



Live Cattle Basis Increased Volatility and Risk Management Implications

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Abstract

Basis variability in live cattle markets has substantially grown over the past few years. Since the beginning of the new cattle cycle (2014), volatility¹ experienced by the live² cattle futures market has grown by more than 150% in comparison to previous years. This new scenario has considerable implications for participants in the futures markets, both hedgers and speculators. We review the changing live cattle market conditions from the implementation of the Livestock Marketing Reporting (LMR) up to date. Additionally, we document and interpret changes to live cattle basis while providing examples of how basis volatility impacts profitability.

Introduction

Live cattle basis has experienced an increase in volatility since 2014, leading to broad discussions about the efficacy of current price risk management practices. Several factors could be the reason for this including changes in the cash market structure, changes to Chicago Mercantile Exchange (CME) Live Cattle Futures contract delivery specifications, and the start of a new period of U.S. cattle inventory expansion.

Regardless of the cause(s), if live cattle cash and futures prices have become misaligned, then beef packers and cattle feeders across the United States will have a difficult time locking in predictable profits. Whereas the basis risk was larger from 2014-2017 than from 2004-2013, our research shows that basis is still predictable and current risk management tools remain a viable option.

1 Sample variance is used as a proxy for variability and volatility within this paper.

2 Synonymous with fed cattle, live cattle are defined here as cattle sold for slaughter.

Changing Cattle Markets

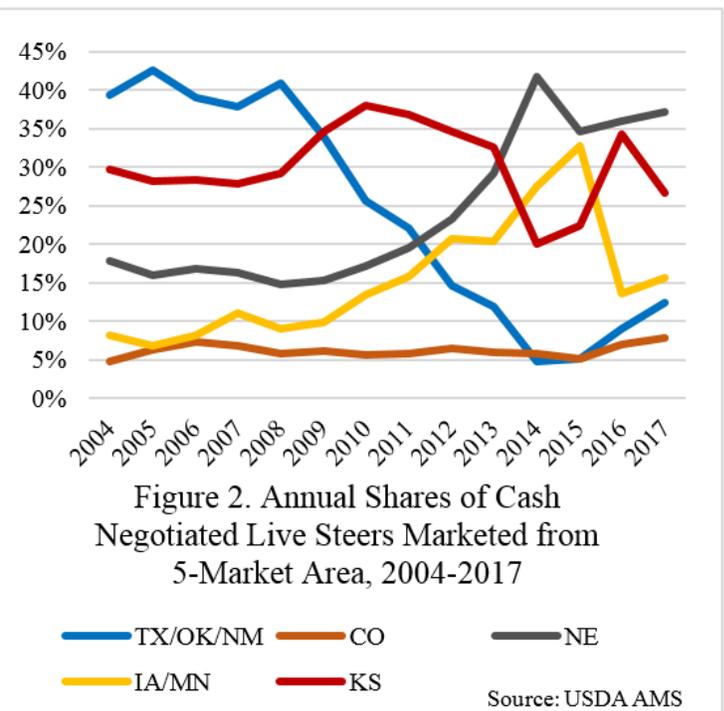
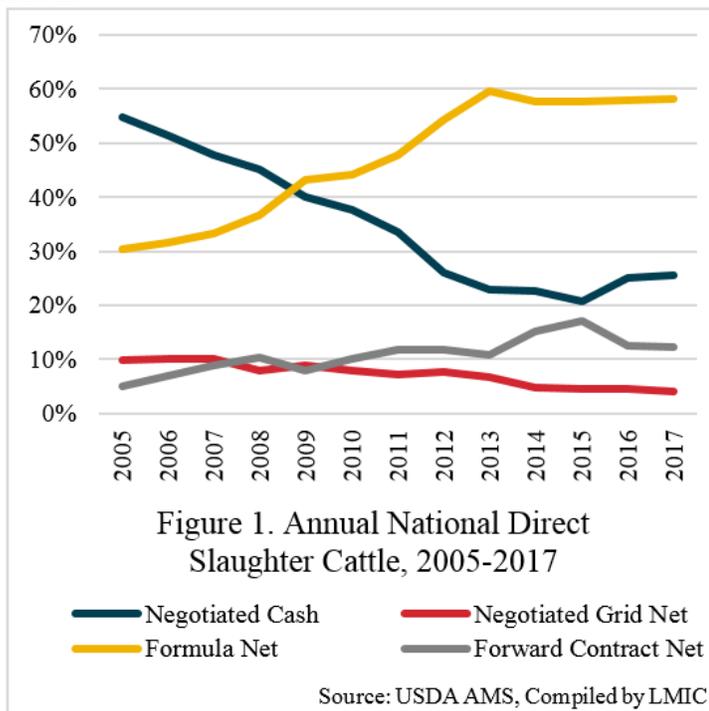
Before investigating changes in the basis environment, it is relevant to note important trends and changes in domestic cattle markets in the new millennium.

