NCCC-134
APPLIED COMMODITY PRICE ANALYSIS, FORECASTING AND MARKET RISK MANAGEMENT

Usage Determinants of Fed Cattle Pricing Mechanisms

by
Matthew A. Diersen and Scott W. Fausti

Suggested citation format:

Diersen, M. A. and S. W. Fausti. 2012. "Usage Determinants of Fed Cattle Pricing Mechanisms." Proceedings of the NCCC-134 Conference on Applied Commodity Price Analysis, Forecasting, and Market Risk Management. St. Louis, MO. [http://www.farmdoc.illinois.edu/nccc134].

Usage Determinants of Fed Cattle Pricing Mechanisms

Matthew A. Diersen

and

Scott W. Fausti[*]

Paper presented at the NCCC-134 Conference on Applied Commodity Price Analysis, Forecasting and Market Risk Management

St. Louis, Missouri, April 16-17, 2012

[*] Diersen is a professor and Wheat Growers Scholar of Agribusiness Management and Fausti is a professor in the Department of Economics at South Dakota State University, Brookings, South Dakota. Partial funding for this research was provided by the South Dakota Agricultural Experiment Station and USDA-NIFA Regional Project: W-3177.

Usage Determinants of Fed Cattle Pricing Mechanisms

Proposed cattle slaughter facilities in the upper Midwest have renewed interest among feedlot operators in the most appropriate mechanism to use when selling cattle. Buyers are also interested in the mechanisms that may have different benefits and seasonal patterns based on established behavior of other buyers in the region. In this paper we model the shares of fed cattle traded using different pricing mechanisms. The intent is to build a forecasting model of shares considering fundamental factors and seasonality. There is regional variation in the use of mechanisms. A Seemingly Unrelated Regression estimation procedure was used to analyze market shares. More variability of forward pricing and negotiated live pricing methods was explained compared to formula pricing and grid pricing methods.

Keywords: forward pricing, formula pricing, grid pricing

Introduction

As the beef industry has evolved there has been a steady shift from trading fed cattle on a live-weight basis at auctions to the current range of live- and dressed-weight direct sale mechanisms. Direct sales now dominate with formula pricing gaining at the expense of negotiated pricing (Packers & Stockyards Program, 2012). Seller interest in the appropriate method is focused on obtaining the highest price, obtaining the best price for provided quality, assuring an outlet for a particular time or quality level, and going with or against tradition. Buyer interest is focused on assuring supply, obtaining a desired quality level, obtaining uniform cattle and maintaining low transactions costs.

Cattle buyers and sellers both look for the best price when trading cattle. Cattle continue to be sold by live weight value, dressed (or hot carcass) weight value, grid value or formula value. Spot, forward contract and futures-delivered cattle may be valued based on live weight or dressed weight values. When looking at volume traded and relative prices under these mechanisms there is often very little to distinguish among the final transactions prices. Part of what may be clouding the analysis is the timing or preference to use different mechanisms under different conditions. However, little research has addressed possible determinants of which pricing mechanisms may be preferred or optimal from buyer and seller perspectives.

The objective of this study is to identify determinants of pricing mechanisms for fed cattle. Conceptually, several sources of market and industry determinants exist. Seasonality in prices remains quite pronounced in the fed cattle market. Thus, the time of year may affect the observed mechanism. The aggregate quantity of fed cattle to be marketed would likely dictate the preferred pricing mechanism. Expected quality differences would also dictate different pricing mechanisms. We analyze the patterns of volume of cattle traded under the different mechanisms and explain the variability as a way to explain the differences (or lack of differences) in prices among the methods.

We build a model of quantity traded by pricing mechanism and explain the quantities using econometric analysis of cattle on feed statistics, seasonal variables, and corn price changes.

The model allows better insight into observed persistent, though small, price differences among mechanisms. Ideally, a model will explain trade-offs among methods, cover local or regional pricing behavior and be useful for forecasting.

Literature

A motivating source is Norwood and Schroeder (1990), who design a forecasting model of feedlot marketings. By modeling marketings as a function of placements and placement weights they are able to find a small improvement in explanatory power. The key is the addition of a fundamental indicator that may explain marketings. This led us to seek similar fundamental variables to explain shares across mechanisms.

