# THE IMPACTS OF QUALITY ON CASH FED CATTLE PRICES

**Rodney Jones, Ted Schroeder, James Mintert, and Frank Brazle**

**Abstract**

Quality factors affecting fed cattle prices were examined during a six-month period in southwestern Kansas. Transaction prices were significantly affected by the percentage of cattle expected to grade choice times the choice-to-select carcass price spread, finish uniformity, average weight, dressing percentage, breed, number of cattle purchased by a single packer on a given day, the packer, the feedyard, the day-of-the-week the cattle were sold, and the number of bids received. Asking prices were significantly affected by many of the same factors. Asking and transaction prices reflected approximately 25 percent of the packer value differentials for expected carcass quality grades.

*Key words:* fed cattle prices, value-based marketing

Do fed cattle prices reflect differences in end-use values of individual pens of cattle? Vermedahl (pp. 25-26) indicated that "...we now trade cattle by the average. Look at what happened in the Texas Cattle Feeder area last week. Eighty percent of the cattle traded brought from $79 to $79.50. ...do we really believe that all the cattle coming out of Texas feedlots are worth within 50 cents per hundred weight of each other?" Vermedahl's comment is indicative of many cattle feeders' beliefs that fed cattle prices do not reflect differences in end-use values. How fed cattle are priced is important because prices that do not reflect end-use values send improper signals to producers resulting in inefficient production and in production of retail products that consumers find undesirable. Concern about this situation is widespread, prompting the National Cattlemen's Association to form a task force in 1989 to identify impediments to value-based marketing and determine how to remove them (Knop).

Important in identifying the impediments to value-based marketing is to determine how fed cattle are priced. This study explores the pricing of fed cattle during May through November 1990 in 13 feedlots in southwestern Kansas. The objective is to quantify the market values of primary characteristics affecting fed cattle prices. In particular, marginal implicit prices paid for specific fed cattle traits are estimated and compared to aggregate market values and asking prices.

## PREVIOUS RESEARCH

Several studies have investigated price-quality relationships for cattle. Most of these studies focused on price differentials for feeder cattle (Bailey and Peterson; Botkin et al.; Buccola; Faminow and Gum; Schroeder et al.; Sullivan and Linton). General conclusions were that feeder cattle prices were affected by weight, sex, breed, condition, health, muscling, frame size, fill, lot size, and time of sale. Considerably less research has evaluated price differentials associated with fed cattle characteristics. In related studies Ward (1981 and 1982) examined factors that affected fed cattle prices. Significant factors included number of head, estimated dressing percentage, live weight, number of days between sale and delivery, difference between asking price and first bid, number of bids, and number of packers bidding.

Ward's (1981 and 1982) research contained limited information regarding the impact of quality on fed cattle prices. Also, Ward's data were collected during 1979, more than 10 years ago. During the past decade the beef industry's market structure, livestock genetics, production technology, and consumer demand have changed. Moreover, given recent interest in value-based marketing, analysis of factors affecting prices of individual pens of fed cattle is overdue. This study provides an updated evaluation using data collected on 1376 pens of fed cattle sold during May-November 1990. In addition, more cattle characteristics were examined for price impacts than in previous research. Models were estimated to determine factors that influence transaction prices as well as asking prices. Previous research has not examined factors that influence

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asking prices. Knowledge of factors influencing asking prices provides insight into transaction price behavior.

## CONCEPTUAL MODEL

The demand for fed cattle is derived from the demand for wholesale beef which is derived from the demand for beef by consumers. The derived demand for fed cattle shifts as consumer demand shifts or when fabrication or marketing costs of processed beef change (Wohlgenant and Mullen).

Most cattle destined for slaughter at a particular plant are purchased within a 100-mile radius of the facility (Ward 1988). This relatively small geographic market, together with price discounts associated with excessively "green" or "over-finished" cattle, implies that the short-run supply of fed cattle in a particular region is highly inelastic. Thus, the demand for cattle can be expressed in price-dependent form.