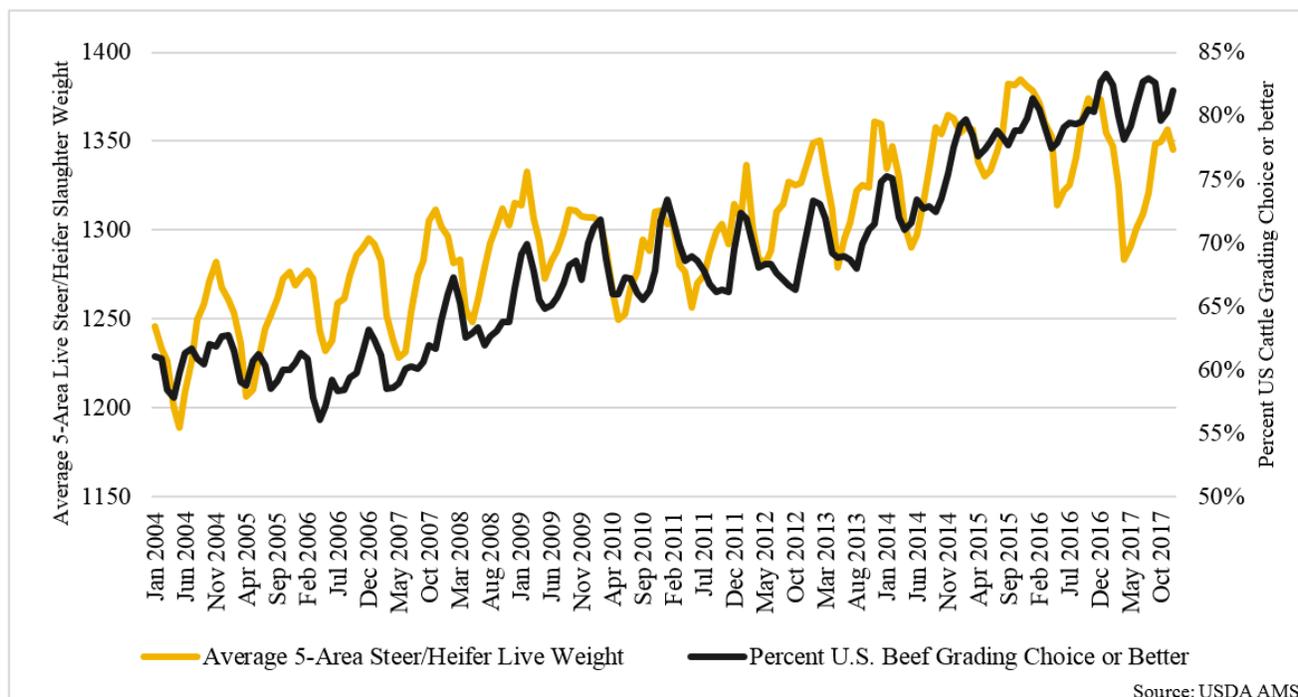
The Livestock Mandatory Reporting (LMR) Act of 1999 was implemented in April 2001³ requiring meat packers to provide the public with complete livestock (cattle, hogs, lambs and products) price and transaction information. Meat packers that slaughter more than 125,000 cattle, 100,000 swine or 75,000 lambs every year must report their daily transactions to the Agricultural Marketing Service (AMS) of the US Department of Agriculture (USDA), who then provides the data to regional market and national industries. Since transaction data was previously reported on a voluntary basis, LMR's purpose was to increase the transparency among these markets, particularly with cattle feeders and meat packers (Koontz and Ward, 2011). Most importantly, implementation of LMR has made it significantly easier to track trends in live cattle markets.