Another motivating source is Mathews and Johnson (2011), in a study of the production practices that explain price differences across major cattle feeding regions. Strong seasonal factors such as calving time, grazing practices and feeding duration lead to different availability of finished cattle across regions. They identify that mandatory price reporting does not account for freight and shrink – both factors that could be masking price differentials. They also document that cattle from the northern region tend to finish at higher weights at higher quality levels compared to cattle from the southern region. In light of their results, we sought ways to include absolute and relative measures of feedlot characteristics by region.

The data used in this study is limited by what was reported in mandatory price reporting. Koontz and Ward (2011) offer a comprehensive summary of research connected with price reporting. After early survey work of feedlots, they argue "no subsequent research is available across species to determine how effectively the mandatory system meets the needs of industry participants". Our study approaches the choice of mechanisms from the perspectives of feedlots and packers.

The one mechanism that has a distinct price pattern is forward contracting. Much of the research on forward contracting centers on price levels in the delivery time with mixed results. Parcell, Schroeder, and Dhuyvetter (2000) included the aggregate volume of cattle forward contracted as an explanatory variable for monthly basis on futures. The volume was not significant in that study. Ward, Koontz, and Schroeder (1998) found a negative relationship between forward contract volume and aggregate transactions prices. Walburger and Foster (1997) also found a negative relationship, but stressed that it does not seem to be economically significant. In contrast, Elam (1992) stressed that a forward contract price will be at a discount to a basis-adjusted futures price.

Some of the discrepancy may depend on the sample period. Muth et al. (2008) argue such in their study that finds forward contract volume was associated with relatively low and volatile prices. They also found general similarity of prices across mechanisms, especially among marketing agreements. Another attempt to forecast forward contracting by Abahana (2010) worked well using time series to explain short run basis behavior. Volume of contracting was also found to have a strong seasonal component. A drawback to the time-series approach was an inability to explain the large absolute levels of contract volume across delivery years or periods.

In a recent summary of grid market shares Fausti et al. (2010) found a negative correlation between negotiated grid and contract grid shares. They also found that carcass quality variability continues to be a problem for the industry. As the percent of choice has increased, up to 2009, there still remains about ten percent of slaughter at yield grades 4 and 5.

Belasco, Schroeder and Goodwin (2010) affirm there is risk from selling on a grid using scenarios when forward contracting eliminates fed cattle and corn price risks. Similarly, Fausti et al. (2013) find that quality differences result in a greater share of steers than heifers being marketed on a grid. Thus, both yield and quality risk may limit use of different mechanisms.

Regional Insights

The presence of new or additional buyers in the upper Midwest raises the issues of what mechanisms are currently in use and whether regional differences exist. The upper Midwest still has a large proportion of farmer-feeders relative to other parts of the U.S. The region has also been heavily influenced by the changing prices of corn, ethanol co-products and fuel. The changing price (or cost) of corn directly affects feedlot profitability. The amount of corn fed in rations affects feedlot performance and the quality of cattle produced. Thus, the changing price of corn has likely affected the relative profitability of cattle sold under different mechanisms.

Feedlots in the upper Midwest use pricing mechanism in different proportions compared to the rest of the United States. For example, in the North Central states (defined as Montana, Wyoming, North Dakota and South Dakota) there are relatively large shares of cattle marketed using forward contracts and on a dressed basis (Table 1). There are relatively small shares marketed using formulas, live-weight basis and on grids.