The derived demand for fed cattle by packers is best described as a multiproduct firm purchasing heterogeneous inputs. Packers produce beef products from live cattle. The value of fabricated beef is directly related to the traits of live cattle. For example, pens having a large percentage of cattle grading choice will have a higher value to the packer than pens having a low percentage of choice cattle. In addition, costs of fabricating beef are directly affected by characteristics of the cattle. Pens having a uniform finish, for example, will have relatively low costs of sorting carcasses during slaughter. Therefore, the packer's fabricated beef production function will depend upon the amounts of various input characteristics of the cattle being slaughtered (Ladd and Martin).

Assuming packers maximize profits, the price-dependent demand for fed cattle can be modeled as the demand for the characteristics of the cattle in each pen. Following Ladd and Martin, the demand for each pen of cattle is

$$(1)\quad r_i = p_h \sum_j \left( \partial F_h / \partial x_{j\cdot h} \right) \left( \partial x_{j\cdot h} / \partial v_{ih} \right)$$

where $r_i$ is the transaction price for an individual pen of cattle, $p_h$ is the packer's selling price of fabricated beef product h (wholesale price), $\partial F_h / \partial x_{j\cdot h}$ is the marginal physical product of one unit of characteristic j used in production of product h ($x_{j\cdot h}$ is the total quantity of each characteristic obtained from the set of inputs ($v_i$'s) used to produce h), and $\partial x_{j\cdot h} / \partial v_{ih}$, is the marginal yield of characteristic j used in the production of product h from input i.

Defining $T_{jh}$ as the value of the marginal product of the j-th characteristic used in producing output h (i.e., $T_{jh} = p_h (\partial F_h / \partial x_{j\cdot h})$), then equation (1) can be written:

$$(2)\quad r_i = \sum_j T_{jh} \left( \partial x_{j\cdot h} / \partial v_{ih} \right)$$

Equation (2) stipulates that the price of an individual pen of cattle is the sum of the values of the marginal yields of input i's characteristics to fabricated beef production.

## EMPIRICAL MODEL

The $T_{jh}$ parameters in equation (2) are an estimate of the marginal values packers are paying for individual characteristics of a pen of cattle. An empirical model of equation (2) can be derived assuming $\partial x_{j\cdot h} / \partial v_{ih} = x_{jih}$ is constant. That is, each input provides a constant level of characteristic as the level of that input changes i.e., an increase in the percentage of choice cattle in a pen increases the level of the characteristic yield at a constant rate. Ladd and Martin argued further that $x_{jih} = x_{jik}$ for all h and k and all i and j. That is, the yield of each characteristic by an input is not affected by the use made of the input. These assumptions provide an empirical representation of equation (2):

$$(3)\quad r_i = \sum_j T_{jh} x_{jih}.$$

The $T_{jh}$ parameters in equation (3) can be estimated by regressing the transaction price of individual pens of cattle against the characteristics of each pen. Hypothesis tests of the significance of these parameters provide evidence of the value of the characteristics of the inputs.

To investigate the impacts of quality factors on fed cattle prices, transaction prices, and associated characteristics, data were needed. These data were most readily collected over time across several feedyards. Thus, equation (3) was modified to adjust transaction prices collected over time for changing aggregate market price levels. This was accomplished by defining the dependent variable as the individual transaction price less the aggregate cash market price on that particular day in the region. The aggregate market price (R) was defined as the western Kansas direct trade price reported by the Agricultural Marketing Service (AMS). The empirical equation is

$$(4)\quad r_{it} - R_t = \sum_j T_{jh}\, x_{jiht}$$

where t refers to the day the cattle were sold.

Cattle analyzed in this study were sold by direct trade between packers and cattle feeders. In direct trade the feedyard manager prepares a show list of cattle ready for market. The list identifies the pen and has information such as owner, sex, number of head, days on feed, and the cattle weight when placed on feed. When the buyer visits the feedyard, visual inspection is made of cattle on the show list and characteristics important in developing a price offer are noted. Price negotiation begins with the feedyard manager providing an asking price for each pen of cattle. This pricing process is important because packers observe the quality of individual pens of cattle and develop bids accordingly. Characteristics important to packers should be reflected in transaction prices. Cattle characteristics expected to be important include items that affect packer revenues and/or costs.

