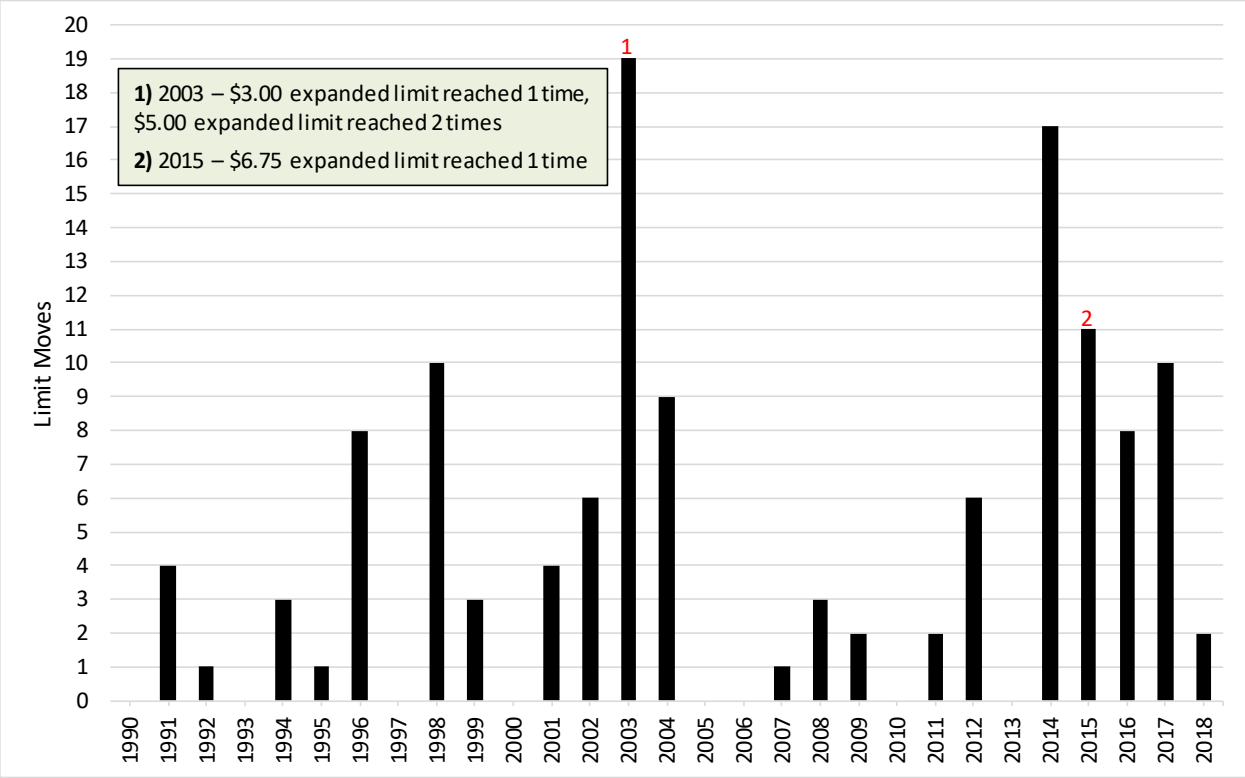
Figure 8. **Feeder Cattle Nearby Futures Prices (January 2, 1990–December 31, 2018)**

Source: Bloomberg

Comprehensive research on the effect of high frequency trading (HFT) on the feeder cattle futures market involves exceedingly granular data and is out of the scope of this project. However, we do observe factors such as daily price movement, intraday price movement, and the relationship between speculation and volatility.

Daily Price Movement. Using the price series for nearby feeder cattle futures, we calculate the number of limit moves made in the nearby contract over time, shown in Figure 9. Note that price limits have been modified periodically over the history of the feeder cattle contract. We illustrate these changes, along with price limit changes for the live cattle contract, in Table 2.

Figure 9. **Feeder Cattle Nearby Futures Annual Price Limit Moves (January 2, 1990–December 31, 2018)**



Source: Bloomberg

Table 2. **Feeder and Live Cattle Futures Contract Price Limits ($/cwt)**

Date Effective	Feeder Cattle	Live Cattle
11/30/1964	-	$1.50
08/01/1969	-	$1.00
11/30/1972	$1.00	-
11/01/1974	$1.50	$1.50
10/01/2003	-	$1.50; expandable to $3.00/$5.00
11/17/2003	$1.50; expandable to $3.00/$5.00	-
02/23/2004	$3.00	$3.00
12/18/2014	$4.50; expandable to $6.75	$3.00; expandable to $4.50

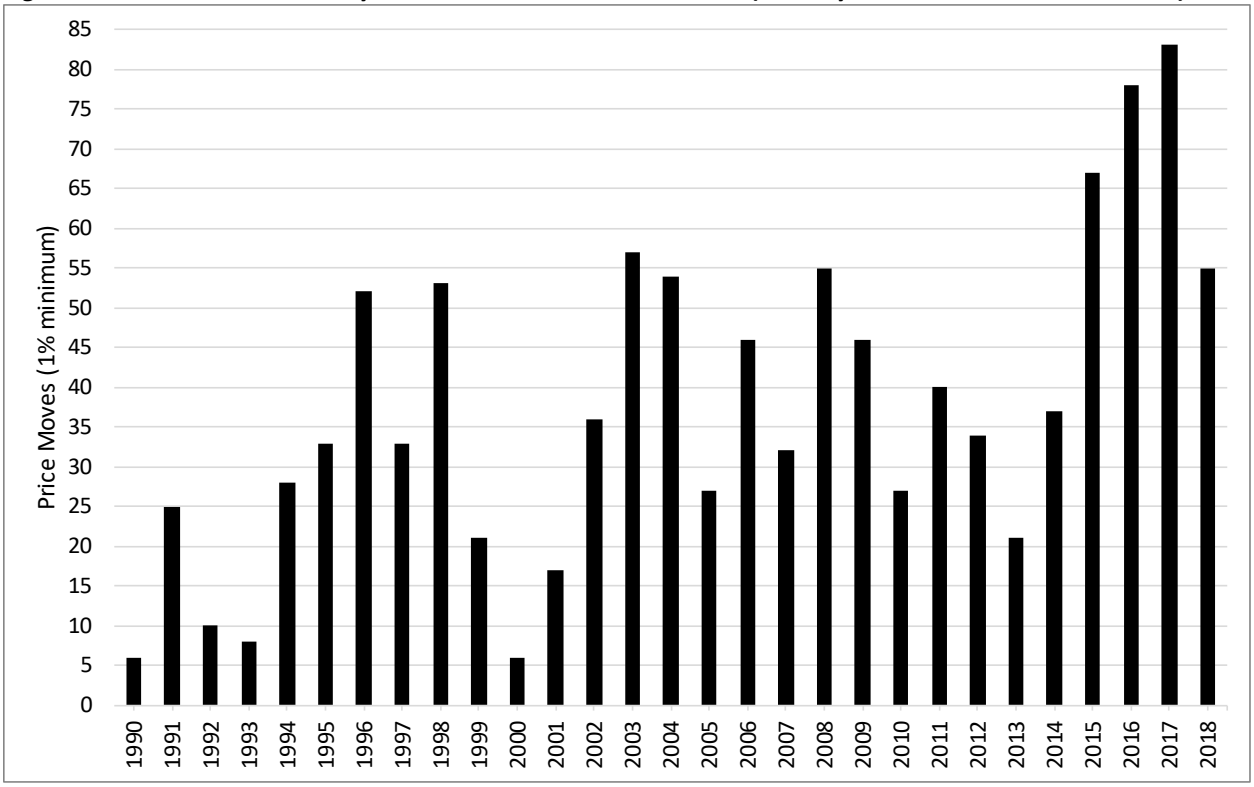
Source: CME Group

Amid the BSE incident of late December and the uncertainty that followed, 2003 experienced the highest occurrence of limit move days at 19. Prior to this event, nearby feeder cattle futures had already settled at limit 14 times for the year, prompting CME to implement expanded limits for the contract. Limit moves were made an additional 5 times in late December—including 3 instances of settlement at the new expanded limits—with another 6 limit move days through the first week of February 2004. Limit moves again escalated in 2014, with all 17 occurring

after May, and CME Group once more amended price limits to the current $4.50/cwt and expanded limits of $6.75/cwt. Limit moves in the nearby feeder cattle futures contract remained high relative to historic levels through 2017.

Since price limits are periodically modified by the exchange, another evaluation of daily price movement is performed by calculating the percentage movement in settlement price from one trading day to the next. Using the same price series for nearby feeder cattle futures, we calculate the percentage change in daily settlement prices. Figure 10 depicts the number of times that nearby feeder cattle futures prices moved at least 1% of the previous settlement price, and on an annual basis.

Figure 10. **Feeder Cattle Nearby Futures Annual 1% Price Moves (January 2, 1990–December 31, 2018)**



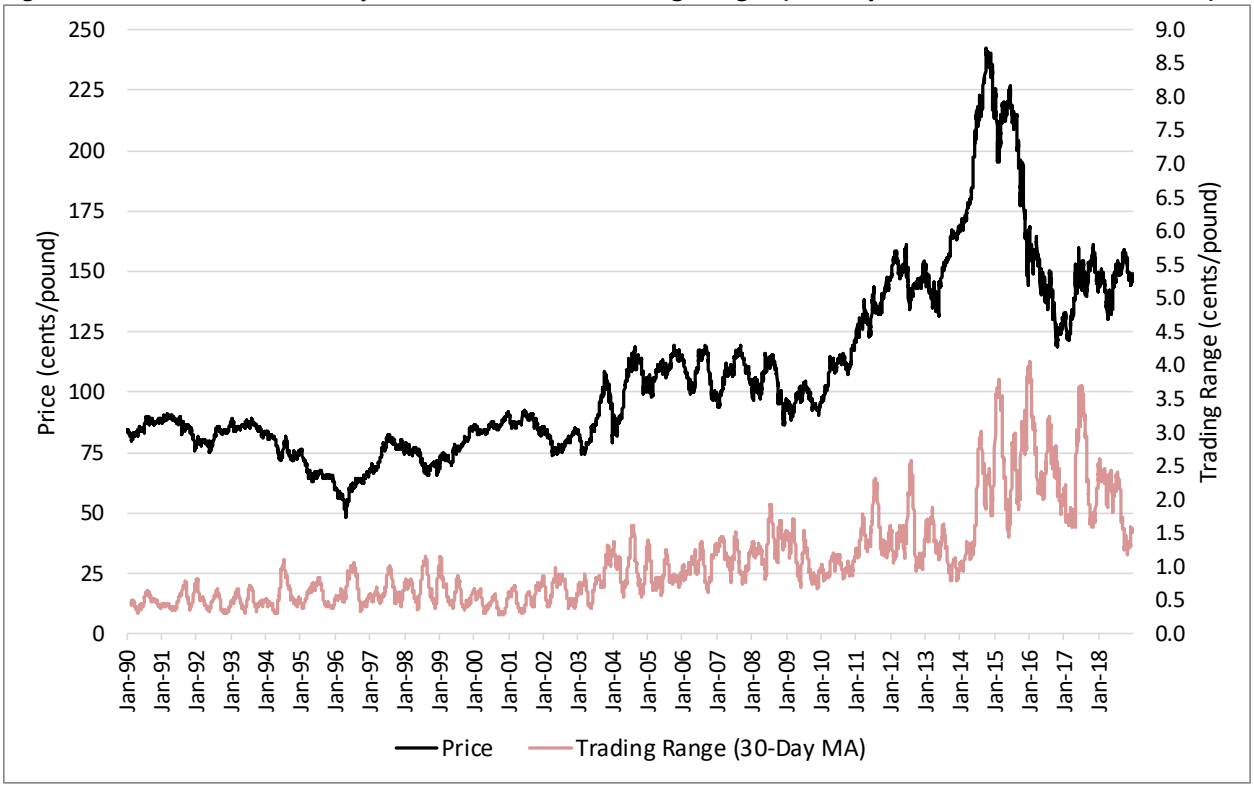
Source: Bloomberg

Graphing annual 1% movements in daily settlement prices, we can view time frames of elevated price movement otherwise unseen by observing limit move days. Feeder cattle nearby futures prices in 2003 and 2004 witnessed higher levels of 1% moves relative to the 1990s and early 2000s, coinciding with the BSE incident of December 2003. 2008 and 2009—an era of economic turmoil and uncertainty—also experienced a slight uptick in 1% price moves before falling back down in the early 2010s. One percent moves in nearby feeder cattle futures prices again began to escalate in December 2014 and have remained high relative to historic levels. Peak 1% price moves occurred in 2017 with a total of 83 days in which the nearby price changed at least 1% from the previous day's

settlement. We see that 2015 through 2017 experienced occurrences of 1% price moves far exceeding that of other highly-volatile time frames, such as during the BSE incident and the economic recession.

