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Price Relationships between Calves and Yearlings: An Updated Structural Change Assessment

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ABSTRACT

This article updates and extends the understanding of U.S. feeder cattle price determinants. Structural change in the summer of 2008 was identified, with both calf and yearling markets adjusting to become substantially more sensitive to changes in corn and expected live cattle prices. The impact of live cattle price expectations on feeder cattle prices is three or more times larger than the same proportional impact of corn price, and this relative impact has increased since 2008. Price spreads between calves and yearlings are also found to be more sensitive to input and output price changes than individual cattle price series. Combined, this enhances the understanding of increased price volatility in U.S. feeder cattle markets.

KEYWORDS

cattle, corn, margin, price, stocker, structural change

One of the most important things for cattle producers to understand is determinants of price differentials (premiums and discounts or the price-weight slide) between cattle of varying weights and characteristics (Schroeder, Mintert, Brazle, & Grunewald, 1988; Anderson & Trapp, 2000). A cow-calf producer needs information on both lighter-weight calves and heavier-weight yearlings in order to make decisions regarding retained ownership in the form of backgrounding or selling calves near weaning (White, Anderson, Larson, Olson, & Thompson, 2007). Similarly, since stocker operations make their profit on the margin incurred by adding weight, it is critical that they have a current and accurate understanding of market impacts on both purchase and sale prices. Furthermore, feedlot operators have the opportunity to place cattle of varying weights and hence need similar information (Mark, Schroeder, & Jones, 2000). The economic importance to the cattle industry of understanding price differentials between cattle of varying weights is clear, and yet the associated research on the subject is limited and dated (Zhao, Du, & Hennessy, 2011).

It is well recognized that the price ($/cwt) of calves tends to exceed that of yearlings. However, what is much less understood is how variable this price differential is, what economic factors influence this spread, and if and when structural changes have occurred. As an example, from January 1993 to March 2016 this spread averaged $17.37/cwt and ranged from –$0.92/cwt to $67.80/cwt (Table 1). As a measure of increased variability, note that the coefficients of variation in calf prices, yearling prices, and the calf-yearling price spread have increased by 50% or more since June 2008. Beyond assessing these summary statistics, visual analysis further suggests that multiple changes may have occurred over time in the price relationship between calves and yearlings (Figure 1). Moreover, looking at corn (Figure 2) and expected live cattle prices (Figure 3), substantial variation and periods of notable change across the 1993–2016 period in feed costs and upstream cattle values are readily apparent.

Perhaps the most germane existing study was provided when Marsh (1985) conducted an econometric analysis of differences in prices of 300–500-pound calves and 600–700-pound yearling steers in an examination of the cattle markets between January 1972 and December 1982. His analysis focused on how cost of gain, slaughter cattle price, and seasonality impact calf price, yearling price, and the differential between calf and yearling prices. To appreciate the need for an updated assessment, consider the substantial