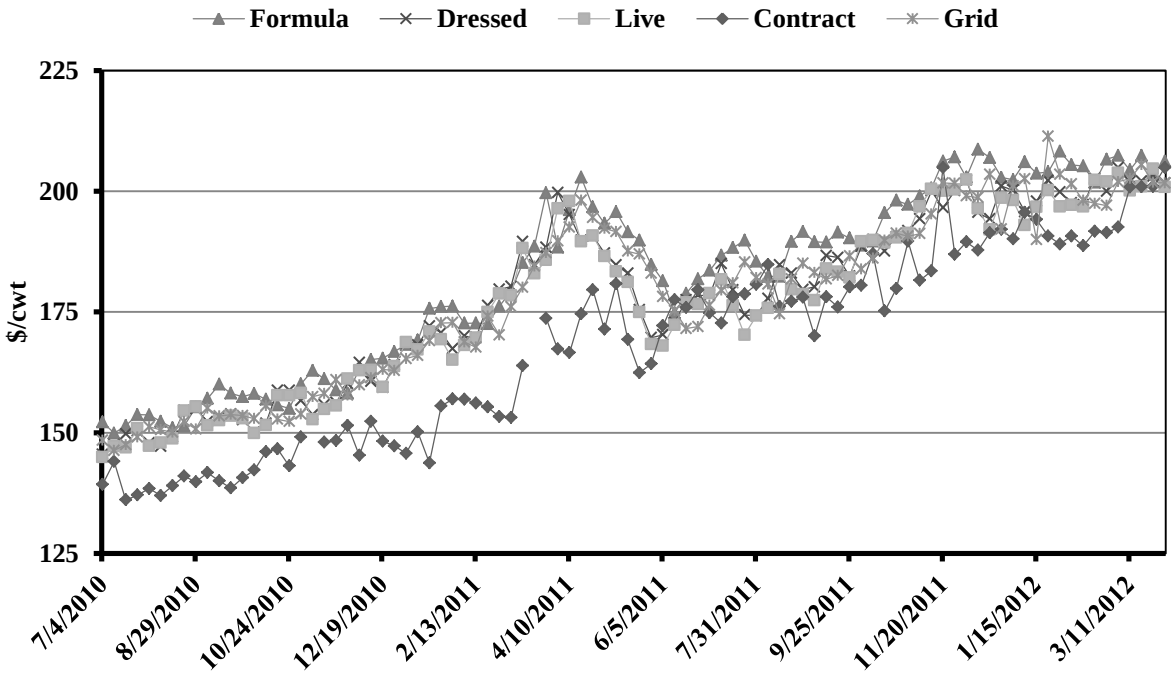
Table 1. Shares of Direct Sales of Fed Cattle in December 2011

	Formula	Live Negotiated	Forward Contract	Dressed Negotiated	Negotiated Grid
United States	49.7	21.3	10.8	11.5	6.7
North Central	39.5	17.7	15.4	22.6	4.8

Source: USDA-AMS

The overall similarity of price levels across mechanisms suggests that finding factors explaining any differences may be difficult (figure 1). The prices shown are from the USDA-AMS report LM_CT151. The live-weight price is converted to a dressed-weight equivalent by using the reported dressing percentage for the week. The lagged nature of the base price in the formula and grid prices is evident in that both price series follow the pattern established the prior week by the live and dressed series. The sample period shown generally has steadily increasing prices. The forward prices thus lag the spot prices, but the opposite would hold during a period when prices unexpectedly decreased.

A new packing plant is under construction in Aberdeen, South Dakota (Waltman, 2012). Northern Beef Packers expects to slaughter 1,500 head of cattle a day at full capacity. Producers in the region currently face $40 per head in transportation costs to reach the next closest packing plant. Another packing plant projected to reopen in Tama, Iowa, Iowa Premium Beef, expects to slaughter 800 head of cattle a day at full capacity (Speer, 2012). The expected volume, however, would be a relatively large percent of cattle finished in the immediate area.



Source: USDA-AMS

Figure 1. Weekly average prices for the North Central region

The average monthly marketings by 1,000 head feedlots in South Dakota is currently 40,000 head per month. In addition, mandatory price reporting shows that for the North Central region, the volume sold to packers from those states has been falling from a high of 111,551 head as recently as November of 2009 to only 56,771 head in May of 2011 (Table 2). Thus, an adequate supply of cattle for slaughter is a concern that could be managed with mechanisms such as forward contracts.