Another change is negotiated cash live cattle sales have witnessed a marked decline in volume as formula pricing has become more widely used. Negotiated cash sales represented 55% of national slaughter cattle marketings⁴ during 2005 but declined steadily to 25% by 2017. On the other hand, formula pricing represented just 30% of national slaughter cattle marketings in 2005 and increased to a 58% share in 2017. The evolution of these series through the years is shown in Figure 1. While negotiated cash sales declined nationwide, the decline was uneven across the five major market regions reported by USDA AMS. The Texas/Oklahoma/New Mexico region, which held nearly 40% of negotiated cash trades in 2004, accounted for only a 12.5% share in 2017. Figure 2 shows the progression of this reallocation by considering how each of the five LMR reporting regions contributes to the average cash price. As these regions rapidly redistributed their share of negotiated cash sales, the weighted average 5-market cash price, which industry is more commonly using as its baseline, is

3 The act expired in October 2005 and was renewed in October 2006 until 2010. Subsequently it was renewed in 2010 until 2015 and renewed again in 2015 to expire September 30, 2020 (USDA).

4 These figures include cattle sold on both and live and dressed basis. Data obtained from USDA AMS and compiled by the Livestock Marketing Information Center (LMIC).





affected by these regions very differently today than in 2004. As noted by Schroeder and Coffey (2018, pg. 36), “Variation in market shares of negotiated live cattle marketings across regions is potentially impactful on live cattle futures market price discovery.”

Over a similar period, live cattle are heavier and yielding higher quality grades (choice⁵ and above). Figure 3 shows that quality grades increased steadily from 2004 to 2016 and slowed in 2017. The chart also shows a steady increase in average live slaughter weights from 2004 to 2015 and a slight decrease during 2016 and 2017.

As the latter change takes hold in the marketplace, there have been increases in the allowed deliverable weights in the CME Live Cattle Futures contract delivery mechanism. Garcia, Irwin, and Smith (2014, pg. 43) note: “if futures contract terms become misaligned with prevailing standards, then the contract may no longer serve as a useful hedging instrument and its continued existence is threatened.” To remain relevant, changes in futures contract delivery terms occur over time to reflect changes in commercial standards for market transactions. Of the 45 amendments to the live cattle futures contract since it began trading in 1964, 26 took place since the year 2000 (CME Group, 2018). The high rate of recent amendments reflects both rapid change in cattle markets and a willingness of the Exchange to make changes needed to remain relevant. A full list of changes to the live cattle futures contract as of 2018 was provided to us by the CME Group⁶.

Despite the CME Group’s efforts to align the contract to industry standards, the National Cattlemen’s Beef Association (NCBA) commissioned a research report (Schroeder and Coffey, 2018) to evaluate current physical delivery practices and present possible alternatives. The existence of this effort points to a continued and widespread frustration towards poor basis performance of a futures contract which Kristoufek and Vosvrda (2013) identified as one of the two least efficient major commodity futures contracts, the other being feeder cattle.

5 Deliveries with a higher percent choice than required by the CME Live Cattle Futures contract receive a premium. Details can be found in Chapter 101 of the CME Exchange Rulebook.

