Managing for Today's Cattle Market and Beyond

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The Impact of Corn and Fed Cattle Prices on Feeder Cattle Price Slides

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Introduction

Feeder cattle price determination and discovery are complex because many factors impact feeder cattle markets. Feeder cattle are an input into a production process; therefore, feeder cattle demand is influenced by all factors that affect future anticipated demand for fed cattle as well as expected feeder cattle backgrounding and/or feeding costs. In addition, as feeder cattle weight varies, the relative importance of expected fed cattle market price and expected input costs changes. Thus, feeder cattle demand determinants vary in importance over time as the cattle grow. A formidable task facing potential cattle buyers and sellers is how feeder cattle market prices are likely to change as the form of the product (i.e., feeder cattle weight) and expected market prices (input and output) change.

Typically, buyers pay a higher price per pound for lightweight feeder cattle relative to heavier feeder cattle because the cost of adding weight (i.e., cost of gain) is generally less than the value of additional weight. This implies that the negative relationship between weight and price, referred to as the price slide, reflecting a buyer's expected cost of gain relative to expected value of gain.[1] Thus, feeder cattle price slides will vary as both feed and fed cattle selling prices vary.

This fact sheet reports and discusses results from a study that examined how feeder cattle price changes as cattle weight, expected input costs, and expected selling prices change. Further discussion will focus on how these factors change in relative importance as feeder cattle weight varies. This information is useful to cattle producers when making management decisions concerning alternative production strategies (e.g., creep feeding calves, rate of gain to pursue in backgrounding programs, length of grazing season) and timing of buy/sell decisions. Understanding how varying market conditions affect price-weight relationships will allow producers to incorporate weight adjustments into price forecasts and thus make more informed production and marketing decisions.

Information in this fact sheet also can help buyers and sellers who forward contract cattle to establish a price slide for weight deviations that is consistent with market conditions. With forward contracted and electronic auction-marketed feeder cattle, price slides are commonly used to adjust price when the delivered weight deviates from the contracted weight. If premiums and discounts associated with weight vary with market conditions, a price slide that is held constant over time increases risk to buyers and sellers of contract cattle. Results

from this study suggest that a dynamic price slide (i.e., a slide that varies with market conditions) is more appropriate than a fixed price slide.

Study Methods

To estimate the feeder cattle price-weight relationship, and how it is affected by feed and fed cattle prices, weekly feeder cattle sales data were collected. Sale price, weight, number of head in sale lot, sex, and breed information were collected on individual lots of feeder cattle from Winter Livestock Auction in Dodge City, Kansas from January 1987 through December 1996. The data over this ten-year time period included 46,081 individual lots of cattle with an average weight of 300 to 900 pounds representing three breed categories (the categories used were: English, mixed, and Continental/European). Slightly over half (55.4%) of the lots were steers with the rest being heifers.

In addition to the information on each individual lot of feeder cattle, weekly average futures prices for fed cattle and corn were collected to be used as proxies for expected fed cattle price and expected corn price.

Summary statistics of the price and weight variables used for the analysis are given in Table 1. The average weight of feeder cattle was 660 pounds. Feeder cattle price averaged $80.65/cwt. over the ten-year period and ranged from a low of $40.10 to a high of $142.50 across weights and time. Average corn and live cattle futures prices were $2.60/bu. (ranging from $1.52 to $4.38) and $69.79/cwt. (from $54.25 to $78.00), respectively.

Table 1. Summary Statistics of Feeder Cattle Sale Data and Futures Prices, January 1987 - December 1996

Variable	N	Mean	Std Dev	Minimum	Maximum
Price ($/cwt.)	46,081	80.65	12.83	40.10	142.50
Weight (lbs.)	46,081	660	141	300	900
Corn futures price[a] ($/bu.)	46,081	2.60	0.46	1.52	4.38
Live cattle futures price[a]	46,081	69.79	4.79	54.25	78.00

[a] Average of third, fourth, and fifth contracts out where the nearby contract is the first contract out.