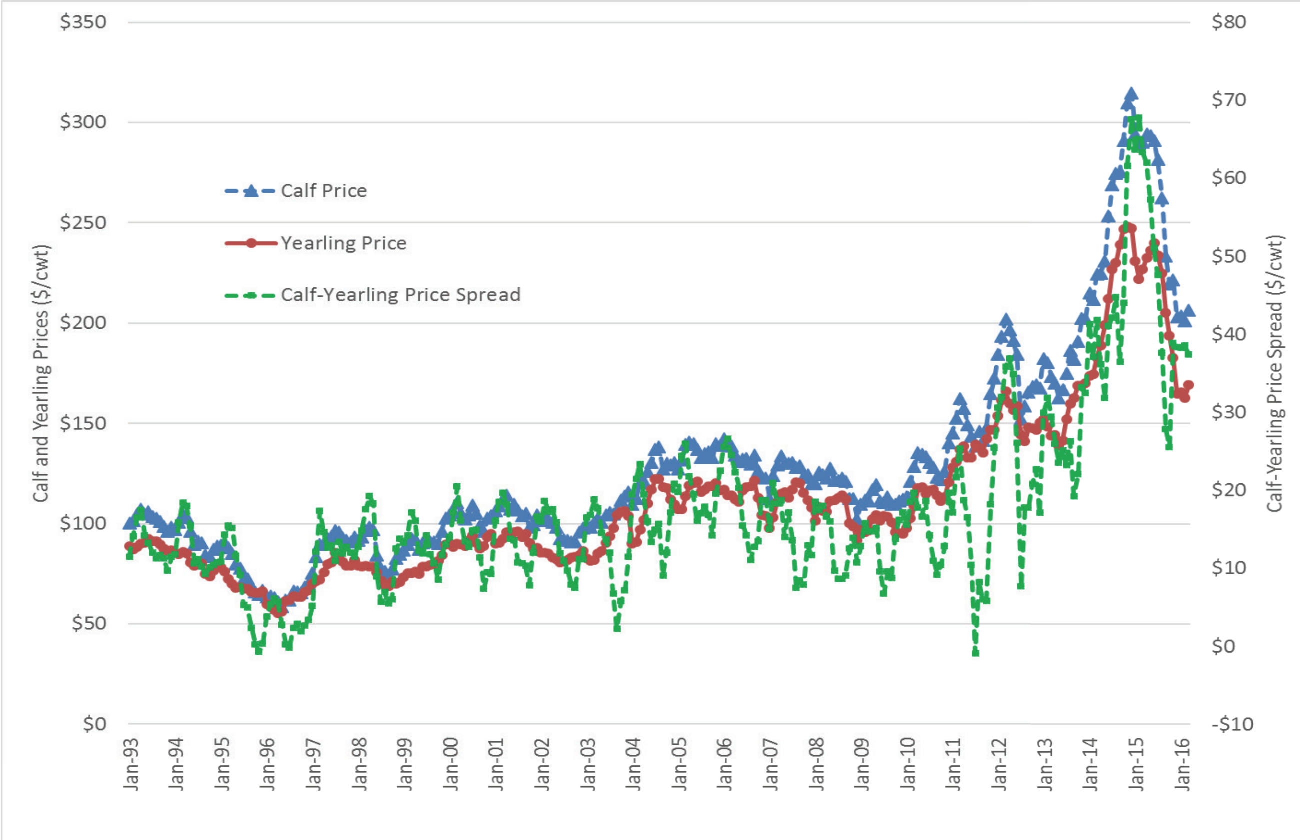

Figure 1. Calf price, yearling price, and calf-yearling price spread: January 1993–March 2016