Intraday Price Movement. One concern of HFT is that it may result in elevated levels of price variation throughout a trading session. While we do not go into detail on the definitive effects of HFT on feeder cattle futures, we do evaluate how intraday price movements have changed across time. Figure 11 depicts nearby feeder cattle futures settlement prices along with a 30-day moving average of daily trading ranges (also obtained from Bloomberg). Trading range is defined as the session high price minus the session low price.

Figure 11. **Feeder Cattle Nearby Futures Prices and Trading Ranges (January 2, 1990–December 31, 2018)**



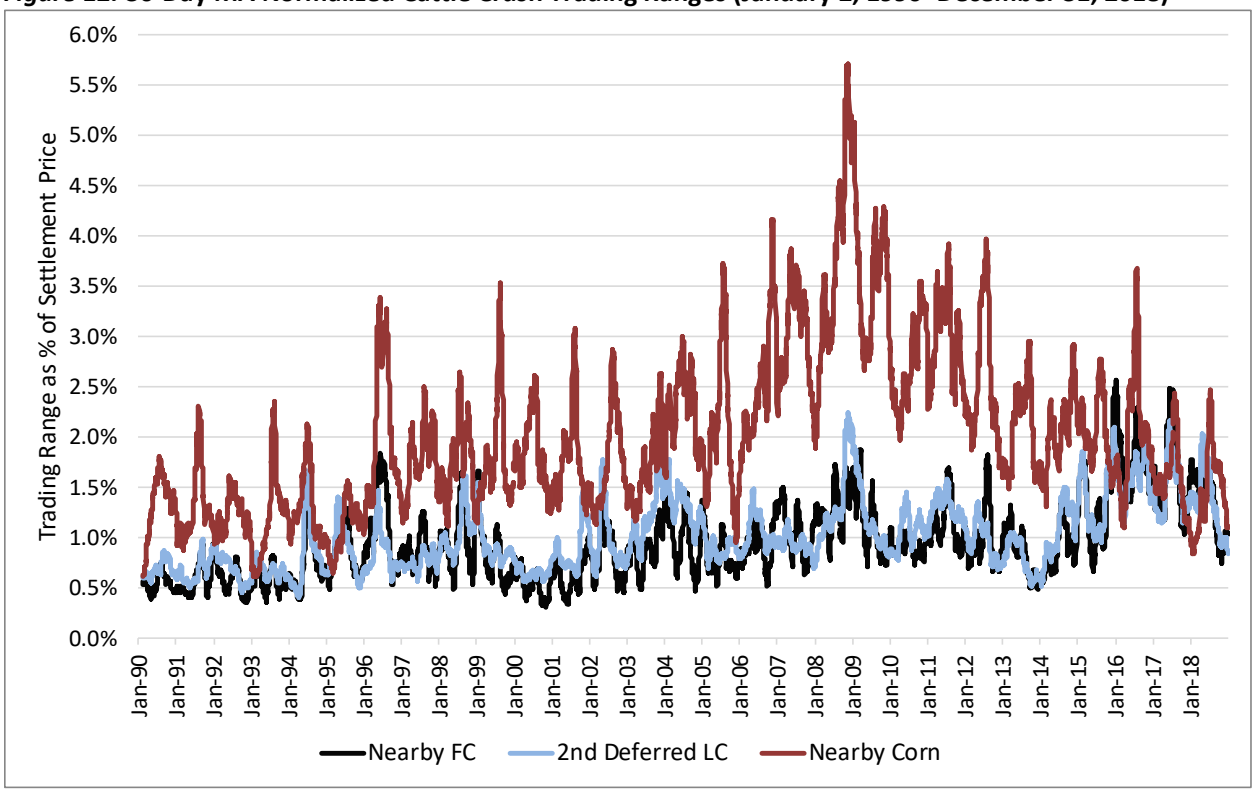
Source: Bloomberg

1990 to 2003 witnessed feeder cattle futures prices of well under 100 cents/lb. and daily trading ranges that rarely exceeding 1 cent/lb. Futures prices exceeded 100 cents/lb. for much of 2004–2009. This time period also experienced increased daily trading ranges, generally hovering between 1 and 2 cents/lb. As mentioned earlier, 2014–2015 brought about record high feeder cattle prices, but also witnessed elevated levels of daily price variation. At their peak, trading ranges reached 4 cents/lb. in early 2016. By the end of 2018, futures prices and daily trading ranges dropped to about 150 cents/lb. and 1.5 cents/lb., respectively. There appears to be a positive relationship between the price of feeder cattle futures and daily trading ranges. This is to be expected as price variations tend to

be larger for higher-priced commodities than for lower priced. We would expect daily price ranges to increase as feeder cattle futures went from roughly 85 cents/lb. in 1990 to 150 cents/lb. in late 2018.

This measure of intraday price variation allows us to see that trading ranges tend to increase as the price of the commodity increases. However, it is unclear whether other factors, such as computerized and high frequency trading, also play a role in increased daily price movements. A clearer evaluation of HFT effects on feeder cattle futures can be made by comparing intraday price movements of feeder cattle to those of other commodities. Figure 12 shows daily trading ranges for all inputs of the cattle crush—nearby feeder cattle futures, nearby corn futures, and 2nd deferred contract live cattle futures. Each day's trading range is normalized as a percentage of that day's settlement price to make comparable between commodities and is graphed as a 30-day moving average to clearly depict changes over time.

Figure 12. **30-Day MA Normalized Cattle Crush Trading Ranges (January 2, 1990–December 31, 2018)**



Source: Bloomberg

The nearby corn contract experienced the highest level of relative intraday price variation of the three commodities, with nearby feeder cattle and 2nd deferred live cattle tending to track each other closely. Corn's highest level of daily price ranges, relative to settlement price, occurred in the late 2000s and early 2010s, a time period characterized by rapid expansion of the corn ethanol market and generally high commodity prices. Feeder cattle and live cattle futures trading ranges as a percentage of their price remained relatively steady from 1990 to about 2015,

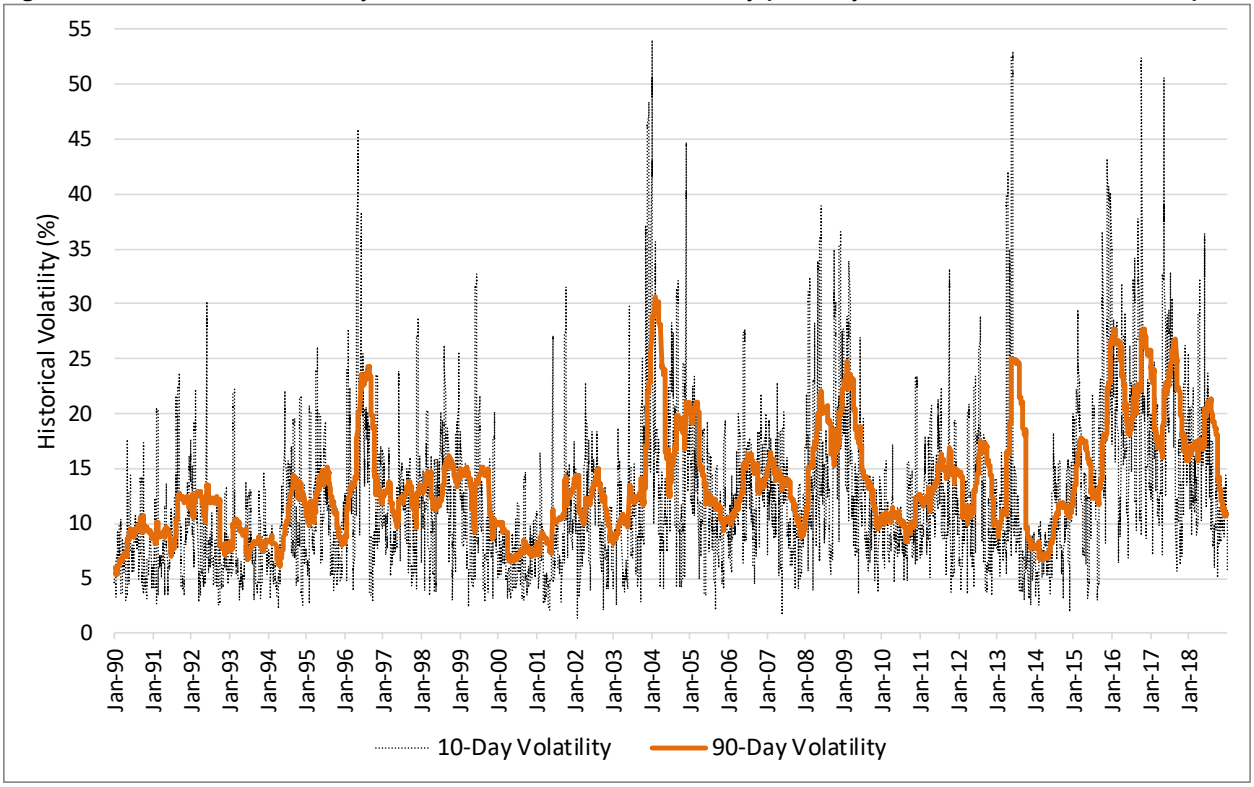
with an uptick during the economic crisis of 2008–2009. From 2015 to about mid-2018, feeder cattle and live cattle trading ranges were slightly elevated. This might be due to the increased daily price limits/expanded limits for feeder cattle and increased expanded limits for live cattle implemented by CME Group in late 2014. Trading ranges have since fallen to levels more in line with those pre-2015.