Table 2. Direct Cattle from Montana, Wyoming, North Dakota and South Dakota

	2009	2010	2011	2012
		----- head -----		
January		75,689	78,169	65,907
February		77,877	73,300	63,964
March		79,627	81,714	69,334
April		75,488	66,701	
May		58,447	56,771	
June		79,314	61,358	
July		97,135	83,998	
August		88,394	63,606	
September	80,073	90,758	69,214	
October	96,424	95,573	85,164	
November	111,551	93,765	78,535	
December	79,167	76,792	67,114	

Source: USDA-AMS

Model

The pricing mechanism used is the result of both sides reaching a consensus on the way cattle will be evaluated. Cattle feeders with low quality and/or heavy weight cattle would prefer a live weight value. Live weight also has the lowest transactions cost if quality is not differentiated. Cattle feeders with high quality would likely prefer a grid price that rewards carcass quality. Cattle feeders may also want to use a forward mechanism to lock in a price that fixes the profit margin at an acceptable level.

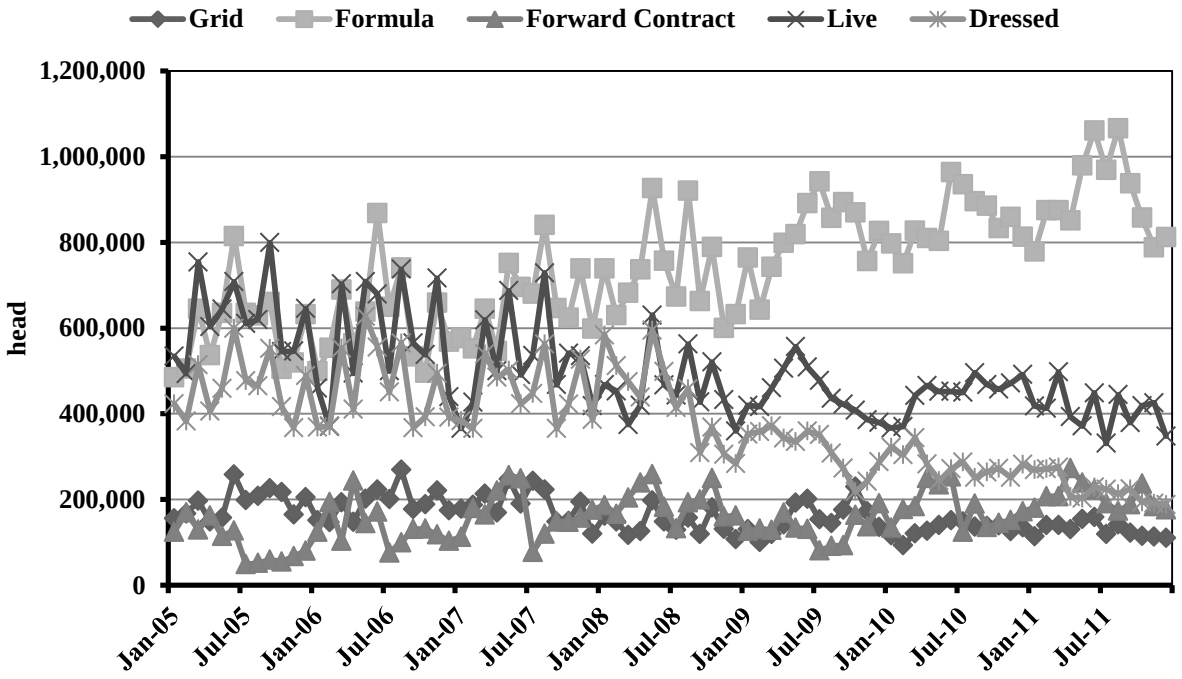
Cattle buyers face a different objective: minimizing the cost of cattle they can process and sell. With ample supplies the mechanism may matter little as the overall level of different quality cattle may be adequate to maintain slaughter at full capacity. With ample supplies they may prefer to offer or "force" the taking of formula prices with minor premiums for quality characteristics.

With tight supplies, packers may need to purchase using forward contracts or take futures deliveries to assure optimal slaughter. With tight supplies they may need to pay high grid premiums to assure quality. Carcass quality is often affected by feeding practices. Feeding practices are influenced during the feeding cycle by changes in the price of corn that affects the marginal returns to feeding a given animal. As cattle are fed longer, there is a greater likelihood the dressing percentage will fall. To capture this effect we will also model changes in the price of corn during the feeding period.