To quantify the feeder cattle price-weight relationship while accounting for major price determinants, feeder cattle price was regressed on weight, sex, live cattle futures price, and corn futures price.[2] Weight squared was also included to allow for nonlinear impacts of weight. Interaction terms between weight and each other variable were included. Estimating this regression model allows the price-weight relationship (i.e., price slide) to be quantified as well as to determine how it is impacted with varying feed and fed cattle prices.

Results and Discussion

Regression results are reported in Table 2. The model explained 88.8% of the variability in feeder cattle market prices. Every coefficient is statistically different from zero at the 0.05 level, which is expected given the large number of observations. Because of the interaction and squared terms, the effects of each variable are difficult to decipher simply by examining the coefficients. Therefore, to enhance interpretation, graphical analysis is used to demonstrate the impacts of various price determinants. Additionally, a specific example is included in a following section to show how the information in Table 2 can be used.

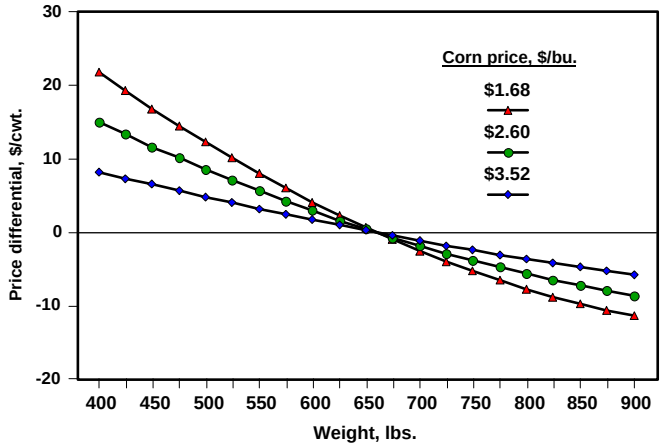
Holding fed cattle futures price at its mean value, Figure 1 shows the feeder steer price-weight relationship for three levels of corn price. As corn price varies from the mean of $2.60/bushel plus and minus two standard deviations, the price slide (i.e., price-weight relationship) responds differently. For lower corn prices, feeder steer price per cwt. decreases more rapidly as feeder cattle weight increases. This is as expected; when corn price is lower, lightweight feeder cattle are worth more relative to heavyweight cattle because the cost of gain is lower.

Table 2. Regression Results (dependent variable is feeder cattle price, $/cwt.)

Variable	Parameter Estimate[a]	Standard Error	p-value
Intercept	-45.64718	5.8844	0.0001
Live cattle futures (LC)	3.91611	0.0793	0.0001
Corn futures (CN)	-36.55697	0.8974	0.0001
Weight	0.06633	0.0198	0.0008
Weight squared	-3.765×10^{-5}	1.6×10^{-5}	0.0197
Heifer x weight	-0.04101	0.0004	0.0001
Heifer x weight squared	4.661×10^{-5}	5.6×10^{-7}	0.0001
LC x weight	-0.00477	0.0003	0.0001
LC x weight squared	2.360×10^{-6}	2.1×10^{-7}	0.0001
CN x weight	0.06202	0.0029	0.0001
CN x weight squared	-3.171×10^{-5}	2.3×10^{-6}	0.0001
R^2	88.8		

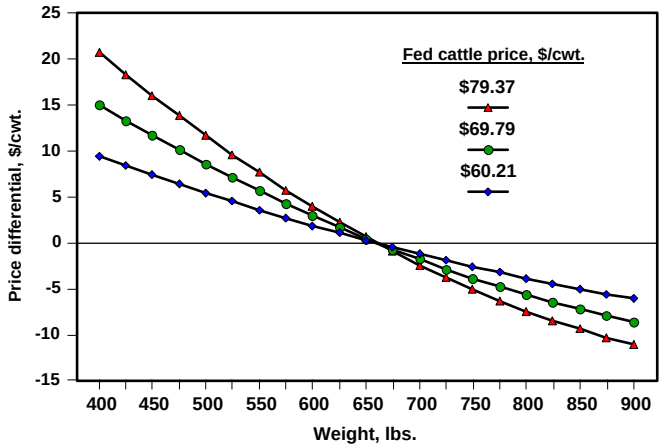
[a] Parameter estimates should not be rounded as predicted values are sensitive to values used.