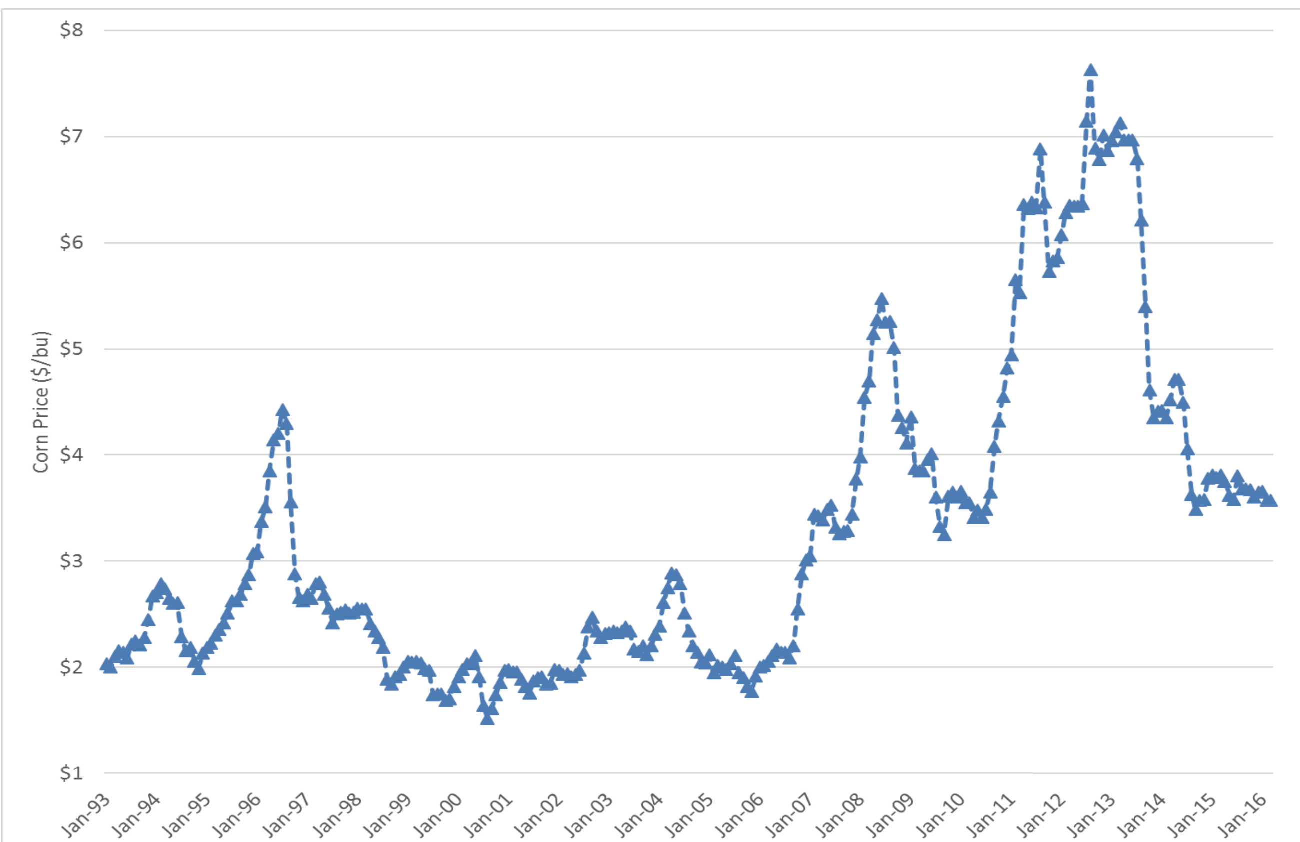

Figure 2. Corn price: January 1993–March 2016

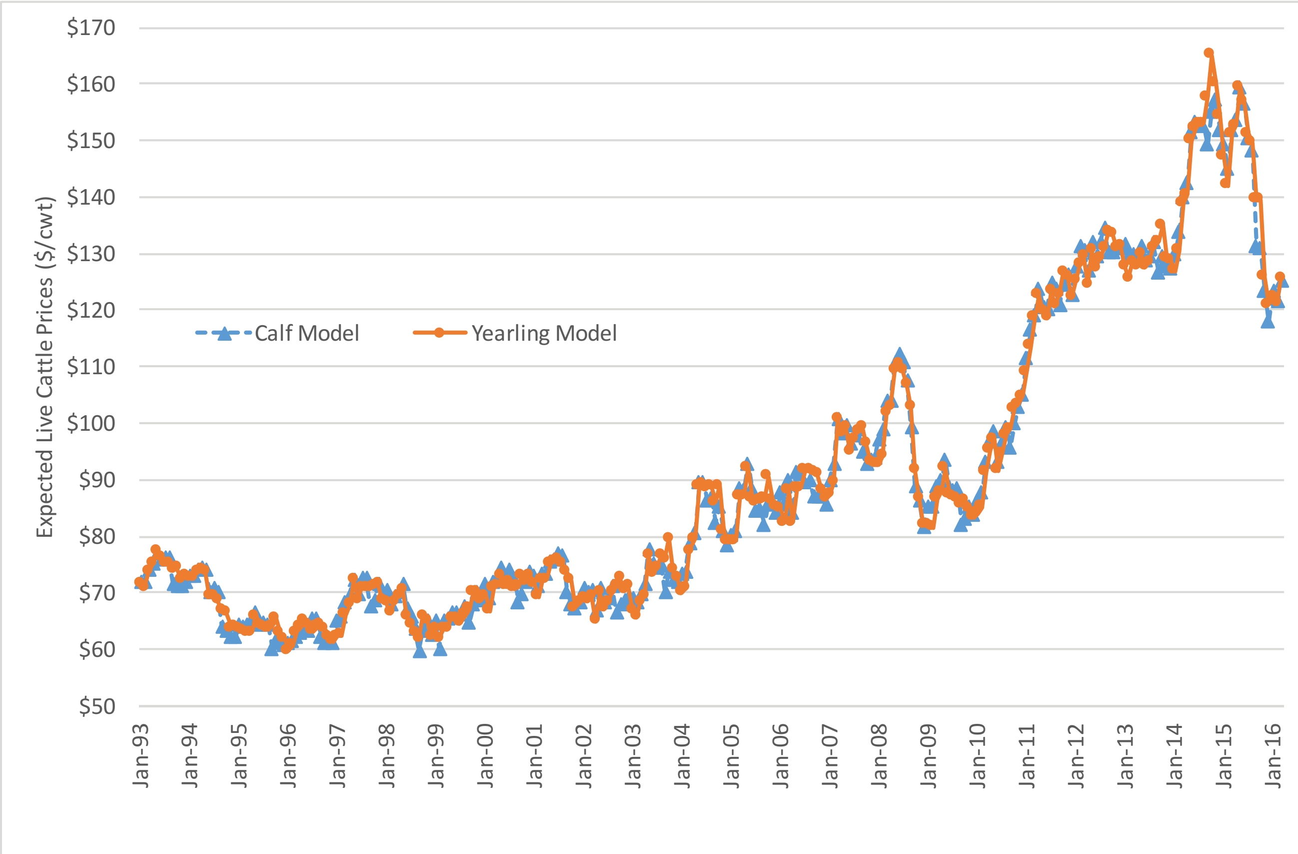

Figure 3. Expected live cattle price: January 1993–March 2016

changes in multiple aspects of the industry that likely underlie changes appearing in Figures 1–3. Key changes that may have had an impact on producer costs of gain include increased variability in corn prices, implementation of ethanol policies (Babcock, 2008; McPhail, Du, & Muhammad, 2012), and a host of weather shocks that influence range and pasture conditions. Similarly, alterations in output markets such as expansion in the role of beef export markets, shocks to cattle markets following animal health events such as the 2003 BSE case, etc., have substantially impacted cattle prices (GAO, 2002; Boetel & Liu, 2010; Marsh, Brester, & Smith, 2008). Furthermore, a host of changes internal to the industry have occurred including feedlot consolidation, increased weaning and finishing weights, and development of multiple growth promoting technologies and genetic improvements (Herrington & Tonsor, 2013; Schroeder & Tonsor, 2011). These effects seem likely to result in changes in how responsive feeder cattle prices are to both corn and live cattle prices. All of this combined with observation of prolonged periods of cattle and corn prices being well outside levels previously examined leads to our direct assessment of structural changes.

Methodologically, it is further important to recognize the insights offered by using techniques from more modern assessments of structural change. Specifically, most existing research in the livestock economics literature (e.g., Schulz, Schroeder, & Ward, 2011) model the impact of events by fixing the date of impact in an exogenous manner where the analyst is presumed to have complete knowledge of the timing on actual events and associated market responses. The broader economics literature is increasingly moving to an approach that allows the effect of market shocks to be considered endogenously and hence be less prone to imposed assumptions by the researcher (Twine, Rude, & Unterschultz, 2015; Hansen, 2001). Furthermore, given the host of changes that occurred in the industry during the period of examination, it is not at all clear ex ante where one should test for structural change. Accordingly, the Bai and Perron (2003) approach is employed here to endogenously explore both the existence and timing of structural breaks in the U.S. feeder cattle market.

MODEL CHARACTERISTICS