Several observable traits of cattle were expected to impact packer revenues. Foremost was the percentage of cattle expected to grade choice and the price spread between choice and select grade wholesale beef. As the percentage of choice cattle increases, derived product value increases, which was expected to increase fed cattle price. The higher the expected dressing percentage, the higher the presumed meat yield, which was anticipated to lead to a higher price. For the same reason, the lower the percentage of yield grade 4 cattle in a pen, the higher the expected price. Other factors that may influence packer revenues include number of brands (if this affects hide value), breed (if this includes quality factors not in other measures), sex (and age[1]), and the number of days on feed (if this affects quality grade).

Other characteristics of the pen may influence marketing costs. The number of cattle procured at a particular feedlot during a day is inversely related to procurement costs: a packer's purchasing large quantities of cattle from a single feedlot reduces buyer time and travel allocated to finding cattle and may also reduce cattle trucking costs. Finish and weight uniformity of a pen of cattle could reduce sorting costs. The weight of the cattle may influence processing costs.[2] Fed cattle are generally priced FOB the feedyard with the packer paying shipping; thus, the distance from the packing plant to the feedyard affects packer shipping costs. The further the distance, the lower the expected price. Finally, as packers attempt to manage their cattle inventory, the number of days between cattle purchase and delivery to the packer may vary, influencing processing costs. Longer delivery time may indicate that the packer desires the feedyard to hold cattle longer than normal, and the packer may be willing to pay for this service. Alternatively, shorter delivery time could indicate a need by the packer for cattle to meet slaughter capacity and, given economies of scale, the packer may be willing to pay more to fill short-term slaughter needs.

Given the cross sectional nature of the data, regressors were included to allow for feedyard and packer effects. The number of bids on each pen was included because it reflects demand for that pen and may have a positive influence on price (Ward 1988). To adjust for possible day-of-the-week effects, binary week day variables were introduced. Day-of-the-week price effects may be present if either the fed cattle market becomes thin late in the week or the feedyards in the survey have fed cattle demands that differ relative to the AMS price systematically by day of the week.

## DATA

Data were collected on 810 pens of steers (99,219 head) and 566 pens of heifers (67,119 head) marketed during May 21, 1990 through November 24, 1990 from 13 feedyards in southwestern Kansas.[3] The specific variables used in the analysis are defined in Table 1. The asking price, individual bids, sale date, transaction price, weight, buyer, and delivery date were recorded by feedyard personnel. To ensure consistency, all quality characteristics of each pen across all feedyards were collected by the same appraiser.[4]

Summary statistics of selected data are provided in Table 2. Average transaction prices were \$77.32/cwt for steers and \$76.94/cwt for heifers. Transaction prices averaged \$0.16/cwt and \$0.18/cwt lower than

[1] For example, the presence of heiferettes or late-cut bulls in a pen may influence the value of the beef products from the pen.

[2] Heavy cattle may yield fabricated cuts too large for standard packaging thus increasing fabrication sorting costs. Excessively large carcasses could also reduce revenue per hundredweight because large cuts often have less value per pound.

[3] Because of data collection resource constraints, 5 of the 13 feedyards were dropped from the data collection survey at the end of August 1990. Thus, only 8 of the yards participated in the survey from September 1, 1990 through November 24, 1990. Analysis conducted using only data from the 8 feedyards for the entire period was consistent with the results reported here using the entire data set.

[4] The data collector had considerable prior cattle experience and was intensively trained to evaluate animal traits by an animal science beef specialist and professional cattle buyers.