The mechanisms considered include forward contracting, formula pricing, live negotiated, dressed negotiated, and negotiated grid pricing. Packer-owned cattle are not considered as there are no prices. Non-direct transactions, through auctions or by smaller non-

reporting packers, are also not considered. The trend at the U.S. level has been for more formula sales at the expense of fewer negotiated live and negotiated dressed sales (figure 2). The potential rationale for fundamental factors explaining each mechanism is presented here with a comprehensive model to follow.

Forward pricing might have the most distinct characteristics that explain volume. The timing of entering the contracts occurs earlier than pricing by other mechanisms. Forward pricing is primarily a risk management tool and volume is likely tied to risk levels in the market for fed cattle. Forward contracts can also be used to assure the timing and location of slaughter. In conjunction with managing corn, forward contracts can be used by feedlots to lock in the feeding margin. Seasonally, the volume peaks from April to June and then again in October. No quality or yield factors are expected to explain volume unless they are lagged. Lagged placements may be an indicator of forward contract volume.



Source: USDA-AMS

Figure 2. Monthly head counts for U.S. fed cattle marketings

Live negotiated are sold by the live weight at a flat price and would be based on subjective measures of yield and quality. This mechanism is more quantity-driven, that is the value of the cattle is likely based on its sheer pounds instead of other characteristics. The observed prices would not include pencil shrink or implicit freight charges. There are few seasonal peaks after 2009. It is expected that the price of corn or changes in the price of corn would influence feeding practices and affect the likelihood cattle would be marketed on a live

negotiated basis. One rationale says that as corn becomes cheaper during the feeding period, the cattle will be fed for more days, leading to increased quality and decreased yield, giving an incentive to market on a live basis.

Dressed negotiated cattle would be based on subjective measures of quality and objective measures of yield. There is no seasonal pattern in the observed volume, but the overall trend has been for lower volume after mid-2008. As for explaining changes in volume routinely, one rationale says that as corn becomes more expensive during the feeding period, the cattle will be fed for fewer days. This may lead to decreased quality and increased yield, giving sellers an incentive to market on a dressed basis.

Grid cattle remove all subjective measures of quality and yield. Conceptually, grid sales would be the most transparent pricing method. However, it seems to rely on the need for a win-win setting where both the feedlot and packer would benefit from targeting desired characteristics and sharing the value to compensate for the added cost of reaching specific goals. From the demand side, the grid premiums would be driven by both grade and yield factors. On the supply side, it may be facilitated by low and stable corn prices. There is no pronounced seasonal pattern in volume.

Formula cattle are difficult to pin down. To some extent, they act as a residual mechanism, tied to volume. If there are ample market-ready cattle, then the easiest pricing is formula pricing. It would have the lowest transactions cost for the packer. They would only have to negotiate the base for a limited number of transactions and all other cattle can be valued off the base. Feedlot perceptions of formula pricing are mixed. Some feedlots have expressed concern that low-quality cattle can be used to set the base price. Other feedlots like the ease of the transactions and are rewarded for higher-valued cattle. Seasonally, volume peaks from April to September.

Preliminary data analysis shows there are high positive correlations among forward and formula shares and among grid, live and dressed shares. There are high negative correlations among forward and grid, live and dressed shares and among formula and grid, live and dressed shares. There is a high positive correlation among corn prices, fed cattle prices, and fuel prices for the sample period. Except for cattle on feed variables, the considered factors have very similar correlations between live and dressed shares.

The cattle on feed variables and prices have strong seasonal patterns, suggesting that seasonal dummy variables may introduce multicolinearity. The overlap between live and dressed led us to suppress modeling dressed shares. The shares were found to be non-stationary, thus resulting in spurious correlations. The first-differences were stationary and are thus modeled. The change in shares exhibited a large negative correlation between the live and formula variables. There are also large negative correlations between the change in forward shares and change in dressed shares, change in grid shares and change in live shares. There was also substantial first-order autocorrelation, so an AR(1) procedure was used in the estimation.