While increasing daily price limits results in higher potential intraday price movement, it is important to realize that elevated levels of volatility in a market are not the result of the increased limits. Rather, increasing price limits are the exchange's way of ensuring market participants' ability to freely enter into and exit out of positions during periods of high volatility. Decreasing daily price limits would certainly reduce rapid and severe price movement, but at the cost of locking traders into unwanted positions. This prevents futures prices from reflecting true supply and demand conditions and is not conducive to a free market. Altering daily price limits can have significant impact on futures trade and should be done only after careful research.

Much more extensive research must be conducted to definitively say whether HFT has had an effect on volatility and intraday price variation in feeder cattle futures trading. However, a brief look into the history of feeder cattle prices and comparison of daily trading ranges between commodities suggests that increases in feeder cattle intraday price movements are most likely the result of higher overall prices and are not indicative of manipulation by computerized traders, at least relative to other futures contracts.

Historical Price Volatility. To determine if excessive speculation by non-commercial traders has affected volatility of feeder cattle futures, we first observe historical price volatility of the contract. Historical volatility data for nearby feeder cattle futures was obtained from Bloomberg from 1990 through 2018. Once again, in this section evaluating volatility, the nearby contract is defined simply as the contract nearest expiration. Bloomberg determines a 10-day historical volatility by calculating the annualized standard deviation of relative price change over the 10 most recent trading days' closing prices, expressed as a percentage. This volatility measure is shown in Figure 13 along with a similarly calculated 90-day historical volatility to highlight trends over time.

Figure 13. **Feeder Cattle Nearby Futures Historical Price Volatility (January 2, 1990–December 31, 2018)**

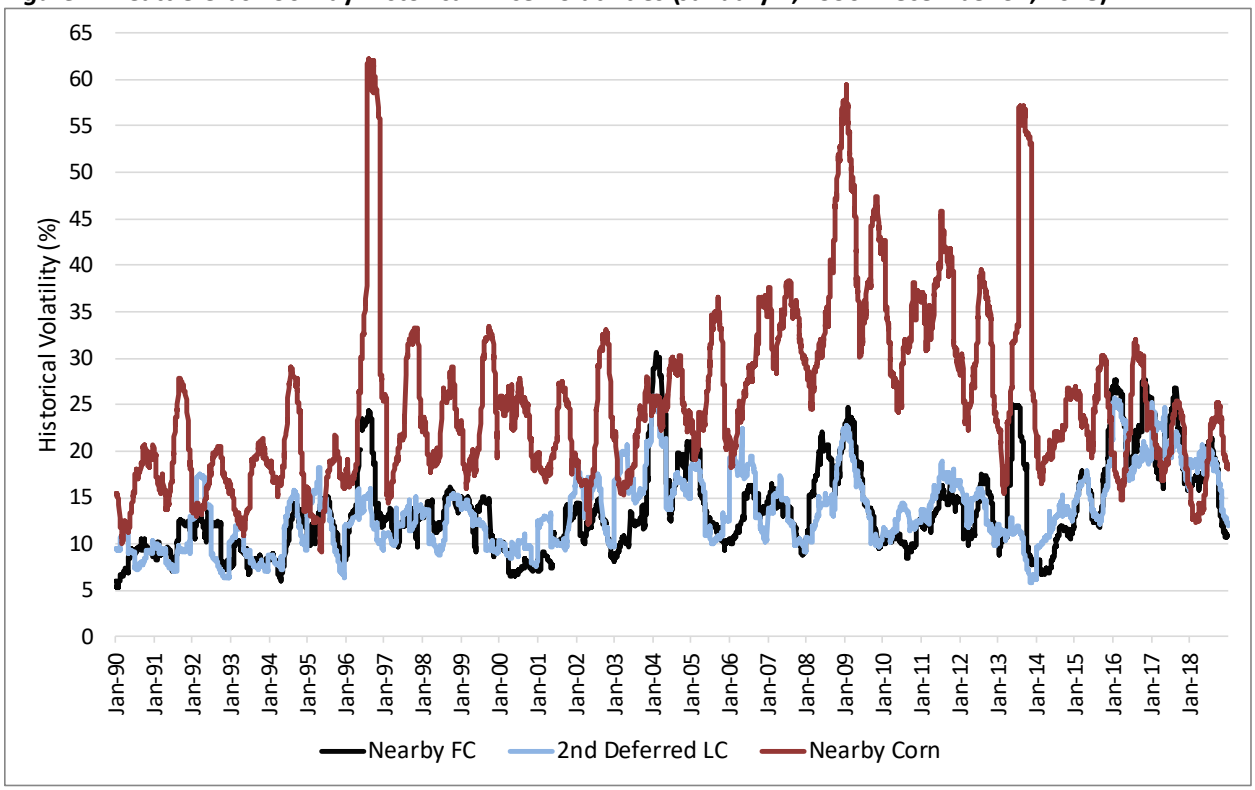


Source: Bloomberg

CME Group feeder cattle futures contract volatility does not exhibit a clear and lasting trend since 1990, but it has experienced periods of elevated volatility. Feeder cattle volatility spiked to over 45% in mid-1996, coinciding with peak cattle inventories and record-high feed grain prices. December 2003 brought about another period of increased volatility after the discovery of a BSE-infected dairy cow in the state of Washington. This event brought uncertainty to the cattle outlook through the first half of 2004. Volatility again escalated when the economic downturn of 2008-2009 led to increased volatility across all commodities. The feeder cattle futures contract last experienced elevated volatility from late 2015 through 2017 after an extreme decline from record high prices set in October 2014. Though this was a turbulent time in the U.S. cattle market, feeder cattle futures prices remained strong relative to historical averages.

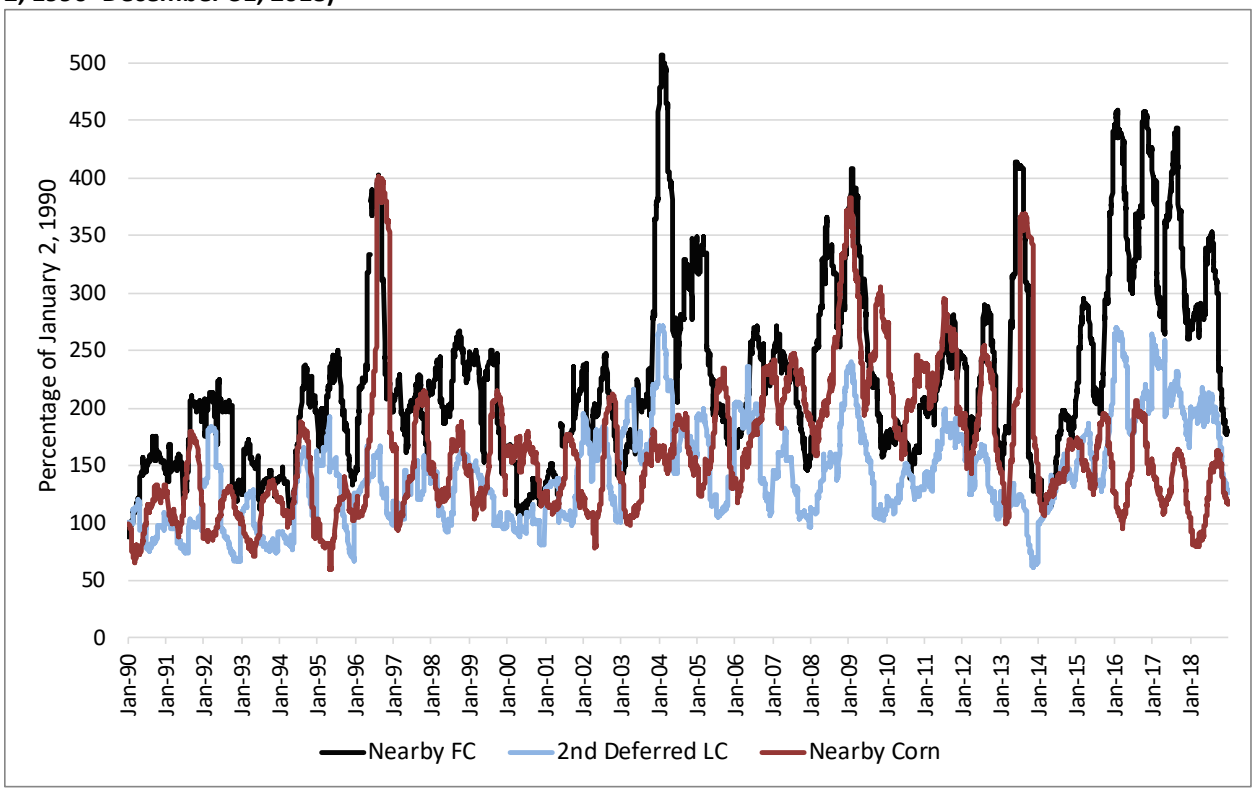
While the feeder cattle futures contract has experienced periods of increased volatility, comparison to other commodities is needed to determine if the contract is volatile relative to other related markets. We compare historical price volatility of nearby feeder cattle futures, nearby corn futures, and 2nd deferred contract live cattle futures, again using Bloomberg's 90-day historical volatility measure (Figure 14). In addition, we index each day's value as a percentage of the volatility on January 2, 1990 (Figure 15). This allows us to view how historical volatility has changed relative to the same base period to make changes comparable across commodities.

Figure 14. **Cattle Crush 90-Day Historical Price Volatilities (January 2, 1990–December 31, 2018)**



Source: Bloomberg

Figure 15. **Index of Cattle Crush 90-Day Historical Price Volatilities as a Percentage of January 2, 1990 Base (January 2, 1990–December 31, 2018)**



Source: Bloomberg

Nearby corn futures have experienced much higher levels of volatility over time than the cattle contracts, with an average 90-day historical volatility of 25.5% from 1990 through 2018. Corn also exhibits strong seasonal trends, with volatility tending to increase during the spring planting season when uncertainty is greatest. Nearby feeder futures and 2nd deferred live cattle futures track each other closely over time, both with average 90-day historical volatilities of 13.6%. However, feeder cattle futures historical volatility has increased disproportionately since late 2015, relative to its January 2, 1990 value. Between late 2015 and mid-2017, feeder cattle nearby futures volatility neared 4.5 times its January 1990 base on three separate occasions. Only four times prior had feeder cattle historical volatility exceeded 4 times the base value. In the same time period, nearby corn and 2nd deferred contract live cattle experienced around 1.5 and 2 times their base volatility values, respectively.

While not as volatile a contract relative to the other cattle crush markets, feeder cattle futures volatility has increased at a greater rate since 2015. We next examine to what extent speculation by non-commercial traders has played a role in this increase in volatility, if any.

Speculation and Volatility. To assess the effect of speculative trading on feeder cattle futures volatility, we examine open interest positions of traders over time. Open interest position data was gathered from the U.S. Commodity Futures Trading Commission (CFTC); the independent agency providing regulatory oversight to the

futures and options markets. The CFTC Commitments of Traders (COT) report provides a breakdown of each Tuesday's open interest for futures and options on futures in which 20 or more traders hold positions equal to or above the reporting levels established by the CFTC. The Legacy COT report breaks open interest positions into two trader classifications: commercial and non-commercial traders. The commercial classification consists of producers, merchants, processors, and users of the physical commodity who use derivative contracts to hedge business risk. The commercial trader classification also includes swap dealers that incur risk in the over-the-counter market and use futures markets to offset that risk. The non-commercial classification includes professional money managers—such as commodity trading advisors, commodity pool operators, and hedge funds—as well as other speculative traders. We focus on the non-commercial classification to evaluate speculative activity; however, it should be noted that position data for a trader classified in the commercial category for a commodity will include all of the trader's positions in that commodity, regardless of whether the position is for hedging or speculative purposes.