Table 1. Definition of Variables

| Variable | Description |
|---|---|
| Dependent Variables | |
| TRANSACTION PRICE | Selling price of cattle fob the feedyard ($/cwt.) |
| ASKING PRICE | Last price asked for cattle by the feedyard ($/cwt.) |
| MARKET PRICE | Choice of western Kansas direct 1100 to 1300 lb. steer price or 1000 to 1200 lb. heifer price ($/cwt.) |
| Independent Variables | |
| WEIGHT | Average pay-weight of cattle when delivered (lbs.). |
| WEIGHT SQUARED | WEIGHT Squared |
| SPREAD*SELECT | Estimated % of cattle in pen grading below choice times the price spread between choice and select grade USDA boxed carcass equivalent price ($/cwt.), prior day's price if cattle sold before 1 p.m., current day's otherwise. |
| DRESSING | Estimated average dressing % of cattle in the pen. |
| YLDGRADE 4 | Estimated % of yield grade 4 cattle in the pen. |
| FINISH UNIF | 1 if finish of cattle is not uniform, zero otherwise. |
| WEIGHT UNIF | 1 if weight range of cattle exceeds 200 lbs., zero otherwise. |
| CATTLE NUMBER | Total head of cattle purchased by the packer on a particular day at a given feedyard (head). |
| DAYS ON FEED | Days cattle were on feed(days). |
| BRANDS | Number of brands on cattle. |
| BULLS | 1 if pen contained bulls, zero otherwise. |
| HEIFFERETTES | 1 if pen contained heifererres, zero otherwise. |
| ANGUS; CHARLAIS; SIMMENTAL; LIMOSIN; EXOTIC X; HEREFORD; HERF ANG X; HOLSTEIN[a]; ENG EXOTIC X; BRAHMAN; MIXED; JUNK[b] | Breed variables equal to 1 if at least 20% of the cattle in the pen were of the respective breed or cross and equal to zero otherwise. |
| YARD i[c] | 1 if yard i, zero otherwise, i = 1, 2,...,10 |
| PACKER i | 1 if packer i purchased the cattle, zero otherwise, i = 1, 2, 3, 4, 5. |
| MONDAY; TUESDAY; WEDNESDAY; THURSDAY; FRIDAY | Day of the week variables equal to 1 if pen sold on that day, zero otherwise. |
| DISTANCE | Approximate road miles from feedyard to buying packer. |
| BID NUMBER | Number of bids made on pen during the week sold. |
| DELIVERY LAG | Number of days between sale and delivery dates. |

[a]If any cattle in the pen were Holstein cross, HOLSTEIN was assigned a value of 1.
[b]The cattle were of varied or nonassignable breeds and of low quality.
[c]Although a total of 13 feedyards were included in the study, four small yards were grouped together in one of the YARD variables because of low volume.

the feedyard's asking prices for steers and heifers, respectively. Steer transaction prices averaged $0.16/cwt lower than the AMS western Kansas direct price. Heifer transaction prices averaged $0.20/cwt lower than the AMS western Kansas direct heifer price. The largest premiums received for steers and heifers relative to the AMS western Kansas choice market prices on the same day were $0.75/cwt. The largest discount received relative to the AMS price was $5/cwt for steers and $4.75/cwt for heifers.

The average percentage of cattle expected to grade choice was 54 percent with a range of 40 percent to 80 percent. The average total number of cattle (steers plus heifers) purchased by the packer at a particular yard on a given day was 679 head when at least one pen of steers was bought and 580 head when at least one pen of heifers was purchased. The number of bids received during the week the pen