Following Zellner (1962), the final equations are specified and modeled as seemingly unrelated regressions:

(1) $\Delta ForwardSH = \quad a_0 + a_1\Delta TX + a_2\Delta Placed + a_3\Delta Weights + a_4\Delta OnFeed + a_5\Delta Volume + a_6 e_1$

(2) $\Delta FormulaSH = \quad b_0 + b_1\Delta TX/NE + b_2\Delta Weights + b_3\Delta OnFeed + b_4\Delta Volume + b_5 e_2$

(3) $\Delta LiveSH = \quad c_0 + c_1\Delta TX/NE + \ c_2\Delta Ch\_Se + \ c_3\Delta Volume + c_4 e_3$

(4) $\Delta GridSH = \quad d_0 + d_1\Delta NE + d_2\Delta Ch\_Se + d_3\Delta Placed + d_4\Delta Weights + d_5\Delta Volume + d_6 e_4$

The forward equation is a function of changes in Texas marketings, placements, slaughter weights, on feed and slaughter volume. The formula equation is a function of changes in the ratio of marketings by Texas to Nebraska feedlots, slaughter weights, on feed and slaughter volume. The live negotiated equation is a function of changes in the ratio of marketings by Texas to Nebraska feedlots, the choice to select spread and slaughter volume. The grid equation is a function of changes in Nebraska marketings, the choice to select spread, placements, slaughter weights and slaughter volume.

Data Sources

The data are primarily from USDA-AMS direct slaughter reports, USDA-NASS *Cattle on Feed* reports and CME prices. The data are available monthly from April 2004 to December 2011. Shares, total volume and prices were obtained from the Livestock Market Information Center (LMIC) and sourced from AMS reports: LM_CT106, LM_CT151 and LM_CT154. Only domestic, all beef type steers and heifers were analyzed. On feed statistics, U.S. corn price and slaughter weights were from NASS. The choice-select spread was calculated from LMIC data from AMS. Diesel price was obtained from the U.S. Energy Information Administration.

Results

The SUR estimation is warranted as there is evidence of strong correlation among the equations (Table 3). Separate models would have biased parameter estimates. The high negative correlation between the live and formula equations is consistent with the earlier observed strong trend favoring formula pricing in recent years. The high negative correlation between the live and forward equations is consistent with those mechanisms being substitutes distinguished by the timing of transactions. The errors across equations were thus included in the final parameter estimates.

Table 3. Cross Model Correlations

	ΔForwardSH	ΔFormulaSH	ΔLiveSH	ΔGridSH
ΔForwardSH	1.00			
ΔFormulaSH	0.08	1.00		
ΔLiveSH	-0.44	-0.66	1.00	
ΔGridSH	-0.21	-0.13	-0.09	1.00

The SUR results show some ability to explain forward and live shares (Table 4). Both estimated equations explain a modest amount of variability in the changes in shares. An increase in placements would be associated with an increase in forward share. A decrease in weights or volume would be associated with a decrease in forward share. The opposite volume relationship exists with the live shares. Increases in the ratio of Texas to Nebraska marketings or in the choice-select spread have positive relationships with live shares.

Table 4. SUR Parameter Estimates for Shares

	ΔForwardSH	ΔFormulaSH	ΔLiveSH	ΔGridSH
Constant	0.762	0.002	-0.0012	-0.0005
	(1.37)	(0.002)	(0.0016)	(0.001)
ΔTX	-0.020			
	(0.046)			
ΔPlaced	0.013			0.000001
	(0.007)			(0.000004)
ΔWeight	-0.86*	0.0004*		0.0003*
	(0.167)	(0.0001)		(0.00012)
ΔOnFeed	0.01*	-0.00001*		
	(0.005)	(0.000004)		
ΔVolume	-0.0266*	-0.0048	0.0208*	0.00075
	(0.0087)	(0.0072)	(0.0077)	(0.0043)
ΔTX/NE		-0.035*	0.0507*	
		(0.0119)	(0.0104)	
ΔCh-Se			0.001*	-0.0004
			(0.0003)	(0.0004)
ΔNE				0.000054
				(0.000028)
Adj. R^2	0.42	0.11	0.44	0.10

Note: * denotes significance at the 0.05 level.

Conclusions

Buyers and sellers are interested in understanding the use of fed cattle pricing mechanisms in different regions. The purpose here was to demonstrate the regional differences in pricing and to work toward building a model to forecast shares under different mechanisms. Because of non-stationary shares and high correlations across equations, a SUR procedure was used to model the changes in shares.