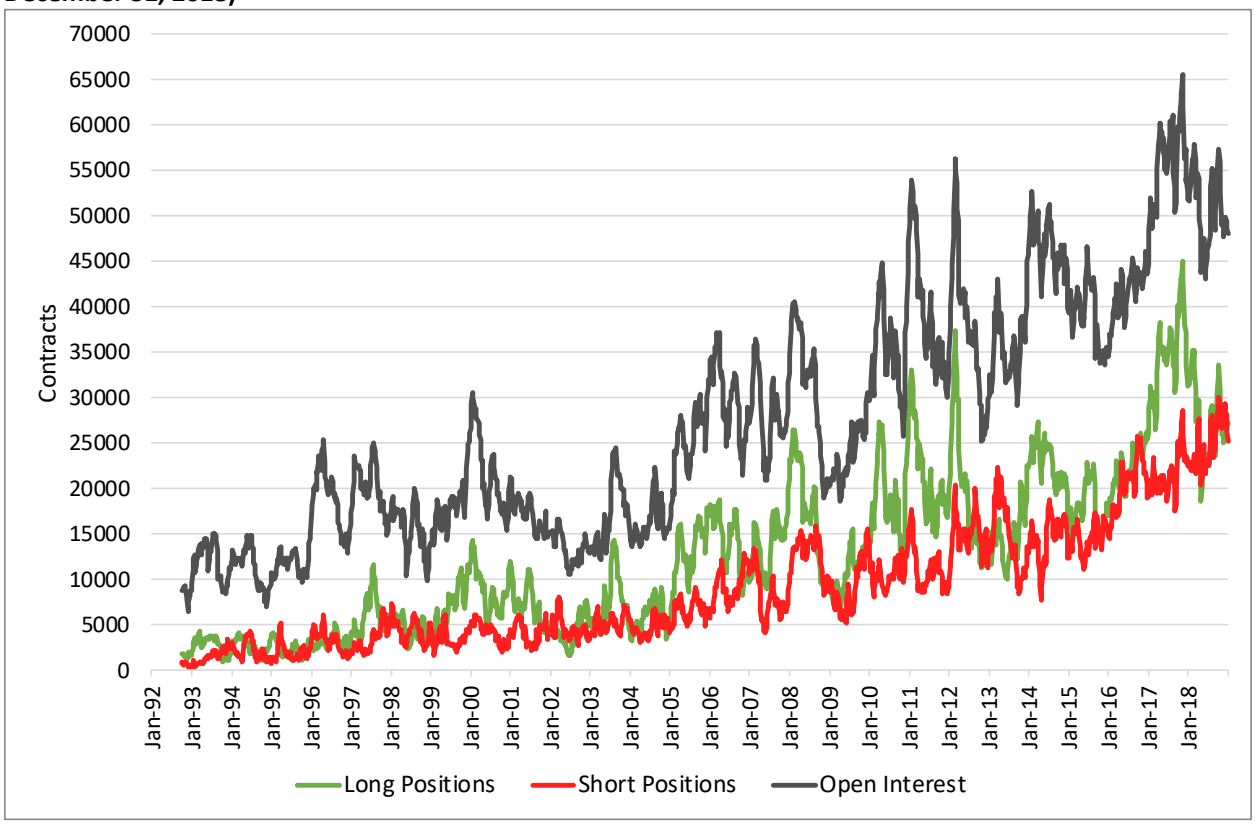
Open interest position data for the feeder cattle futures contract was obtained from September 30, 1992 to December 31, 2018. Prior to September 30, 1992, COT reports were only provided mid-month and at month's end—as opposed to the current release schedule, with reports issued each Friday afternoon detailing the previous Tuesday's open interest. Reportable positions in feeder cattle are broken down into the commercial and non-commercial trader classifications described previously. The non-commercial classification also includes data on spreading positions. Spreading occurs when traders hold equal long and short futures positions. For example, if a non-commercial trader holds 2,500 long positions and 2,000 short positions in feeder cattle futures, 500 contracts will be allocated to the "Long" category while 2,000 contracts will be allocated to the "Spreading" category. Thus, to calculate the true number of long (short) positions held by non-commercial traders, the long (short) category must be added to the spreading category to find the total. Figure 16 depicts both long and short positions held by non-commercial, or speculative, traders in feeder cattle futures over time, along with open interest in the contract. Figure 17 depicts total positions held by non-commercial traders, along with their percentage share of open interest in feeder cattle futures trade. Total non-commercial positions and the percentage share of open interest was calculated using the following formulas:

$$Total\ Non\text{-}Commercial\ Positions = \#long\ contracts + \#short\ contracts + (2 * \#spreading\ contracts)$$

$$Non\text{-}Commercial\ Share\ of\ Open\ Interest\ (\%) = \frac{Total\ Non\text{-}Commercial\ Positions}{2 * Open\ Interest} * 100$$

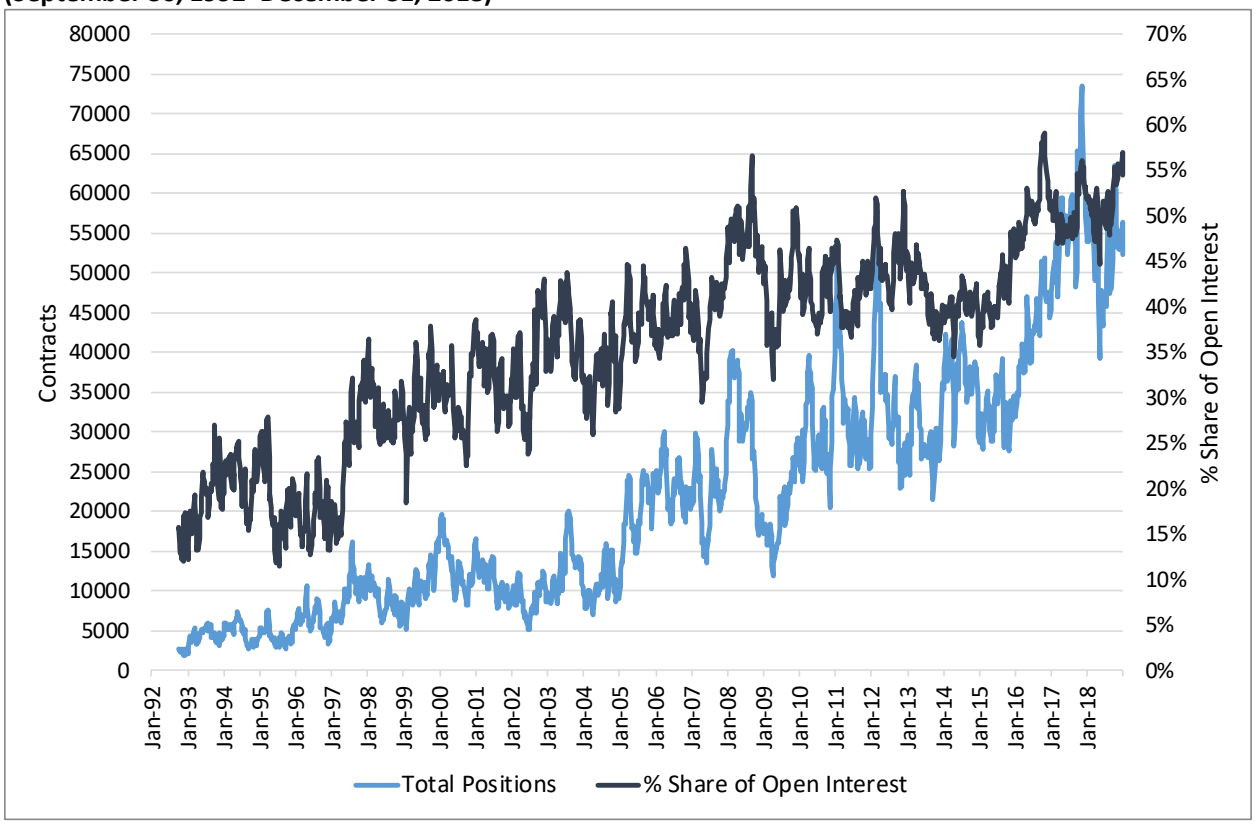
The total number of long (short) positions is found only after adding the number of spreading positions. Also, when calculating non-commercial share of open interest, we count both long and short sides of trade. Thus, we account for the two-sided nature of futures trade by multiplying open interest by two.

Figure 16. **Feeder Cattle Futures Open Interest and Reportable Non-Commercial Positions (September 30, 1992–December 31, 2018)**



Source: CFTC

Figure 17. **Feeder Cattle Futures Reportable Non-Commercial Total Positions and Percentage Share of Open Interest (September 30, 1992–December 31, 2018)**