A profit maximizing stocker or feedlot producer interested in purchasing feeder cattle to add weight and sell at heavier weights conceptually considers the price of corn and live cattle in deriving his or her willingness to pay for candidate incoming feeder cattle. By extension, the extent to which demand for calves differs from that faced by yearlings is likely influenced differently by corn and expected live cattle prices given changes in the volume of feed needed and the feeding period required, respectively, to produce an animal ready for slaughter. Accordingly, to assess drivers of calf prices, yearling prices, and the price spread between calves and yearlings, our analysis consists of estimating three key equations:

1) $P500_t = f(Corn_t, E_t\,[LiveCattle_{t+8}], D, P500_{t-j}, e_{P500,t})$,
2) $P700_t = f(Corn_t, E_t\,[LiveCattle_{t+6}], D, P700_{t-j}, e_{P700,t})$,
3) $P500 - P700_t = f(Corn_t, E_t\,[LiveCattle_{t+7}], D, P500 - P700_{t-j}, e_{P500-P700,t})$, and $j - 0, 1, \ldots p$;

This approach reflects a broad hypothesis that calf and yearling prices ($P500_t$ and $P700_t$) and the price differential between calves and yearlings ($P500 - P700_t$) are impacted by the cost of corn ($Corn_t$) as a proxy for cost of gain, live cattle prices expected x months in the future ($E_t[LiveCattle_{t+x}]$), seasonality (D is vector of 11 monthly dummy variables, with January omitted as the base month), lagged dependent variables ($P500_{t-j}$, $P700_{t-j}$, $P500 - P700_{t-j}$), and random disturbance terms ($e_{P500,t}$, $e_{P700,t}$, $e_{P500-P700,t}$). Each equation includes lagged dependent variables consistent with the flexible adjustment process hypothesized by Marsh (1985), where t represents a specific month, j represents specific lags on certain variables, and p is the amount of months to be lagged. Each equation is estimated in log-log format, enabling a cleaner percentage change–based comparison of the relative impact of changes in corn and fed cattle prices.

While it may be tempting to only estimate calf and yearling price models, some additional insights are offered by directly estimating the price spread model as well. This third model directly and more cleanly identifies the impact of corn and live cattle prices on calf-yearling price spreads. Specifically, any concerns about possible omitted variables in equations 1 and 2 are reduced by direct estimation of equation 3, as uncontrolled for variables are effectively "cancelled out" in the price spread model. Moreover, by estimating all three models we can explicitly compare the relative impact of changes in corn and live cattle prices on feeder cattle price levels and differentials, which is key for margin operators such as stockers and feedlots.