Figure 1. Impact of corn price on feeder steer price-weight relationship.



For example, the price spread between 500 and 800 lb. steers is almost $20/cwt. when corn price is $1.68/bu. and declines to just slightly over $8/cwt. with a $3.52/bu. corn price. The size of the price slide also varies with weight. For example, the price deviation for a 10-pound interval around 500 pounds (i.e., 490 or 510 pounds) is $0.89, $0.61, and $0.33/cwt. with corn prices of $1.68, $2.60, and $3.52/bu., respectively. However, the price deviation for a 10-pound interval around 800 pounds (i.e., 790 or 810 pounds) is $0.44, $0.34, and $0.24/cwt. with corn prices of $1.68, $2.60, and $3.52/bu., respectively. An important implication is that price slides should be adjusted for different corn prices and this adjustment varies depending on feeder cattle weight.

Figure 2. Impact of fed cattle price on feeder steer price-weight relationship.

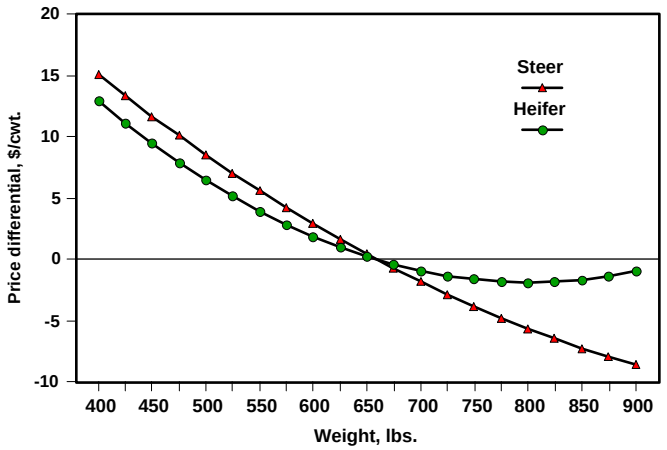


Expected fed cattle price also has a sizeable impact on the price-weight relationship (Figure 2). Holding corn futures price at its mean, with a $79.37/cwt. fed cattle futures price (mean price plus two standard deviations), the price spread between 500 and 800 lb steers is about $19/cwt., whereas with a fed cattle futures price of $60.21/cwt (mean less two standard deviations), the spread is approximately $9/cwt. In addition to fed cattle

prices, the size of the price deviation also varies with weight. For example, the price deviation for a 10-pound interval around 500 pounds (i.e., 490 or 510 pounds) is $0.84, $0.61, and $0.38/cwt. with fed cattle prices of $79.37, $69.79, and $60.21/cwt., respectively. However, the price deviation for a 10-pound interval around 800 pounds (i.e., 790 or 810 pounds) is $0.43, $0.34, and $0.24/cwt. with fed cattle prices of $79.37, $69.79, and $60.21/cwt., respectively. Thus, price slides clearly depend on expected fed cattle prices as well as corn prices and in both cases the price slides also depend on feeder cattle weight.

Figure 3 shows the relationship between feeder steer and feeder heifer prices as weight varies with corn and fed cattle prices evaluated at their average prices. As expected, the price-weight relationship (i.e., price slide) is negative for both steers and heifers, however, the relationship differs between steers and heifers. Steer prices decrease essentially linearly over the weight range examined (i.e., 400 to 900 pounds), whereas, the relationship between heifer prices and weight is nonlinear.

Figure 3. Impact of sex on feeder cattle price-weight relationship.