6 The list is available at: www.uidaho.edu/cals/idaho-agbiz

Table 1. Occurrence of Basis Range vs. Futures Range from 2004-2017

Futures Contract Month	Basis Range > Futures Range	Basis Range < Futures Range	Percent of Time Basis Range is Greater Than Futures Range
Feb	5	9	35.7%
April	3	11	21.4%
June	7	7	50.0%
Aug	6	8	42.9%
Oct	3	11	21.4%
Dec	4	10	28.6%

Evaluating Basis Performance

A futures contract is deemed successful if the cash and futures prices converge to the commercial value of the commodity at contract maturity. This price convergence is necessary for hedging effectiveness, which is essential for futures contract success (Working, 1953). Non-convergence, as coined by Irwin et. al. (2009), became prevalent in grain markets in 2005 prompting a need to re-evaluate both contract specifications and hedging practices across all agricultural commodities.

The non-storable nature of livestock commodities prevents the general application of foundational theories regarding basis relationships, which root back to Keynes' (1923, 1930) Theory of Normal Backwardation and Working's (1949, 1953) Theory of Price Storage (Naik and Leuthold, 1988). It is also generally known that marketing of cattle happens more often than once every month. With these points in mind, we take a bit more detailed approach to evaluating basis, and the success of the live cattle futures contract as a risk management tool.

When a market participant places a hedge,⁷ price risk is traded for basis risk. Fortunately, basis is typically far less volatile than either the futures prices or the underlying cash price. We look at range and variance, two measures of dispersion, to discuss the overall volatility of live cattle basis from 2004-2017. For this analysis, we used daily futures closing prices and daily cash prices from the Bloomberg spot cattle price index⁸ for the final two months before contract expiration. Daily basis calculations were made for this two-month period, and range was calculated by subtracting the smallest from largest values obtained.⁹ The range of nearby¹⁰ basis was larger than the range of the nearby futures contracts for one-third of futures contracts expiring in the 2004-2017 timeframe. This means that during a third of contract months, the actual change in basis was larger than the actual change in the futures price while each futures contract neared expiration. Table 1 shows that this occurred most often in contracts with a June expiration and least often in contracts with an April or October expiration.

Additionally, variance shows us that both futures and basis are significantly more volatile from 2014 to 2017 than they were from 2004 to 2013. Variance here is aggregated by contract month and represents sample variance for each listed contract during the final two months to expiration. Basis, cash and futures variance over the whole period is shown below in Figure 4. The basis variance for the entire 2014-2017 period was 16.75,

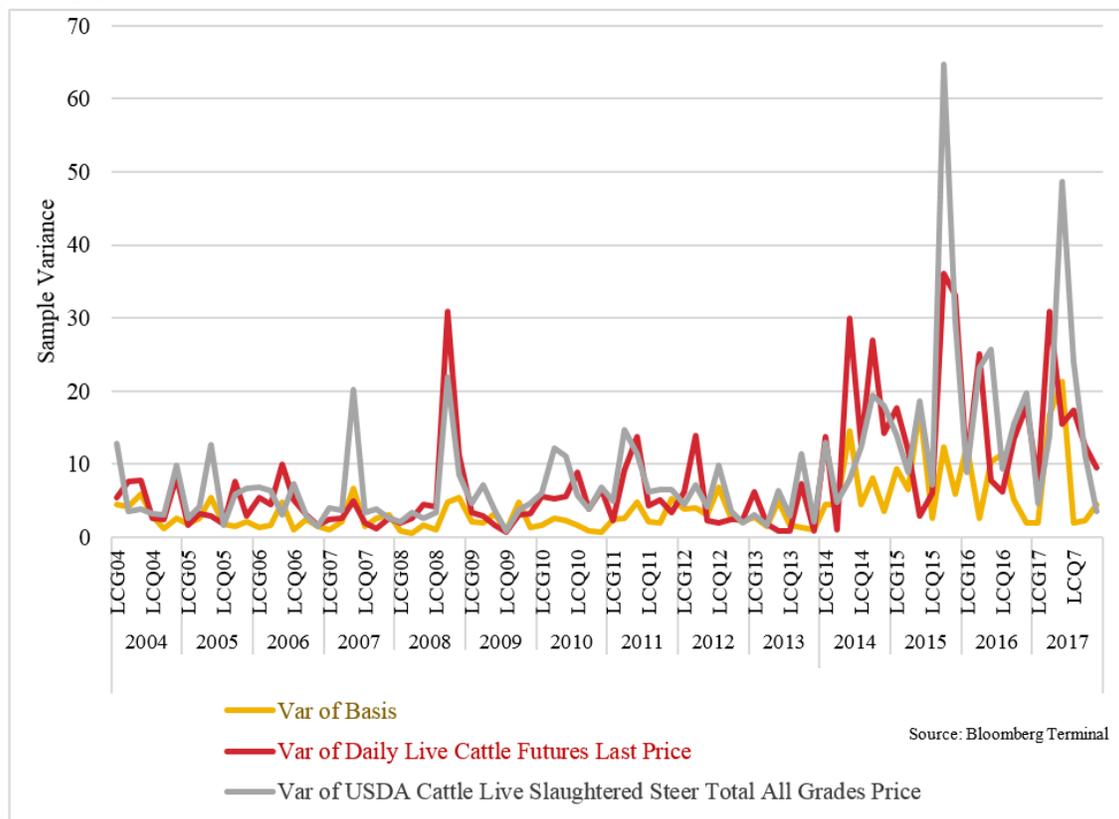
7 Simultaneously participating in the cash and futures market to “lock in” a price margin.