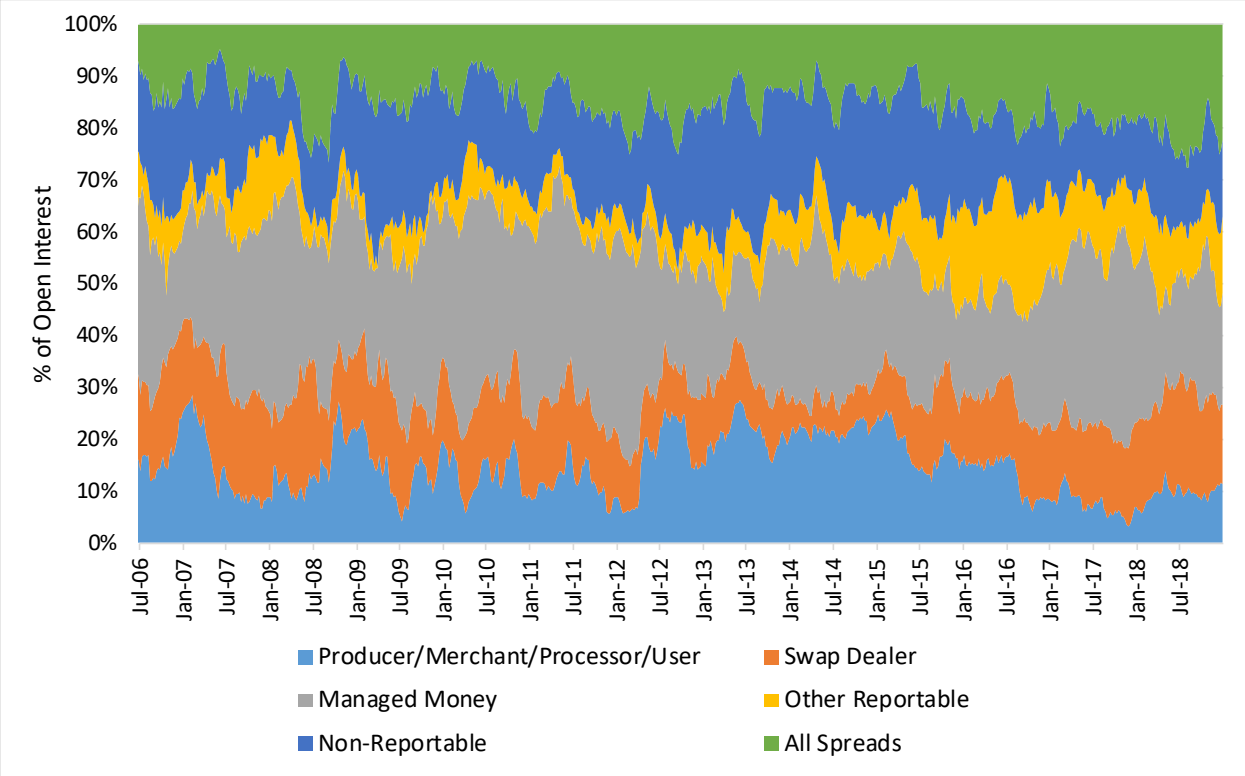
Source: CFTC

Both long and short non-commercial positions have generally increased since 1992, with noticeably higher levels of long open interest positions than short over that time frame. Determining the cause for net long positions among speculative traders is beyond the scope of this project. However, possible reasons include a widely-held sentiment that commodity prices will generally increase over time, or the use of commodity derivatives as an inflation hedge in an investment portfolio. Non-commercial long positions in the feeder cattle futures contract appear to be more responsive to periods of volatility in the feeder cattle market, with stark increases during the economic crisis of 2008, the high commodity price era of the early 2010s, and mid-2014 during the rapid upswing in feeder cattle prices. Non-commercial long positions and open interest in feeder cattle futures also witnessed rising levels from late 2015 through 2017. Total non-commercial open interest positions increased from 30,000-35,000 contracts in early 2015 to well over 60,000 in late 2017. The percentage of overall open interest in feeder cattle futures trading attributable to non-commercial, or speculative, traders increased from around 40% in early 2015 to well over 50% by the end of 2018.

To analyze which types of traders are long or short in the feeder cattle futures contract, we gathered open interest data from the CFTC's Disaggregated Commitments of Traders report (futures only)—available from mid-2006.

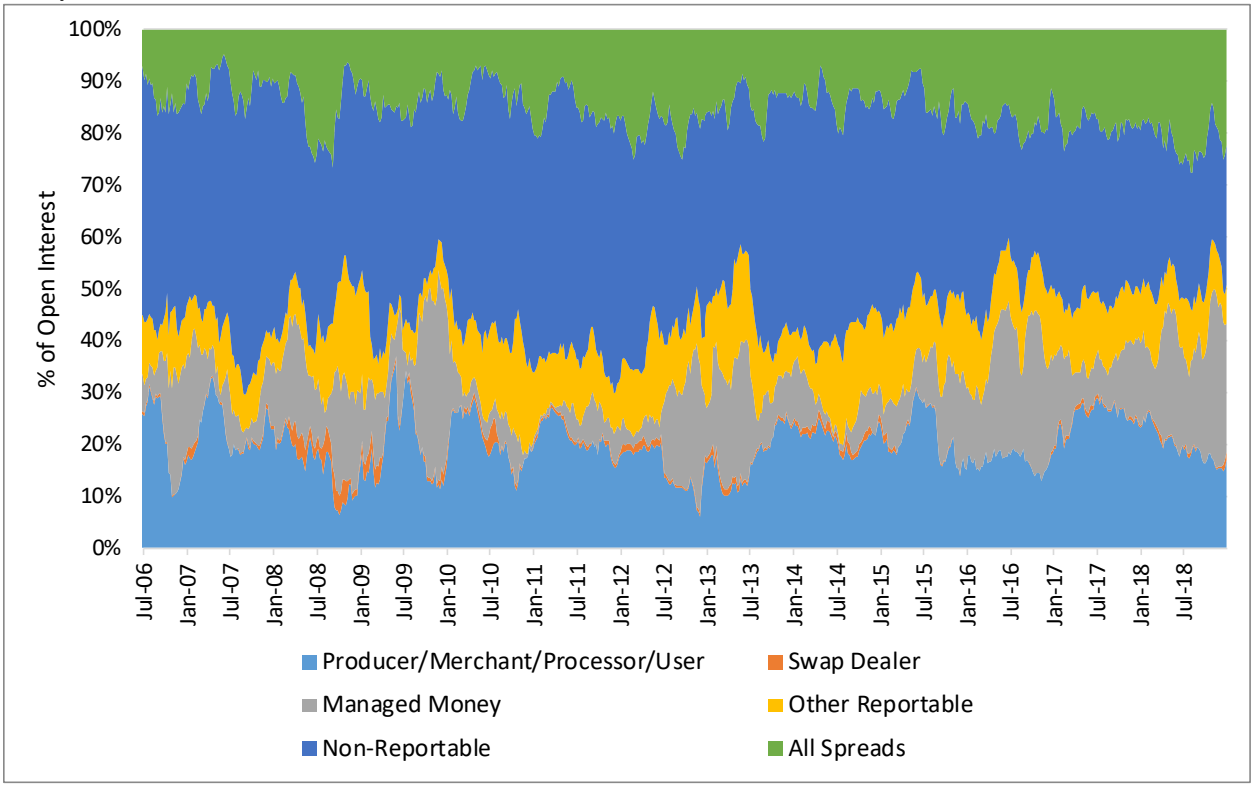
The Disaggregated report differs from the Legacy report in that it further breaks open interest positions down into four categories of traders: producer/merchant/processor/user, swap dealer, managed money, and other reportables. This increases transparency from the Legacy report, which delineates only by commercial and non-commercial traders. Figures 18 and 19 depict the percentage of long and short open interest held by each Disaggregated COT report trader classification, respectively.

***Figure 18*. Percent of Long Feeder Cattle Open Interest Held by All COT Classifications (July 3, 2006–December 31, 2018)**



Source: CFTC

***Figure 19*. Percent of Short Feeder Cattle Open Interest Held by All COT Classifications (July 3, 2006–December 31, 2018)**

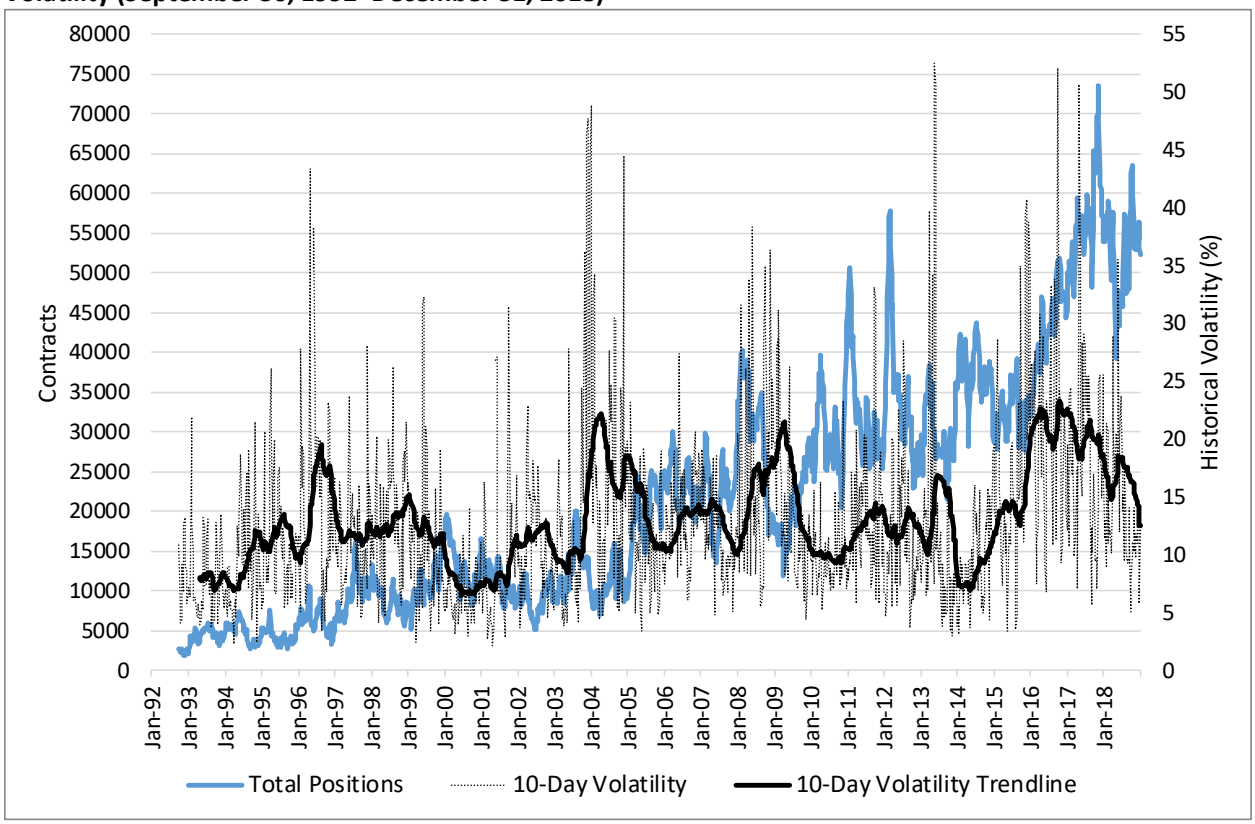


Source: CFTC

We see a significant difference in the percentage of long and short open interest held by swap dealers and managed money over time. Managed money tends to claim a much higher percentage of long positions than short positions. Swap dealers' percentage share of short positions over time is low to none. Another point of interest is non-reportable traders' percentage share of short open interest, which is much higher than their share of long open interest over the same time frame. Other reportables and producer/merchant/processor/users appear to hold similar shares of both long and short open interest positions, though producers' share of long (short) open interest has decreased (increased) since the end of 2016.

To determine if varying levels of non-commercial trading, or speculation, are related to volatility in feeder cattle futures trade, we compare non-commercial open interest positions with Bloomberg's historical volatility measure. Figure 20 includes the nearby feeder cattle futures 10-day historical volatility and the previously calculated total open interest positions held by non-commercial traders. We reconcile weekly COT report data with daily historical volatility data by only including volatilities on CFTC report dates. A 30-period moving average trendline is also included with the 10-day historical volatilities to more clearly depict how volatility has changed over time.

Figure 20. **Feeder Cattle Futures Reportable Non-Commercial Total Positions and Nearby 10-Day Historical Price Volatility (September 30, 1992–December 31, 2018)**



Source: Bloomberg & CFTC

There does not appear to be any discernable relationship between the level of volatility in feeder cattle futures trade and the amount of speculative activity in the market from 1992 through 2013. Volatility began increasing around mid-2014 and remained at an elevated level from about late 2015 through 2017. However, total non-commercial open interest positions did not begin its rapid ascent until early 2016. This implies that volatility did not increase due to an influx of non-commercial speculative activity in the feeder cattle futures market, but rather increasing volatility may have provided profit opportunities, inducing non-commercial traders to enter the market. Regressing the 10-day historical volatility series against non-commercial share of open interest in the feeder cattle futures contract, we find that the variation in speculative percentage share of open interest only explains about 5% of the variation in volatility from 1990 through 2018. More comprehensive research may be done to definitively assess the effect of speculative trade on volatility in feeder cattle futures, but our study suggests that speculators enter a market as a result of the risk (opportunity) inherent in that market due to other economic factors.