It is expected that corn prices will be negatively correlated with feeder cattle prices, reflecting the reduced derived demand for feeder cattle that arises when feedstuff prices (the core expense in total cost of gain) increase. Conversely, it is anticipated that expected live cattle prices will have a positive effect on feeder cattle prices, reflecting the enhanced derived demand for feeder cattle that develops with increased revenue expectations. What is less clear is the *relative* impacts on the price differential between calves and yearlings. The difference between calf and yearling prices may narrow when cost of gain increases as a larger proportional impact on derived demand for calves, given the additional volume of feed involved in feeding them to a finished weight. Similarly, the price differential may widen with increases in slaughter price expectations, given that calves offer an opportunity to put additional pounds on at the higher anticipated ending value. Conversely, this price differential could narrow if producers place substantial value on the lower temporal risk of live cattle price reduction that aligns with feeding yearlings. Our analysis is motivated by interest in if and how these effects have changed both since the analysis by Marsh (1985) and within the period examined here (1993–2016).

Monthly historical cash cattle, live cattle futures market, and cash corn prices were collected from the Livestock Marketing Information Center (LMIC, 2016) from January 1993 to March 2016. Table 1 contains summary statistics for the full period

Table 1. Summary statistics of full period examined, January 1993–March 2016

	Mean	Minimum	Maximum	Standard Deviation
Dependent Variables				
Calf price ($/cwt)	128.23	58.63	314.84	51.89
Yearling price ($/cwt)	110.86	55.25	248.33	41.53
Calf-yearling price spread ($/cwt)	17.37	–0.92	67.80	11.77
Independent Variables				
Year	2004	1993	2016	6.72
Corn price ($/bu)	3.25	1.52	7.63	1.47
Expected live cattle price (calf model) ($/cwt)	90.12	59.79	159.44	26.64
Expected live cattle price (yearling model) ($/cwt)	90.03	59.91	165.05	26.78
Expected live cattle price (price spread model) ($/cwt)	90.08	60.53	160.13	26.68

Notes: N=279.

analyzed. Following Marsh (1985), all price variables are deflated by the consumer price index. In today's industry it is much more common to wean calves at 500 pounds instead of the 400 pounds considered by Marsh (1985). Accordingly, calf prices used are for the 500-pound weight class, and yearling prices are for the 700-pound weight class represented by Oklahoma City, Oklahoma, steer price quotes.[1] A proxy for cost of gain was also collected from LMIC, compiled from *USDA-NASS Monthly Agricultural Prices*, and is represented by the corn price received by farmers. The current cash price of slaughter cattle is the USDA-reported Nebraska price quote for Choice cattle, weighing 1,100 to 1,300 pounds as obtained from LMIC (2016).

To incorporate live cattle futures market information as a measure of expected live cattle prices at different points in the future, multiple steps were taken given the alternative selling dates that correspond with derived demand for calves and yearlings. To derive cash price expectations, we added 3-year historical, moving average basis values to live cattle futures prices following Tonsor, Dhuyvetter, and Mintert (2004) and McElligott and Tonsor (2012). To identify the appropriate futures contract month, we utilized final weight and average daily gain information from Kansas State University's *Focus on Feedlot* data as available from LMIC (2016) to estimate 8- and 6-month horizons for calves and yearlings, respectively.[2] When considering the price spread between calves and yearlings, we averaged values from each individual process.

RESULTS

Prior to estimating models described by equations 1–3, time series properties of the dependent variables of interest were examined. Augmented Dickey Fuller unit root tests were used to examine stationarity.[3] Based on the full period of time, we fail to reject unit roots for all three dependent variables in levels but do reject in first differenced form. Accordingly, each model is estimated in first differences.

Each model was then estimated including additional lagged dependent variables to identify preferred models. Utilizing AIC and SSE measures and statistical insignificance of including additional lags, final specifications based on including lagged dependent variables were identified as most appropriate in each model.[4] With preferred model specifications identified, the full period results were obtained and are provided for brevity in the Appendix. Rather than focus on the full period results, we instead consider structural changes consistent with the previously noted host of adjustments that the cattle industry has experienced.

The approach employed by Twine, Rude, and Unterschultz (2015) was employed in exploring existence, number, and timing of structural changes separately for the three models. Using BIC and LWZ information criterion, we fail to reject the null hypothesis of no breaks in both the calf and yearling price models and fail to reject the null of two breaks in favor of one break in the price spread model. As suggested by Bai and Perron (2003), information criterion may not be sufficient when suggesting no structural breaks, so we proceeded with the sequential approach of testing the null hypotheses of *l* breaks against the alternative of *l+1* breaks. The heteroskedastic- and autocorrelation-consistent estimator was employed along with an assumption of heterogeneous distribution of errors and regressors across regimes.[5] Both the double maximum tests (UDmaxF and WDmaxF) and the supF test reject the null hypothesis of no structural breaks and reinforce the value in employing the sequential approach outlined by Bai and Perron (2003). We allowed up to five breaks (six regimes) using a 15% trimming rate that results in each regime having at least 41 monthly observations (Bai & Perron, 2003; Boetel & Liu, 2010; Twine, Rude, & Unterschultz, 2015).[6]