8 The index, found in Bloomberg as “CATLLSPT Index”, is based on USDA AMS live slaughter steer prices, weighted by all weights and all grades. This was the most complete daily data source for live cattle we could locate for this study.

9 The futures range was calculated by subtracting the lowest closing price from the highest closing price for the same period.

10 ‘Nearby’ refers to the nearest expiring futures contract

Figure 4. Variance of Nearby Basis, Futures Prices, and Cash Prices by Futures Contract Month



166% higher than sample variance from the full 2004-2013 period which was 6.288. Alternatively, futures variance was only 35% higher and cash price variance was only 44% higher during the 2014-2017 period than during the full 2004-2013 period.

In order to investigate the impact of this new scenario, for each contract expiring between 2004-2017 we computed historical basis at four different points in time:

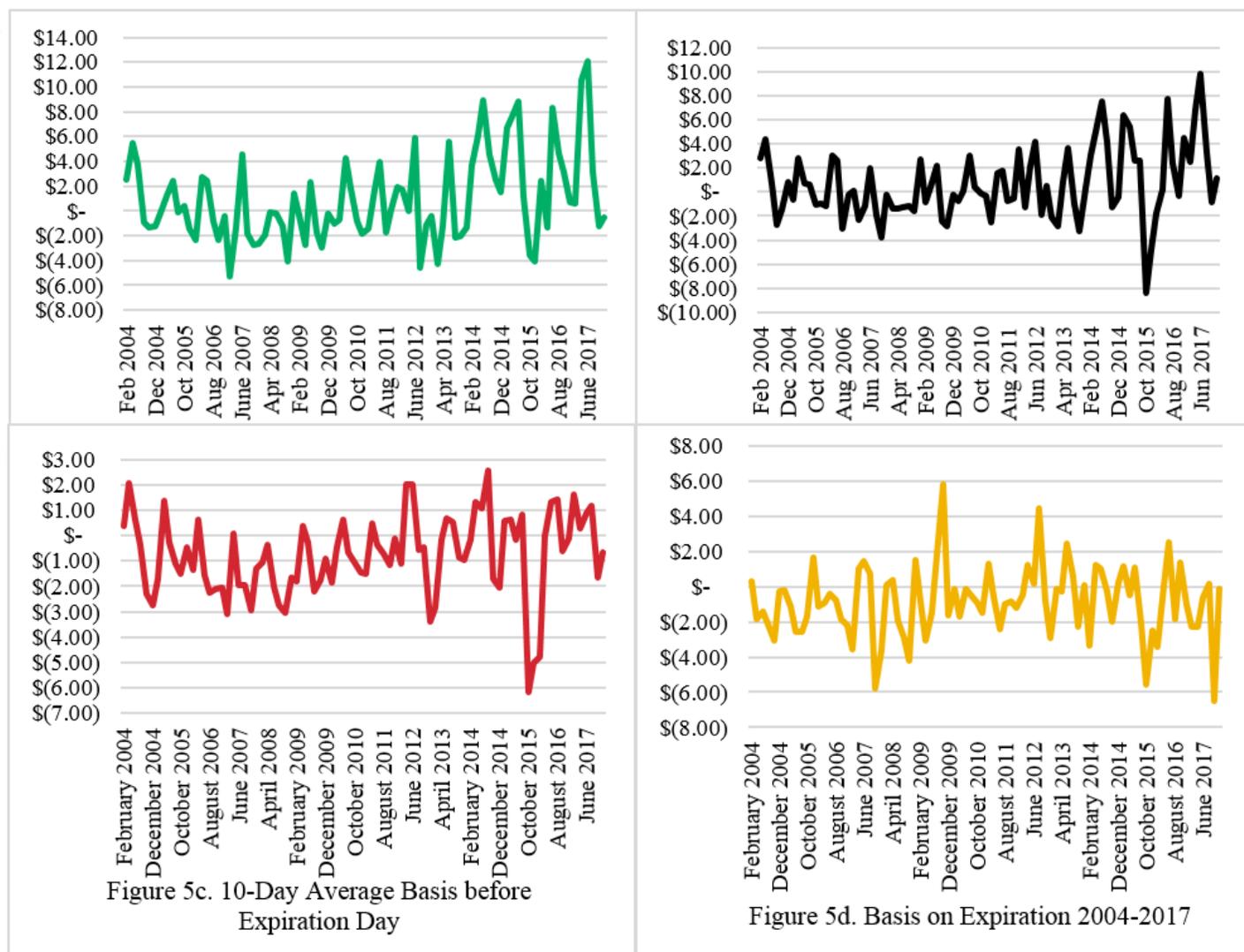
- (i) On contract expiration day
 - a. For live cattle futures, expiration day is the last business day of the contract month.
- (ii) Considering a 10-day average of both cash and futures prices leading up to expiration day.
- (iii) Basis at First Notice Day (FND)
 - a. FND is the first day the buyer of a futures contract (holder of a long futures contract) may be called upon to take delivery. For live cattle futures, FND is the first business day of the contract month.
- (iv) Basis at the roll
 - a. The roll is represented by the first week in which open interest¹¹ of the current futures expiration month becomes smaller than open interest of the next closest futures expiration month. For example, the week in which open interest for the February 2004 futures contract became smaller than open interest for the April 2004 futures contract.