Evaluating Price Discovery Performance

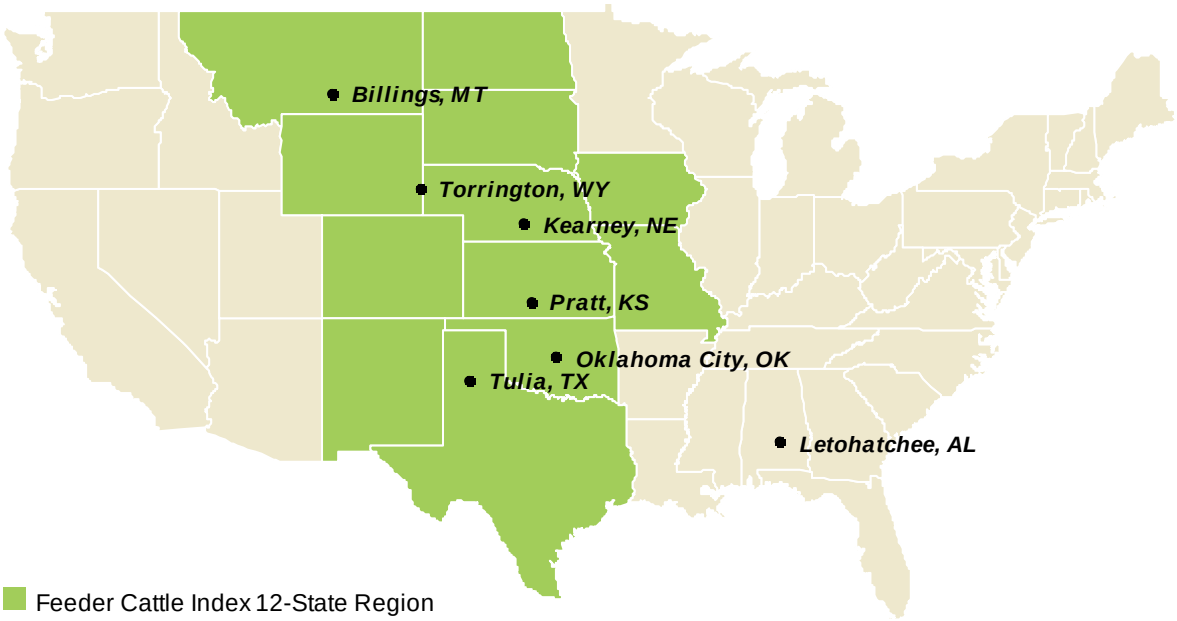
Price discovery is the determination of the market-clearing price of an asset given uncertain supply and demand conditions. As it pertains to feeder cattle futures—an asset whose value is derived from the underlying cash

commodity—price discovery performance is the ability of futures trade to accurately represent underlying cash prices and market conditions. In this section, we evaluate the price discovery performance of the CME Group feeder cattle futures contract. That is, we assess the ability of feeder cattle futures trade to reliably track and represent the true underlying cash market conditions upon which the contract's value is derived.

The process of assessing price discovery performance is complicated by the fact that there are numerous geographical locations, or cash markets, in which feeder cattle are bought and sold—each with specific and constantly changing supply and demand conditions. Feeder cattle futures prices may accurately portray the market conditions in one region while being unrepresentative of market conditions in another. As such, we evaluate the representativeness of feeder cattle futures prices by computing cash-futures price correlation and basis variability across numerous cash markets.

Cash and Futures Price Correlation. In this section, we once again use nearby futures settlement prices for the feeder cattle contract obtained from Bloomberg. Feeder cattle cash price data was collected from the Agricultural Marketing Service of the USDA (USDA-AMS) for seven cash markets, shown in Figure 21. Six markets—Billings, Montana; Kearney, Nebraska; Oklahoma City, Oklahoma; Pratt, Kansas; Torrington, Wyoming; and Tulia, Texas—reside within the specified 12-state region used in the calculation of the CME Feeder Cattle Index (defined in the following section). Assessment of these locations is necessary due to the heavy concentration of U.S. cattle feeding in the central and southern Great Plains, along with important production in the northwest. Letohatchee, Alabama is included in our assessment to provide some comparison with a relatively sparsely-traded market not located in a major cattle-feeding region of the country.

***Figure 21*. Feeder Cattle Index 12-State Region and Cash Markets**



Weighted average prices are reported by the USDA-AMS for each cash markets' weekly auctions. With numerous frame sizes, muscle thicknesses, and weight ranges traded in the cash market from week to week, we simplify by using only cash price data for 700-799 lb. Medium and Large Frame #1 feeder steers. This is the only category of feeder cattle that has been consistently included in calculation of the Feeder Cattle Index since the Index transitioned to USDA-reported cash price data in 1992. The USDA-AMS reports auction data by 50 lb. groupings. Thus, we take the average of the 700-749 lb. and 750-799 lb. weight categories to determine a single cash price. Cash prices were then compared to the nearby futures price corresponding to that auction day. Table 3 depicts the correlation between cash prices and nearby futures prices for each market from the earliest available USDA-reported data through 2018. To better depict how nearby feeder cattle futures prices correlate to cash prices currently, we include correlations for 2014 through 2018 in Table 4.

***Table 3*. Feeder Cattle Cash-Futures Price Correlations (through 2018)**

Market	First Observation	Number of Observations	Cash/Futures Correlation
Billings, MT	01/06/2000	478	0.9897
Kearney, NE	01/05/2000	660	0.9950
Oklahoma City, OK	01/03/2000	865	0.9972
Pratt, KS	01/06/2000	877	0.9964
Torrington, WY	01/07/2000	651	0.9916
Tulia, TX	06/29/2000	829	0.9960
*Letohatchee, AL	03/16/2004	466	0.9807

Source: Bloomberg & USDA-AMS

***Table 4*. Feeder Cattle Cash-Futures Price Correlations (2014–2018)**

Market	Number of Observations	Cash/Futures Correlation
Billings, MT	134	0.9803
Kearney, NE	178	0.9877
Oklahoma City, OK	229	0.9946
Pratt, KS	220	0.9913
Torrington, WY	169	0.9819
Tulia, TX	229	0.9936
*Letohatchee, AL	172	0.9708

Source: Bloomberg & USDA-AMS

Nearby feeder cattle futures prices and cash prices have been highly and positively correlated for each market since 2000 (2004 for Letohatchee). Correlation between cash and futures prices dropped off for the 2014–2018 period, but only slightly. High correlations imply feeder cattle futures and cash market prices have similar patterns over time. High correlations are also indicative, though not conclusive, of feeder futures being an effective hedging instrument. Correlation coefficients may vary depending on frame size and muscle grades, weights, gender, and marketing alternatives.

Basis Variability. Representativeness of the feeder cattle futures contract can also be assessed by evaluating basis variability. Basis is defined as cash price minus futures price and can have either a positive or negative value. Basis differs by location, as each market experiences its own supply and demand conditions, transportation costs, and other factors that influence the cash price of the asset. A wide basis—or basis that is highly positive or negative—is not necessarily indicative of a flaw in the futures contract. A futures contract can remain a valid and effective tool to hedge price risk regardless of basis level as long as futures prices remain highly correlated with cash prices. Rather, unexpected changes in basis, or basis variability, can introduce another form of risk and decrease hedging effectiveness when participating in commodity futures markets. We assess variability of basis for each market by first

calculating basis from the cash price and same-day nearby feeder futures price and then finding minimum, maximum, and average basis values and standard deviations over time. Table 5 depicts these measures of basis variability for each market from the earliest available USDA-reported data through 2018. Table 6 displays the same information, but for 2014 through 2018.

***Table 5*. Feeder Cattle Basis Summary Statistics ($/cwt, through 2018)**

Market	First Observation	Mean	Std. Dev.	Minimum	Min. Date	Maximum	Max. Date
Billings, MT	01/06/2000	0.55	6.15	-27.73	11/19/2015	24.24	05/14/2015
Kearney, NE	01/05/2000	5.02	4.27	-7.10	06/12/2013	28.75	07/1/2015
Oklahoma City, OK	01/03/2000	1.92	2.84	-8.78	01/26/2015	16.44	07/13/2015
Pratt, KS	01/06/2000	2.37	3.20	-6.97	05/26/2016	16.69	04/23/2015
Torrington, WY	01/07/2000	3.72	5.25	-17.53	06/6/2014	26.35	07/18/2014
Tulia, TX	06/29/2000	0.53	3.25	-13.53	10/30/2003	12.63	09/25/2014
*Letohatchee, AL	03/16/2004	-13.52	6.48	-32.17	10/21/2014	10.84	04/7/2015

Source: Bloomberg & USDA-AMS

***Table 6*. Feeder Cattle Basis Summary Statistics ($/cwt, 2014–2018)**

Market	Mean	Std. Dev.	Minimum	Min. Date	Maximum	Max. Date
Billings, MT	5.28	7.10	-27.73	11/19/2015	24.24	05/14/2015
Kearney, NE	8.98	5.24	-4.05	11/19/2014	28.75	07/1/2015
Oklahoma City, OK	3.27	3.63	-8.78	01/26/2015	16.44	07/13/2015
Pratt, KS	4.57	4.39	-6.97	05/26/2016	16.69	04/23/2015
Torrington, WY	7.59	6.53	-17.53	06/6/2014	26.35	07/18/2014
Tulia, TX	1.52	3.70	-9.04	06/5/2014	12.63	09/25/2014
*Letohatchee, AL	-15.20	7.98	-32.17	10/21/2014	10.84	04/7/2015

Source: Bloomberg & USDA-AMS

We notice that, over time, Kearney and Torrington experience positive basis levels substantially higher than the other markets, while Letohatchee cash prices are steeply discounted relative to feeder cattle futures—probably coinciding with the market's increased distance from the major cattle-feeding region of the U.S. and necessarily larger costs to transport cattle to feedlots. For the six markets within the Index 12-state region, average basis and standard deviation of basis for the 2014–2018 period was markedly higher than for the 2000–2018 period. This is probably due to the increase in overall feeder cattle prices since 2014. We would expect that as overall prices increase, the absolute difference between cash and futures prices would be amplified. In fact, for the six markets within the 12-state region, the relative standard deviation—defined as the standard deviation of basis divided by mean basis—was smaller for the 2014–2018 period than for the 2000–2018 period, meaning that these markets have experienced relatively smaller basis variation since 2014. Letohatchee has also experienced wider basis levels (though negative) and increased standard deviation of basis, but with a slightly higher relative standard variation.

Highly and positively correlated cash and nearby futures prices, along with basis variation that has generally decreased during an era of historically high feeder cattle prices, implies that the feeder cattle futures contract is a valid price discovery tool and generally tracks cash market conditions across numerous locations. More in-depth research and discussion with industry users can be used to more definitively gauge the hedging effectiveness and price discovery performance of the feeder cattle futures contract.