Table 2. Summary Statistics of Selected Variables

| Variable | Average | Standard Deviation | Minimum Value | Maximum Value |
|---|---|---|---|---|
| Steers | | | | |
| TRANSACTION PRICE ($/cwt) | 77.32 | 1.86 | 72.50 | 82.00 |
| TRANSACTION-MARKET PRICE ($/cwt) | -.016 | 0.45 | -5.00 | 0.75 |
| ASKING PRICE ($/cwt) | 77.48 | 1.84 | 72.50 | 82.00 |
| ASKING-MARKET PRICE ($/cwt) | -0.00 | 0.67 | -4.75 | 4.00 |
| CHOICE (%) | 54.0 | 6.6 | 40.0 | 80.0 |
| DRESSING (%) | 63.4 | 0.2 | 62.5 | 64.0 |
| YLDGRADE4 (%) | 1.2 | 0.9 | 0.0 | 4.0 |
| WEIGHT (lbs) | 1198.8 | 65.8 | 953.0 | 1416.0 |
| WEIGHT UNIF | 0.5 | 0.5 | 0.0 | 1.0 |
| FINISH UNIF | 0.0 | 0.1 | 0.0 | 1.0 |
| CATTLE (head) | 678.6 | 597.1 | 47 | 2489 |
| HEAD (head per pen) | 122.5 | 62.8 | 29 | 792 |
| BID NUMBER | 1.6 | 1.0 | 1 | 6 |
| TOTAL BIDS[a] | 1.8 | 1.3 | 1 | 9 |
| DELIVERY LAG (days) | 4.4 | 2.2 | 0 | 17 |
| Heifers | | | | |
| TRANSACTION PRICE ($/cwt) | 76.94 | 1.91 | 71.00 | 82.00 |
| TRANSACTION-MARKET PRICE ($/cwt) | -0.20 | 0.52 | -4.75 | 0.75 |
| ASKING PRICE ($/cwt) | 77.12 | 1.85 | 72.00 | 82.00 |
| ASKING-MARKET PRICE ($/cwt) | -0.01 | 0.61 | -2.75 | 3.50 |
| CHOICE (%) | 53.6 | 6.1 | 40.00 | 70.0 |
| DRESSING (%) | 63.3 | 0.2 | 62.5 | 64.0 |
| YLDGRADE4 (%) | 1.1 | 1.0 | 0.0 | 5.0 |
| WEIGHT (lbs) | 1058.6 | 56.1 | 902.0 | 1303.0 |
| WEIGHT UNIF | 0.6 | 0.5 | 0.0 | 1.0 |
| FINISH UNIF | 0.0 | 0.1 | 0.0 | 1.0 |
| CATTLE (head) | 580.1 | 498.2 | 58 | 2489 |
| HEAD (head per pen) | 118.7 | 61.6 | 23 | 780 |
| BID NUMBER | 1.4 | 0.8 | 1 | 7 |
| TOTAL BIDS[a] | 1.7 | 1.1 | 1 | 9 |
| DELIVERY LAG (days) | 5.4 | 2.2 | 0 | 12 |

[a]Total bids received on the pen during the time they were on the show list.

was sold (including multiple offers by the same packer) ranged from 1 to 7.

## RESULTS AND DISCUSSION

Equation (4) was estimated separately for steers and heifers using ordinary least squares. The dependent variable for the steer model was the transaction price for each pen minus the AMS western Kansas direct price for choice 1100 to 1300 lb steers on the day the pen was sold. The dependent variable for the heifer model was the transaction price minus the AMS choice 1000 to 1200 lb western Kansas direct heifer price on the same day. All cattle were sold with 4 percent pencil shrink, FOB the feedyard.

Table 3. Parameter Estimates of Factors Affecting Transaction Price Differentials of Fed Cattle[a]