Weekly live steer data from the five major LMR reporting areas and daily cattle spot index prices from Bloomberg are used here for cash prices.¹² Daily data can sometimes be biased by market thinness in the case where cash sales may not take place on a given day. In figures 5a and 5b, it seems that basis has continued to

11 The total number of active long or short futures positions

12 Weekly live steer cash prices from LMR were used for Weekly Average calculations (Figures 5a and 5b) per USDA data; Bloomberg cash prices were used for 10-day Average calculations (Figures 5c and 5d). Daily data was used to capture basis for the exact expiration day. Results from using daily or weekly data are similar

Figures 5a-d. Weekly Basis Trends – February 2004 through June 2017



become increasingly positive at the roll and at first notice day¹³. However, if we look at figure 5d, we see that basis trended more negative than typical at expiration from 2014-2017.

These trends have interesting implications for short hedgers¹⁴. As basis strengthens¹⁵ relative to the hedge entry point, profitability of the hedge increases. Looking at Figures 5a-5d, it stands to reason that a cattle feeder who lifted hedges near the roll could have seen substantially higher per-head gains than a cattle feeder who waited to lift their hedge or who intended to use the delivery mechanism from 2014-2017. Using the June 2015 contract as an example, a short hedger would have seen basis of \$8.80 at the roll, \$2.59 at FND and \$1.10 at expiration. This means, a short hedger who exited their position¹⁶ at the roll could have captured an additional \$7.70/cwt, which equates to an additional \$100/head for each 1300-pound steer¹⁷. In contrast, a beef packer

13 Long hedgers who own a position past First Notice Day may be forced to accept delivery. Unless the hedger plans to receive delivery, they will exit the position before FND.