Table 2 presents structural break results and the associated sequential test statistics that were statistically significant. In all three models the *supF*(1|0) statistics reject the null hypothesis of no breaks. Accordingly, sequential *supF*(l+1|l) tests were conducted to identify the number and timing of breaks in each model. One break was identified in June 2008 in the calf price model, one break was identified in July 2008 in the yearling price model, and two breaks were identified in the price spread model in July 1996 and March 2011. Utilizing 95% confidence intervals, we fail to reject the hypothesis of the calf and yearling price models having the same break date.

While by design this analysis does not explicitly identify *why* a break occurred, it is instructive to examine possible drivers of structural change. Corn prices increased over $2/bu between September 2007 and June 2008 (Figure 2), while expected live cattle prices increased over $18/cwt between January 2008 and July 2008 (Figure 3). Meanwhile, the actual calf and yearling prices during this period were comparably stable (Figure 1), suggesting that the core adjustments at play involved the relative impact of corn and live cattle price expectations on calf and yearling prices largely offsetting each other. This initial conclusion is reinforced by comparing the model results provided in Table 3.

In the calf price model, the impacts of a 1% change in corn price and expected live cattle price

Table 2. Structural break test results

Calf Price Model	sup*F*(1|0)		
	56.612		
	Break Dates	**95% Lower Bound**	**95% Upper Bound**
	June 2008	December 2007	December 2008
Yearling Price Model	sup*F*(1|0)		
	109.511		
	Break Dates	**95% Lower Bound**	**95% Upper Bound**
	July 2008	February 2008	December 2008
Price Spread Model	sup*F*(1|0)	sup*F*(2|1)	
	73.203	64.438	
	Break Dates	95% Lower Bound	95% Upper Bound
	July 1996	November 1995	March 1997
	March 2011	September 2009	September 2012

Notes: Presented sequential test statistics [SupF(l+1|l)] are significant at the 1% level.
Insignificant (at 1% level) test statistics are not presented.

Table 3. Regression results of calf price, yearling price, and calf-yearling price spread models

	Calf Price		*Yearling Price*		*Calf-Yearling Price Spread*		
	Regime 1 (pre– June 2008)	Regime 2 (post– June 2008)	Regime 1 (pre– July 2008)	Regime 2 (post– July 2008)	Regime 1 (pre– July 1996)	Regime 2 (July 1996– March 2011)	Regime 3 (post– March 2011)
Intercept	–0.373***	–0.804***	–0.374***	–0.748***	–4.870*	–0.595	–3.488***
Corn Price	–0.107***	–0.185***	–0.102***	–0.180***	–1.774**	–0.263***	–0.516**
Steer Price	0.380***	0.769***	0.427***	0.869***	1.720*	0.350	1.566***
Feb	0.046***	–0.013	0.044***	–0.013	–0.186	0.108*	–0.035
Mar	0.026**	–0.015	0.021*	–0.024*	–0.189	0.059	–0.067
Apr	0.008	–0.027	0.023**	–0.017	–0.236	–0.076	–0.105
May	–0.021*	–0.061***	0.004	–0.055***	–0.574	–0.179**	–0.245**
June	–0.001	–0.041**	0.029**	–0.022*	–1.075*	–0.287***	–0.229***
July	–0.003	–0.069**	0.017	–0.020	–0.750*	–0.304***	–0.550*
Aug	–0.007	–0.046**	0.014	–0.037***	–0.735*	–0.329***	–0.288***
Sept	–0.003	–0.056***	0.010	–0.049***	–0.739	–0.473***	–0.539***
Oct	–0.005	–0.038**	–0.002	–0.068***	–1.369*	–0.292***	–0.428***
Nov	0.028**	–0.008	0.021*	–0.037***	–0.682	–0.008	–0.108
Dec	0.030***	–0.019	0.036***	–0.029**	–0.488	–0.059	–0.178
1 period Lag dep. Var.	0.956***	0.711***	0.997***	0.580***	0.510*	0.557***	0.277**
2 Period Lag dep. Var.	–0.202***	–0.154*	–0.301***	–0.156**			
SSE	0.243		0.156		16.565		
BIC	–6.692		–7.137		–2.139		

Notes: Asterisks (*, **, ***) denote statistical significance at the 10%, 5%, and 1% levels, respectively. Models were estimated in log-log format. For each model, fit statistics are for all regimes.

have increased by 73% and 102%, respectively. Specifically, in the most recent period (regime 2), a 1% increase in corn prices reduces calf prices by 0.185% compared to 0.107% prior to June 2008. Meanwhile, a 1% increase in expected fed steer prices increased calf prices by 0.380% prior to June 2008 but has a 0.769% impact more recently.