In this analysis, heifer prices decrease as weight increases up until heifers reach approximately 750 pounds after which there is little further decline in price as weight increases. For example, the price change for a 10-pound deviation from 500 pounds (i.e., 490 or 510 pounds) is $0.61/cwt. for steers compared to $0.55/cwt. for heifers (corn and fed cattle prices evaluated at their means). However, the price change for a 10-pound deviation from 800 pounds (i.e., 790 or 810 pounds) is $0.34/cwt. for steers compared to $0.00/cwt. for heifers. A couple possible explanations exist for this result. First, an 800-pound heifer is not equivalent to an 800-pound steer because they have different end weights and thus the price-weight relationship is not expected to be exactly the same. Although this may be partially what is occurring, it is likely not the only factor. Some of the heavyweight heifers in this data may have actually sold as replacement heifers. These heifers are in a completely different market than steers (e.g., breeding stock versus feeder cattle) and differences between price slides would be expected. Regardless of the reason, these results suggest that the price slide (i.e., weight discount) is similar for lightweight steers and heifers but it is considerably less for heavyweight heifers than for heavy steers on average.

The relationship between feeder cattle prices and weights (i.e., price slides) vary as feed and fed cattle prices vary. Thus, it is important to account for current market conditions when estimating the impact of weight on feeder cattle price. Additionally, while price slides are comparable for feeder steers and heifers at lighter weights (e.g., less than 600 pounds), price slides diverge at heavier weights.

Price Slide Example

The information in Table 2 may appear complicated and hard to interpret, however, it is fairly easy to use this information to predict price slides using a computer spreadsheet.[3] The following hypothetical example is given to demonstrate how the information in Table 2 can be used to assist producers in making management decisions.

Consider the following, a cattle feeder is backgrounding steers and is considering alternative rations with varying rates of gain. If the cattle are fed a more energy intensive ration they will end up weighing approximately 775 pounds after the feeding program. However, if a more roughage-based ration is fed the cattle will only weigh around 700 pounds. The producer is trying to determine which of these feeding programs will be the most profitable. The producer has a forecast of $78.50/cwt. for 750 pounds steers at the time the cattle will come off feed. While this forecast may have come from any number of sources (e.g., futures + basis, university outlook, industry newsletter) it is most likely quoted for "700-800" pound steers. However, because the producer does not believe it is

appropriate to assume the same price (i.e., $78.50) for both feeding programs, he needs to "adjust" this price for that of both a 700 and a 775 pound steer. Using the information in Table 2 along with his expectations of corn and fed cattle prices the producer can estimate the prices for 700, 750, and 775 pounds steers. Based on expected prices of $2.50/bu. and $70/cwt. for corn and fed cattle, respectively, the producer estimates the prices as shown in Table 3.

Table 3. Predicted price for steers of varying weights assuming a corn price of $2.50/bu. and a fed cattle price of $70/cwt. using parameter estimates reported in Table 2.

750 lb steer	**700 pound steer**	**775 pound steer**
- 45.64718	- 45.64718	- 45.64718
+ 3.91611 x ($70)	+ 3.91611 x ($70)	+ 3.91611 x ($70)
- 36.55697 x ($2.50)	- 36.55697 x ($2.50)	- 36.55697 x ($2.50)
+ 0.06633 x (750)	+ 0.06633 x (700)	+ 0.06633 x (775)
- 3.765 x 10^{-5} x $(750)^2$	- 3.765 x 10^{-5} x $(700)^2$	- 3.765 x 10^{-5} x $(775)^2$
- 0.04101 x (750) x (0)[a]	- 0.04101 x (700) x (0)[a]	- 0.04101 x (775) x (0)[a]
+ 4.661 x 10^{-5} x $(750)^2$ x (0)[a]	+ 4.661 x 10^{-5} x $(700)^2$ x (0)[a]	+ 4.661 x 10^{-5} x $(775)^2$ x (0)[a]
- 0.00477 x ($70) x (750)	- 0.00477 x ($70) x (700)	- 0.00477 x ($70) x (775)
+ 2.36 x 10^{-6} x ($70) x $(750)^2$	+ 2.36 x 10^{-6} x ($70) x $(700)^2$	+ 2.36 x 10^{-6} x ($70) x $(775)^2$
+ 0.06202 x ($2.50) x (750)	+ 0.06202 x ($2.50) x (700)	+ 0.06202 x ($2.50) x (775)
- 3.171 x 10^{-5} x ($2.50) x $(750)^2$	- 3.171 x 10^{-5} x ($2.50) x $(700)^2$	- 3.171 x 10^{-5} x ($2.50) x $(775)^2$
= $79.85/cwt	= $81.98/cwt	= $78.88/cwt
Difference from 750 lb price, $/cwt.	$2.13/cwt.	$0.97/cwt.
Difference from 750 lb price, %	2.67%.	-1.21%

[a] If predicted prices were for heifers this value would be equal to one (for steers it is zero).