The preliminary results are encouraging. There are fundamental factors that explain variability in the shares of forward contracting and live negotiated pricing. The trend in recent years (our sample period) has been for a dominant increase in formula pricing. The equations for formula and grid pricing did not explain much of the observed variation in those mechanisms. There are trade-offs observed between live negotiated pricing and both formula and forward contract pricing.

Changes in slaughter weights, cattle on feed, slaughter volume, and the choice-select spread were significant in at least one share equation. The ratio of Texas to Nebraska marketings was also significant, highlighting regional pricing practices. When looking specifically at the upper Midwest, forward contracting and negotiated dressed pricing are more common compared to national totals. Corn price was not significant in the models, despite the high sample correlation among corn price, cattle price and fuel price.

References

Abahana, Z. 2010. "Statistical Time Series Analysis on Basis and Volume of Forward Contracted Cattle in the United States." Unpublished M.S. Thesis, South Dakota State University.

Belasco, E.J., T.C. Schroeder and B.K. Goodwin. 2010. "Quality Risk and Profitability in Cattle Production: A Multivaritate Approach." *Journal of Agricultural and Resource Economics* 35(3): 385-405.

Elam, E. 1992. "Cash Forward contracting versus Hedging of Fed Cattle, and the Impact of Cash Contracting on Cash Prices." *Journal of Agricultural and Resource Economics* 17(1): 205-217.

Fausti, S.W., M.A. Diersen, B.A. Qasmi, J. Li and B. Lange. 2013. "The Effect of Animal Gender on Producer Marketing Behaviour." *Applied Economics Letters* 20(2): 180-185.

Fausti, S.W., M.A. Diersen, B.A. Qasmi, and J. Li. 2010. "Value-Based Marketing: A Discussion of the Issues and Trends in the Slaughter Cattle Market." *Journal of Agribusiness* 28(2): 89-110.

Koontz, S.R. and C.E. Ward. 2011. "Livestock Mandatory Price Reporting: A Literature Review and Synthesis of Related Market Information Research." *Journal of Agricultural & Food Industrial Organization*. Vol. 9; Iss. 1, Article 9.

Mathews, K.H. and R.J. Johnson. 2011. *Cattle Sector Production Practices and Regional Price Differences*. LDP-M-202-1, USDA-Economic Research Service, April.

Muth, M.K., Y. Liu, S.R. Koontz, and J.D. Lawrence. 2008. "Differences in Prices and Price Risk Across Alternative Marketing Arrangements Used in the Fed Cattle Industry. *Journal of Agricultural and Resource Economics* 33(1): 118-135.

Norwood, B. and T.C. Schroeder. 2000. "Usefulness of Placement-Weight Data in Forecasting Fed Cattle Marketings and Prices." *Journal of Agricultural and Applied Economics* 32(1): 63-72.

Packers & Stockyards Program. 2012. *2011 P&SP Annual Report*. USDA-Grain Inspection, Packers and Stockyards Administration, March.

Parcell, J.L., T.C. Schroeder, and K.C. Dhuyvetter. 2000. "Factors Affecting Live Cattle Basis." *Journal of Agricultural and Applied Economics* 32(3): 531-541.

Speer, J. (Ed.) 2012. "IPB looks to June Tama opening." *Tama News-Herald*. January 19.

Walburger, A.M. and K.A. Foster. 1997. "Assessing the Relationship between Market Factors and Regional Price Dynamics in U.S. Cattle Markets." Journal of Agricultural and Resource Economics 22(1): 133-144.

Waltman, S. 2012. "Investors buying into beef plant." *Aberdeen American News*. March 22.

Ward, C.E., S.R. Koontz, and T.C. Schroeder. 1998. "Impacts from Captive Supplies on Fed Cattle Transaction Prices." *Journal of Agricultural and Resource Economics* 23(2): 494-514.

Zellner, A. 1962. “An Efficient Method of Estimating Seeming Unrelated Regression Equations and Tests for Aggregation Bias.” *Journal of the American Statistical Association* 57: 348-368.