Appropriateness of the Feeder Cattle Index

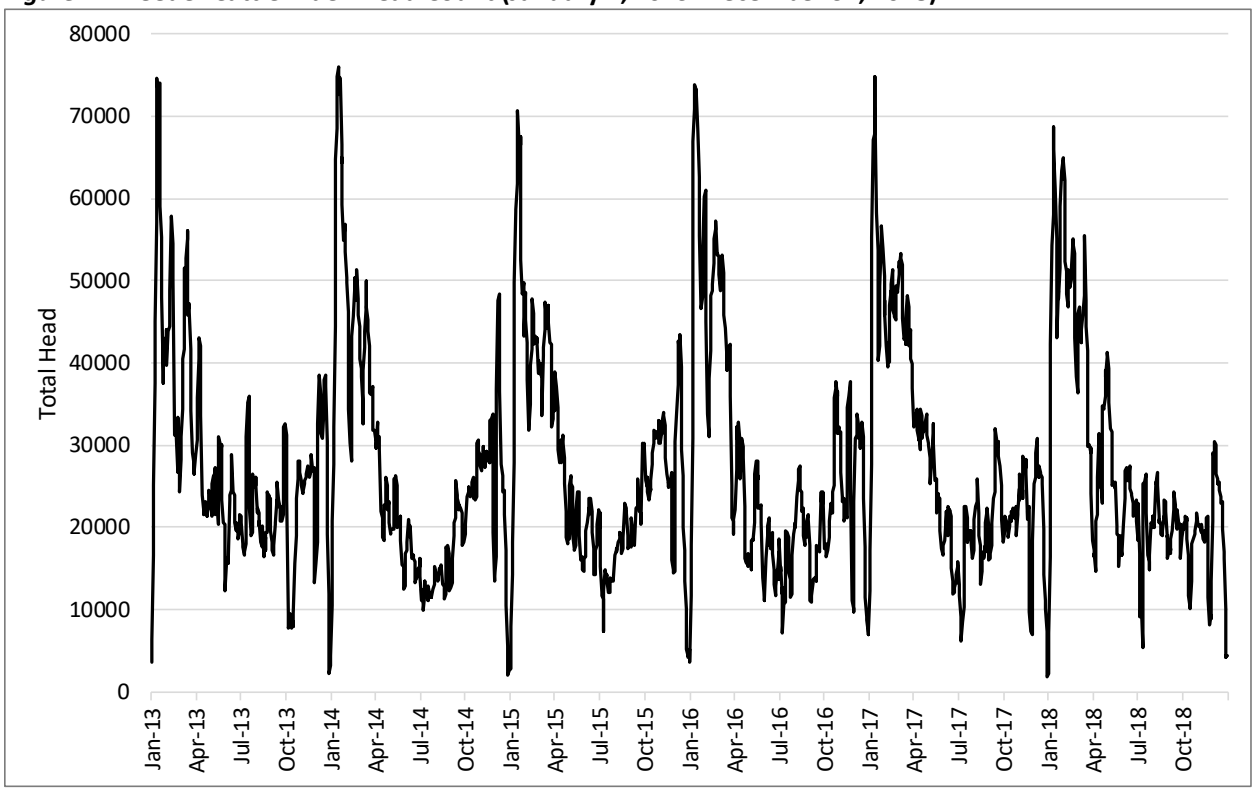
Delivery of feeder cattle does not take place with termination of trading on the CME Group feeder cattle futures contract. Rather, all contracts open at the termination of trading are cash settled to the CME Feeder Cattle Index, which uses a mathematical calculation that includes head counts, weights, and cash prices to determine a settlement price. The Index is a seven-day weighted average, defined as the total dollars sold during the seven-day period divided by the total pounds of feeder steers sold during the same seven-day period. CME Group's Commodity Product Research and Development department calculates the Index every Monday through Friday using data reported by the USDA Agricultural Marketing Service.

The USDA-AMS releases daily reports containing Index-eligible feeder cattle. Eligible cattle—a sample of all feeder cattle transactions—must reside within specific gender, weight, and frame categories; 700-899 lb. Medium and Large Frame #1 feeder steers, and 700-899 lb. Medium and Large Frame #1-2 feeder steers. This sample includes all USDA-reported auction, direct trade, and video/internet sale transactions for the 12-state region of Colorado, Iowa, Kansas, Missouri, Montana, Nebraska, New Mexico, North Dakota, Oklahoma, South Dakota, Texas, and Wyoming. Feeder steers must originate from within the 12-state region and be reported FOB for their sale to be included in the Index, meaning that steers bought from outside but delivered into the specified 12-state region are not counted toward the Feeder Cattle Index. The USDA-AMS must report number of head, weighted average weight, and weighted average price for the transaction to be included. Further, steers with origin outside the United States or identified as having predominantly dairy, exotic, or Brahma breeding are excluded from the Index. Steers identified as being fancy, thin, fleshy, gaunt, or full are included in the Index commencing with the May 2019 contract.

For each USDA-AMS report, and for each relevant weight/frame category, the number of head is multiplied by the weighted average weight to obtain total pounds of feeder steers sold in that category. The total pounds sold for each relevant weight/frame category is aggregated to determine the total pounds sold for that report. Similarly, the product of head count and weighted average weight is then multiplied by the weighted average price to determine the total dollars sold in each relevant weight/frame category, which is then aggregated to find total dollars sold for the report. Total pounds of feeder steers sold and total dollars sold for all reports covering relevant transactions are aggregated to obtain total pounds sold and total dollars sold across the 12-state region and for a seven-calendar-day period. Total dollars sold in the 12-state region during the seven-day period is then divided by total pounds of feeder steers sold in the 12-state region during the seven-day period to determine the final Feeder Cattle Index value.

Included Cattle. The Feeder Cattle Index is based on a sample of all feeder cattle transactions. As such, the sample, or the eligible cattle that are included in the Index, must be representative of the entire feeder cattle market to be a viable input in the cash-settled commodity index. To determine the appropriateness of the Feeder Cattle Index, we first look at the number of cattle included in the Index over time. Daily Index data was obtained from CME Group from January 1, 2013 through 2018. Figure 22 depicts the seven-day aggregated feeder steer head counts included in the Index over that time frame. It should be noted that weight/frame categories were amended on November 1, 2016 from 650-849 lb. Medium and Large Frame #1 feeder steers and 650-849 lb. Medium and Large Frame #1-2 feeder steers to the current categories of 700-899 lb. Medium and Large Frame #1 feeder steers and 700-899 lb. Medium and Large Frame #1-2 feeder steers.

Figure 22. **Feeder Cattle Index Head Count (January 1, 2013–December 31, 2018)**



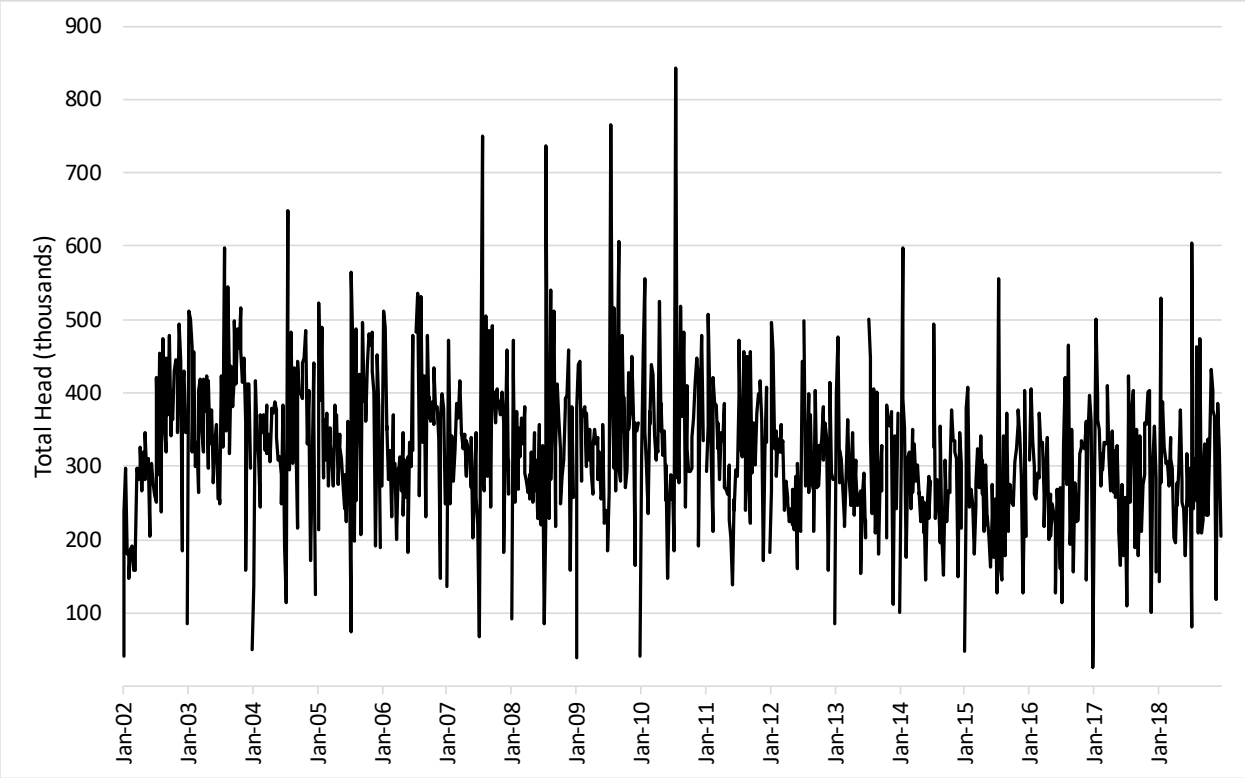
Source: CME Group

The number of steers included in the Feeder Cattle Index exhibits a strong seasonal pattern. Included cattle is at its lowest during the end-of-year holiday season, probably coinciding with auction barns and other mediums of feeder steer transactions being inactive during this time frame. Conversely, the aggregated 7-day head count reaches its maximum around mid-January each year, with total included cattle routinely exceeding 70,000 head. The number of cattle included in the Index remains high during the late winter and early spring months, before dropping to levels around 20,000 head during the summer and fall.

Included Cattle vs. Feeder Cattle Market. While important to understand the sample size of cattle that comprises the Feeder Cattle Index, appropriateness of the Index can be placed in more perspective by comparing the sample to the entire feeder cattle market. That is, what is the percentage of all feeder cattle sold that are included in the Index over time?

Size of the U.S. feeder cattle market was estimated using the National Feeder & Stocker Cattle Summary report, published each Friday by the USDA-AMS. Included in the report are nationwide, weekly receipts for all feeder cattle auction, direct trade, and video/internet transactions reported by the USDA. That is, the total number of USDA-reported feeder cattle sold throughout the country each week. The summary report, released each Friday, includes transaction data from the previous Friday through Thursday. Feeder cattle receipt information is recorded from the National Feeder & Stocker Cattle Summary and archived by the Livestock Marketing Information Center, from which our data was obtained. Figure 23 depicts the USDA-reported total number of feeder cattle sold nationwide from the week ending January 3, 2002 through 2018.