Examining the yearling price model yields a similar story regarding relative impacts of corn and live cattle prices, with both factors exerting a much larger impact on yearling prices since July 2008. A 1% increase in corn price since July 2008 reduces yearling prices by 0.180% compared to an impact of 0.102% prior to July 2008. The impact of a 1% change in expected live cattle prices has also increased from 0.427% to 0.869%.

Policy and trade aspects of these changes in the calf and yearling price models could include responses to ethanol policy and subsequent changes in corn demand as well as expanded beef exports and the related derived demand for cattle. Regardless of the underlying causative drivers, a key implication to draw from Table 3 is that calf and yearling prices have become much more responsive to main input and output prices since the summer of 2008.

Going further, it is instructive to see how the *relative* impact of corn and fed steer prices has changed over time. The ratio of impacts from a 1% change in expected live cattle prices and corn prices has increased from 3.57 to 4.16 on calf prices and from 4.17 to 4.83 on yearling prices. This suggests that not only are calf and yearling prices more sensitive to corn and expected live cattle prices, but the relative impact of corn prices has also declined compared to the role played by downstream cattle price expectations. While direct understanding of *why* this adjustment has occurred is not offered by our empirical assessment, one leading explanation for consideration is the relative ability to adjust production and mitigate price effects. In the case of live cattle price, being the primary output of live cattle production makes it challenging for any producer to adjust practices to mitigate any adverse changes in live cattle prices. Conversely, the ability to alter a feed ration or to adopt alternative technologies (e.g., beta-agonists at the feedlot level) influencing production relationships to reduce the impact of corn prices is likely larger.

The final structural change assessment was conducted for the price spread model, with two breaks being identified in July 1996 and March 2011. There are three cases where the price spread was inverted, with yearlings having a higher $/cwt price than calves: November 1995, July 1996, and July 2011 (Figure 1). The first structural break identified corresponds with the second price inversion. Moreover, the $2/bu increase in corn price between November 1994 and July 1996 stands out. By contrast, the pattern in expected live cattle price was more stable over this period. Combined this suggests that the first break in the calf-yearling price spread model was likely tied to adjustments in the corn market.

The second structural break seems likely to correspond with adjustments in both corn and live cattle markets. Corn prices increased over $3/bu between July 2010 and August 2011 (Figure 2), while expected live cattle prices increased $30/cwt between June 2010 and April 2011 (Figure 3). Combined with the third incident of yearling prices exceeding calf prices in July 2011, this suggests that the second identified structural break in March 2011 (with a fairly wide 95% confidence interval of September 2009 to September 2012) reflects substantial changes in both key input and output price markets impacting feeder cattle prices.

These conclusions drawn by visual assessment are reinforced by the regression results presented in Table 3. The estimated model suggests that a 1% increase in corn prices reduced the calf-yearling price spread by 1.774% prior to July 1996 but reduced the spread by 0.263% between July 1996 and March 2011 and by 0.516% since March 2011. Likewise, a 1% increase in expected live cattle prices had a positive impact of 1.720% in regime 1, no significant impact in regime 2, and a 1.566% impact in regime 3. The main implication to draw from this is that feeder cattle price spreads have become much more responsive since March 2011 to both corn prices and live cattle price expectations. Going further, moving from regime 1 (pre–July 1996) to regime 3 (post–March 2011), the ratio of impacts from a 1% change in expected live cattle prices and corn prices has increased from 0.97 to 3.0. Consistent with the individual calf and yearling price models, this suggests that not only is the price spread between calves and yearlings more sensitive to corn and expected live cattle prices than in the past, but the *relative* impact of corn prices has also notably declined compared to the role of expected live cattle prices.

It is also useful to quickly compare the relative effect of corn and live cattle price changes in the most recent regime in each of the three models. Doing so reveals that changes in corn and expected live cattle prices have a much larger impact on the calf-yearling price spread than on either calf or yearling prices themselves. This observation reinforces the previously noted point by Marsh (1985) that price differentials are more responsive than the levels of calf or yearling prices to new market information on key inputs and outputs.

It is also illustrative to consider changes between April and October 2016. In April, which is just outside the period of data used here, producers may have been formulating plans for their weaned calf crop, with many operations intending to sell in October. Over this period the CME Live Cattle October contract prices fell nearly 14%. Using the full-period results, this change would have suggested an expected decline in calf prices, if nothing else changed, of 6.5%. Conversely, using results reflecting the identified 2008 structural break, this same decline in expected live cattle values would result in an expected calf price reduction of 10.8%. While no analyst fully predicted this 2016 market decline and many other factors were at play, this simple example demonstrates the real value of updating past research and considering structural change effects in corresponding assessments.