14 A hedger who owns the physical commodity and sells futures contracts to manage price risk.

15 Becomes more positive or less negative.

16 Bought back their futures contracts and sold in the physical cash market.

17 This may not always be possible due to the non-storable nature of cattle and does not account for the additional weight which can be added by more days on feed.

using live cattle futures contracts as a long hedge would likely have seen gains from holding contracts to expiration as basis weakened. In practice, placing a hedge at the optimal moment for maximum potential gain is difficult¹⁸. As such, the inherent volatility of basis over the life of the contract is of just as much concern as the basis values at typical hedge exit points.

Recent research (Coffey, Tonsor, and Schroeder, 2018) evaluated the magnitude of basis and its impact of hedging effectiveness during the rapid futures rise and decline from 2014-2016. The study found changes in basis prediction error due to the volatility of price momentum were smaller than the impacts of the volatility of delivery costs and the net benefit of adding pounds to cattle. Still, the fact that price and basis volatility remains in the marketplace beyond 2016 (Figure 4) warrants further research into the long-run relationship between live cattle cash and futures prices.

Cointegration: Cash and Futures Prices Long-run Relationship

Cointegration is an econometric technique for testing the long-run relationship, or correlation, between non-stationary time series. In light of prior assertions, for this case we use the test to determine whether live cattle cash and futures prices have continued to move together. If cash and futures prices are found to no longer be cointegrated, then basis should no longer be predictable. This can result in higher volatility of profit margins. While the technique was first defined in 1987 (Engle and Granger), we use a slightly more recent version of the test as developed by Johansen (1991). A significant amount of literature is available which uses cointegration to examine the relationship between futures and cash prices including Chowdhury (1991), Fortenbery and Zapata (1993), Lien (1996) and Bekiros and Diks (2008). Cointegration testing has also been used to evaluate the spatial relationships between regional live cattle markets (Goodwin and Schroeder, 1991).

Coffey, Tonsor, and Schroeder (2018) found no inherent bias in basis predictability in any of the five LMR reporting regions, providing sufficient grounds to use the five-market weighted average cash price for our more general discussion here. We evaluated the cointegration of weekly weighted average live steer prices from the five major LMR reporting regions and weekly CME Live Cattle Futures contract prices for three different timeframes:

- (i) The full observation period, 2004-2017
- (ii) The first period with lower overall variation, 2004-2013
- (iii) The second period with higher overall variation, 2014-2017

Unit-root tests were previously applied and results indicated statistical evidence that both cash and futures prices were non-stationary for all three periods. Subsequently, our test for cointegration found statistically significant evidence that cash and futures prices were cointegrated in all three periods. This implies, even with substantially higher basis volatility, basis is still predictable and basis risk may still be smaller than price risk. We can further infer that hedging the cash markets with the use of futures markets is still (statistically) efficient (switching price risk to a lower basis risk) and should continue to be a useful risk management tool.

Conclusions

Despite rapidly changing and volatile cattle markets, our research shows that live cattle cash and futures prices are still moving together in the long run (cointegrated). Thus basis is still predictable and its risk, though it has increased, remains smaller than price risk. Still, basis over the last three years experienced 166 percent more variation than basis from 2004-2013. While basis remains highly volatile, risk managers should expect to see larger swings in their profitability. Additional research into the sources of increased basis variation and whether this elongated period of high volatility is the beginning of a long-term structural change may assist cattle feeders and beef packers alike in further understanding the implications of recent price performance.

18 Traditional hedging strategies do not involve attempting to “time” the market for maximum profits. Any effort to time a hedge for additional profits is, by definition, speculation. Trading futures and options is risky and the comments in this article should not be construed as trading advice.

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