After calculating the information in Table 3, the producer can estimate what the price of a 700 and 775 pound steer will be either using the $/cwt. or the percent difference from the base price (i.e., $78.50 for a 750 pound steer). For example, using the $/cwt. difference implies a price of $80.63/cwt. ($78.50 + $2.13) for the 700 pound steers and a price of $77.53/cwt. ($78.50 . $0.97) for the 775 pound steers. Given these prices for 700 and 775 pounds steers along with projected costs of gain, the producer can make a more informed decision about the relative profitability of the alternative feeding programs.

Using the percent difference approach would suggest prices of $80.59/cwt. (78.50 x 1.0267) and $77.50/cwt. (78.50 x 0.9879) for the 700 and 775-pound steers, respectively. In this case, both methods (fixed dollar amount and percent) resulted in similar prices because the model-predicted price for the 750 pound steer (i.e., the "base weight") was close to the producer's price expectation.[4] While the percent adjustment method requires several additional calculations, it is probably the more appropriate method. This is especially true if the predicted price for the base weight is considerably higher or lower than the producer's price forecast (i.e., the difference between the $78.50 and the $80.04 in this example).

This example has shown how a price slide can be estimated based on expected prices for corn and fed cattle as well as feeder cattle weight. It should be noted that actual price slides might vary from model-predicted slides seasonally and if feed conversion varies from what would be expected in Kansas (remember the parameter coefficients in Table 2 were estimated with price data from Dodge City, Kansas). For example, the price slide for heavier weight feeder cattle tends to be a "flatter" in the summer months (June-September) compared to the rest of the year. In other words, it may be that

discounts for additional weight on 700-900 pound feeder cattle will be slightly less than the model-predicted slide in the summer months. Thus, while the information in Table 2 is useful for helping producers make management decisions, it is important to remember that actual observed price slides may vary from model-predicted slides.

Summary

Several important determinants need to be considered when analyzing feeder cattle price-weight relationships. The two most economically important price-weight slide determinants are expected fed cattle price and corn price. Price-weight slides increase notably when corn prices decline (i.e., the premium for lightweight calves increases as feed prices decrease). Likewise, when expected fed cattle prices increase, price-weight slides increase. In addition to varying with corn and fed cattle prices, price slides vary with feeder cattle weight and also differ between steers and heifers, at least at heavier weights. Knowing this information can help producers who forward contract feeder cattle, backgrounders making decisions regarding feeding calves to varying weights, and producers making feeder cattle purchase decisions.

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[1] In this fact sheet, the term price slide is used in a generic fashion to represent how price of feeder cattle changes as weight varies. When the exact weight of feeder cattle is unknown at the time of sale, buyers and sellers often use a predetermined price slide to adjust their price for deviations in weight from some agreed upon base weight.

[2] Models including variables for breed, seasonality, profitability, and price variability were also estimated. Results with regards to the variables of interest here (fed cattle and corn prices) were similar, so the simpler model is presented to save space.

[3] An Excel® spreadsheet (Price slides.xls) can be found at www.agecon.ksu.edu/kdhuyvetter to estimate the feeder cattle price-weight relationship for various corn and fed cattle prices and feeder cattle weights.

[4] The model-predicted price for a 750 lb. steer of $80.04 can vary from the producer's forecast of $78.50 for several reasons. First, the model was estimated using prices from Dodge City, Kansas and thus prices may differ geographically (i.e., regional differences in basis). Also, forecasted prices may differ due to varying price expectations for feed costs and fed cattle prices (i.e., the corn and fed cattle price expectations of the different people or firms providing a price forecast may differ from the futures market).