CONCLUSIONS AND IMPLICATIONS

An issue long of interest to the cattle industry has been identifying and understanding determinants of feeder cattle prices. Despite the obvious economic importance of this understanding, most existing research is dated and was conducted prior to a host of major weather, policy, animal disease, and other events that led to multiple adjustments in cattle markets. This article updates and extends past understanding of feeder cattle price determinants.

In examining the 1993–2016 period, we find that changes in feed prices and expected live cattle prices have a much larger relative impact on price differentials across feeder cattle weight classes than on a single weight class. This suggests that price differentials are more responsive to market information than the levels of calf or yearling prices and feedlot profitability risk being shifted (at least partially) to price differentials across cattle placed at different weights. The implication is direct for decisions focused on backgrounding and stocker management where feeder cattle price differentials are key to profitability. These segments need to be particularly aware of adjustments in feed prices and live cattle prices, as feeder cattle price differentials are more sensitive to said adjustments than either calf or yearling prices alone.

Another focus of this analysis was on structural change in feeder cattle markets. Evidence of significant structural changes was found with a pattern in the relative effect of changes in feed and live cattle prices over time. Feeder cattle prices have become much more responsive to main input and output prices since the summer of 2008. Price spreads have likewise become much more responsive to live cattle price expectations and corn prices. Furthermore, the relative impact of live cattle prices has increased compared to corn and remains comparatively dominant in influencing feeder cattle prices.

Given the dynamic nature of cattle markets and the ongoing adjustments in factors once viewed as external that are increasingly internal, ongoing research is warranted. The sheer economic importance of the subject warrants updates to be less than three decades apart so that future updates are encouraged. Similarly, future assessments may consider alternative methods or specific markets to further extend the core findings offered here.

In the meantime, cattle producers can benefit from this analysis in several ways. Given increased sensitivity of feeder cattle prices to live cattle prices, producers selling calves or yearlings also have an increasing indirect stake in ongoing discussions surrounding price discovery at the fed cattle level of the industry. Similarly, as weather events, ethanol policies, and trade agreements impact the corn markets, this research points to increasing relevance to U.S. cattle producers.

NOTES

1. Specifically, the Oklahoma Combined Weekly Auction Summary (KO_LS794 report), provided weekly by USDA-AMS, is the source used for feeder cattle prices. The 400–500 and 500–600 categories were averaged to our calf price, and our yearling price is an average of the 600–700 and 700–800 reported categories.

2. In practice placement weight, final weight, average daily gain, and days on feed likely differ for calves and yearling feedlot placements. However, that level of detail is not available in the *Focus on Feedlot* survey, and the exact impact given our use of monthly data is not clear.

3. PROC AUTOREG in SAS 9.4 was used for this analysis.

4. Q and LM statistics also indicate that we fail to reject homoscedastic residuals in these identified preferred models such that both stationarity and homoscedasticity properties are as desired.

5. In SAS 9.4 this involves employing the *HAC*, *HE*, and *HR* options within PROC AUTOREG. Not imposing these options results in a larger set of suggested breaks, which encompasses those presented here.

6. As noted in other applications, the exact number and timing of breaks varies with selection of trimming rates. Here the breaks identified with a 15% trimming rate capture a smaller set of breaks that follows from alternatively using 20% and 25% rates.

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APPENDIX

Table A1. Full period models

	Calf Price Model	Yearling Price Model	Price Spread Model
Intercept	–0.550***	–0.504***	–3.001***
Corn price	–0.095***	–0.088***	–0.402***
Expected live cattle price	0.465***	0.492***	1.215***
Feb	0.024**	0.021**	0.008
Mar	0.010	0.006	–0.075
Apr	–0.007	0.007	–0.189**
May	–0.038**	–0.018**	–0.351***
June	–0.018*	0.009	–0.471***
July	–0.026**	0.002	–0.440***
Aug	–0.019*	–0.006	–0.367***
Sept	–0.020*	–0.010	–0.520***
Oct	–0.012	–0.021**	–0.456***
Nov	0.019*	0.003	–0.052
Dec	0.012	0.013	–0.137
1 period lagged dependent var.	0.930***	0.957***	0.654***
2 period lagged dependent var.	–0.183***	–0.264***	
SSE	0.301	0.210	24.135
BIC	–6.826	–7.184	–2.422

Notes: Asterisks (*, **, ***) denote statistical significance at the 10%, 5%, and 1% levels, respectively. Models were estimated in log-log format.