Figure 23. **Nationwide Weekly Feeder Cattle Sales (January 3, 2002–December 27, 2018)**



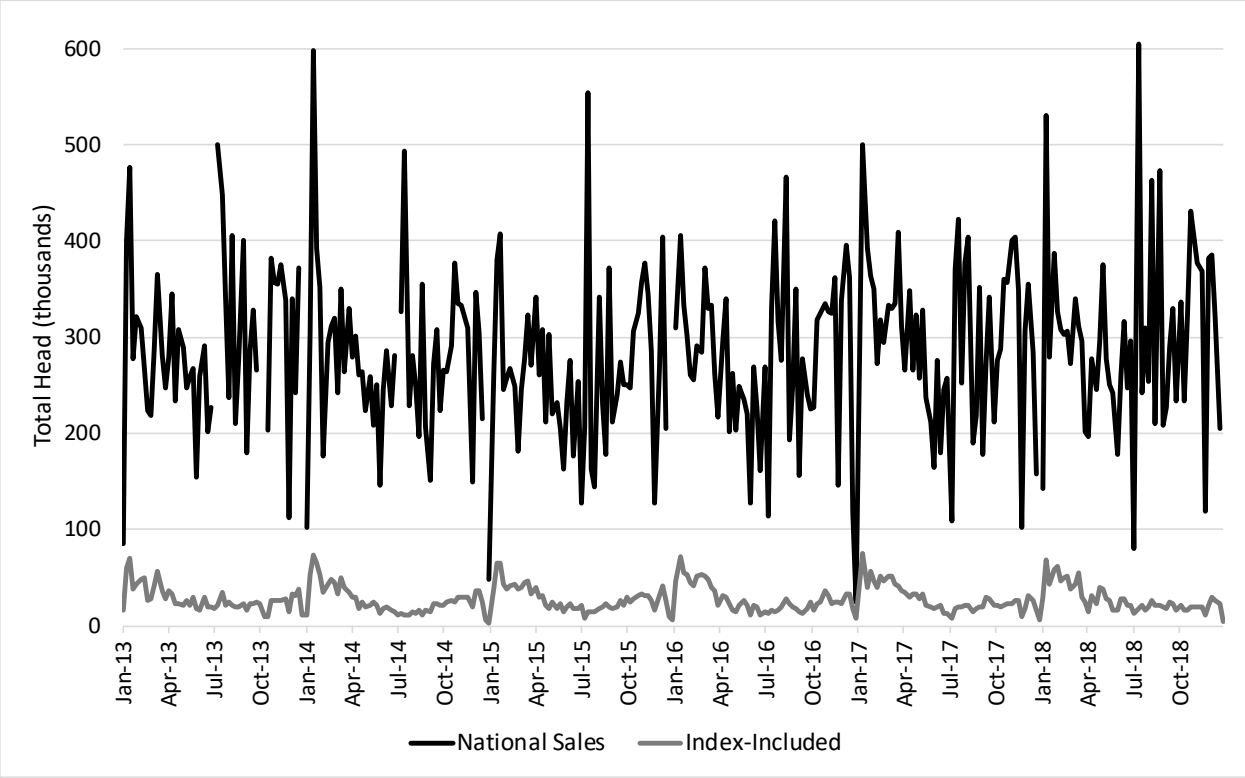
Source: LMIC & USDA-AMS

A distinct pattern can be seen each year, with national weekly feeder cattle sales experiencing their lowest levels around holiday seasons—most noticeably the week of New Years and the week of Independence Day. Conversely, feeder cattle sales tend to peak on the weeks following these major holidays as auction barns and other

mediums of transaction restart operations. Weekly sales have remained steady since 2002, generally hovering slightly above 300,000 head, with the exception of holiday seasons. It should be noted that direct trade transaction data is reported to the USDA on a voluntary basis. A true estimate of the size of the U.S. feeder cattle market would include even those transactions which are not covered by the USDA. As such, our estimation of the size of the feeder cattle market in Figure 23 is, in actually, the size of the *publically-reported* U.S. feeder cattle market.

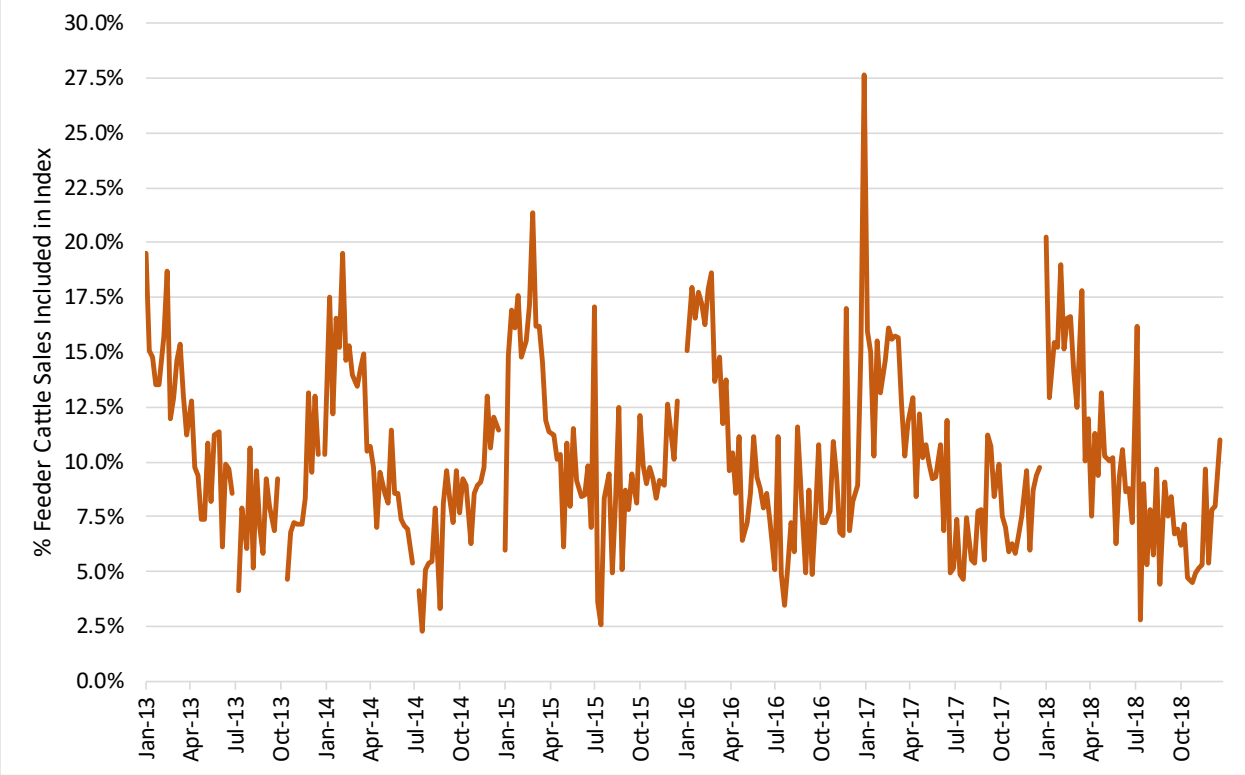
We compare this estimate of the U.S. feeder cattle market to the number of cattle included in the CME Feeder Cattle Index in Figure 24. Figure 25 depicts, in percentage terms, the relationship between Index-included feeder steers and the U.S. feeder cattle market over time. Recall that the USDA's National Feeder & Stocker Cattle Summary is released each Friday and includes feeder receipt data for the previous Friday through Thursday. Also recall that the Feeder Cattle Index is a seven-day weighted average. As such, Figures 24 and 25 compare the national weekly feeder cattle sales for each week ending on Thursday to each Thursday's Index 7-day aggregated head count.

Figure 24. **Nationwide Weekly Feeder Cattle Sales vs. Feeder Cattle Index Head Count (January 3, 2013–December 27, 2018)**



Source: CME Group, LMIC, & USDA-AMS

***Figure 25*. Percentage of National Feeder Cattle Sales Included in the Feeder Cattle Index (January 3, 2013–December 27, 2018)**



Source: CME Group, LMIC, & USDA-AMS

Again, we observe Index-included feeder steers at their lowest levels around the year-end holiday season and peak head count levels around mid-January through the early spring months. Feeder steers included in the Index then taper off through the summer and fall months. Total national feeder cattle sales tend to be lowest around holiday seasons, but rapidly increase in the weeks following these time periods. Notice that the Feeder Cattle Index does not exhibit the same rapid increase in head count around mid-July as experienced by national feeder cattle sales. Consequently, the percentage of feeder cattle sold which are included in the Index tends to be lowest around this time of year and remains low through autumn. Conversely, the Feeder Cattle Index represents a larger share of the overall U.S. feeder cattle market during the late winter and early spring months, when Index-included cattle reach peak levels. Feeder cattle sales that are included in the Index range from around 5% in the summer to around 17.5-20% in the winter. The Feeder Cattle Index—derived from a sample of cattle meeting the previously mentioned requirements—includes about 10% of all feeder cattle sold nationally each week, on average.

Knowing the percentage of feeder cattle sales included in the Feeder Cattle Index over time—while useful and important—does not, by itself, yield conclusions as to the appropriateness of the Index. That is, more information is needed to definitively say whether the Index, in its present form, is an adequate representation of the entire market and a valid approach to determining a final settlement price for the feeder cattle futures contract. Discussion

with industry users of the contract regarding market characteristics and Index specifications must be had to gain more perspective on this issue.

Conclusions

The CME Group feeder cattle futures contract plays important roles in the feeder cattle market as both a point of price discovery and as the chief price risk management tool. The importance of feeder cattle futures to risk management in the feeder market warrants a close assessment into the performance and effectiveness of the contract. This study addressed important research questions to better understand contract performance across time and in comparison to other agricultural derivatives.

We find that feeder cattle futures trade volume—both front month and deferred contracts—has increased drastically in the last 15 years, but still pales in comparison to similar agricultural products. Discussions with industry users is necessary to determine if the contract should be considered "illiquid" or "thinly traded," but it appears to be relative to other derivative products in the agricultural complex.

Recent volatility in the feeder cattle futures contract is not out of line with certain historical periods, though it has been more sustained in the last five years. Comparison to the other cattle crush inputs shows that feeder cattle volatility is similar across time to that of live cattle and substantially less than corn. However, feeder cattle volatility has increased disproportionately since around 2015. Speculative trade activity was assessed to determine its role in increased volatility in feeder cattle futures; however, we conclude that volatility does not increase due to an influx of speculative activity, but rather that speculators enter a market as a result of the risk (opportunity) already inherent in that market due to other economic factors.

Cash and nearby futures prices remain highly correlated across time and geographic locations. In addition, basis variation generally decreased in 2014–2018, an era of historically high feeder cattle prices and increased volatility. This implies that the feeder futures contract is a valid price discovery tool and generally tracks cash market conditions across numerous locations.

The number of feeder cattle included in the CME Feeder Cattle Index exhibits strong seasonal patterns, as does the total number of feeder cattle sold nationally. As such, the percentage of the feeder cattle market that is included in the Index also shows distinct seasonal patterns, with the share of the feeder market included in the Index being highest in the winter months and lowest in the summer and fall. On average, the Feeder Cattle Index includes about 10% of all feeder cattle sold nationally each week.

Our research provides a better understanding of the issues surrounding the feeder cattle futures contract and the contract's performance over time. However, more extensive research and, especially, discussion with industry users must be conducted to definitively gauge performance of the contract. Moving forward, increased communication between contract users and CME Group about industry needs and feasibility issues is essential to guarantee successful future use of the contract for price discovery and price risk management purposes.

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K-State Agricultural Economics | 342 Waters Hall, Manhattan, KS 66506-4011 | 785.532.1504
www.ageconomics.k-state.edu