| Dependent Variable = TRANSACTION PRICE - MARKET PRICE ($/cwt) | | | | |
|---|---|---|---|---|
| | Steers | | Heifers | |
| Independent Variable | Estimate | t-statistic | Estimate | t-statistic |
| Quality Factors | | | | |
| WEIGHT | 0.0194 | 4.07** | 0.0373 | 4.45 |
| WEIGHT SQUARED | $-8.51 \bullet 10^{-6}$ | -4.29** | $1.80 \bullet 10^{-5}$ | -4.63** |
| SPREAD*SELECT | -0.00103 | -7.25** | -0.00115 | -5.06** |
| DRESSING | 0.227 | 2.39** | 0.167 | 1.21 |
| YLDGRADE 4 | 0.031 | 2.11** | -0.005 | 0.23 |
| FINISH UNIF | -0.348 | -3.57** | 0.060 | 0.32 |
| WEIGHT UNIF | -0.012 | -0.43 | 0.047 | 1.11 |
| Quality F-Statistic | 17.75** | | 8.40** | |
| Pen Factors | | | | |
| CATTLE NUMBER | $4.32 \bullet 10^{-5}$ | 1.52 | $1.02 \bullet 10^{-4}$ | 2.09** |
| DAYS ON FEED | 0.00033 | 0.59 | -0.000 | -0.02 |
| BRANDS | 0.012 | 0.44 | 0.106 | 2.66** |
| BULLS | -0.066 | -0.76 | | |
| HEIFFERETTES | | | -0.264 | -2.17** |
| Pen F-Statistic | 0.89 | | 3.96** | |
| Breeds | | | | |
| ANGUS | -0.026 | -0.39 | 0.149 | 1.26 |
| CHAROLAIS | -0.160 | -2.44** | 0.110 | 0.99 |
| SIMMENTAL | 0.211 | 3.09** | -0.088 | -0.55 |
| LIMOSIN | -0.059 | -0.70 | -0.007 | -0.04 |
| EXOTIC X | 0.066 | 1.04 | 0.054 | 0.49 |
| HEREFORD | -0.067 | -0.49 | 0.432 | 1.32 |
| HERF ANG X | 0.089 | 1.45 | 0.019 | 0.16 |
| HOLSTEIN | 0.157 | 1.21 | | |
| ENG EXOTIC X | 0.019 | 0.27 | 0.104 | 0.86 |
| BRAHMAN | -0.185 | -1.55 | 0.034 | 0.18 |
| MIXED | 0.049 | 0.58 | 0.003 | 0.02 |
| JUNK | -2.459 | -10.59** | -0.370 | -1.04 |
| Breeds F-Statistic | 12.89** | | 0.70 | |
| Feedyard (Default = YARD 1) | | | | |
| YARD 2 | -0.083 | -1.59 | 0.129 | 1.72* |
| YARD 3 | -0.045 | -0.99 | -0.166 | -1.90* |
| YARD 4 | -0.082 | -1.55 | 0.018 | 0.24 |
| YARD 5 | -0.019 | -0.33 | 0.033 | 0.39 |
| YARD 6 | -0.096 | -1.23 | 0.070 | 0.49 |
| YARD 7 | 0.034 | 0.55 | -0.007 | -0.07 |
| YARD 8 | 0.008 | 0.08 | -0.160 | -0.74 |
| YARD 9 | -0.354 | -3.67** | -0.120 | -1.44 |
| YARD 10 | 0.002 | 0.02 | -0.147 | -1.28 |
| Feedyard F-Statistic | 2.06** | | 1.90** | |

Table 3. cont.

| Independent Variable | Steers | | Heifers | |
|---|---|---|---|---|
| | Estimate | t-statistic | Estimate | t-statistic |
| Packer-Buyer (Default = Packer 1) | | | | |
| PACKER 2 | -0.018 | -0.12 | -0.028 | -0.39 |
| PACKER 3 | -0.113 | -2.27** | 0.020 | 0.27 |
| PACKER 4 | 0.014 | 0.38 | -0.250 | -2.85** |
| PACKER 5 | 0.052 | 1.33 | 0.016 | 0.23 |
| Packer-Buyer F-Statistic | 2.44** | | 3.41** | |
| Day-of-the-Week (Default = Monday) | | | | |
| TUESDAY | -0.035 | -1.01 | 0.060 | 1.16 |
| WEDNESDAY | -0.084 | -1.99** | -0.085 | -1.31 |
| THURSDAY | -0.246 | -4.29** | -0.065 | -0.73 |
| FRIDAY | -0.169 | -2.35** | -0.104 | -1.00 |
| Day F-Statistic | 5.44** | | 2.12* | |
| Other Factors | | | | |
| DISTANCE | -0.00093 | -1.55 | 0.003 | 3.58** |
| BID NUMBER | 0.072 | 4.37** | 0.045 | 1.53 |
| DELIVERY LAG | -0.005 | -0.81 | 0.012 | 1.07 |
| Other F-Statistic | 7.37** | | 5.32** | |
| INTERCEPT | -25.348 | -3.78** | -30.246 | -3.08** |
| Adj. R-Square | 0.39 | | 0.26 | |
| RMSE ($/cwt) | 0.35 | | 0.44 | |
| Equation F | 13.13** | | 5.69** | |
| Observations | 810 | | 566 | |

[a]Single and double asterisks indicate statistically different from zero at the 0.10 and 0.05 levels, respectively.

For categorical variables it was necessary to specify a base pen to avoid perfect collinearity among certain regressors. The base pen was purchased by PACKER 1, from YARD 1, on MONDAY. Coefficient estimates represent $/cwt price changes from the base pen associated with each factor.

## Transaction Prices

Estimates of the factors affecting the transaction to western Kansas direct price differentials for individual pens of cattle are in Table 3. The models explained 39 percent of the variability in steer prices and 26 percent of heifer prices.[5] Several factors were important in explaining price differences including weight, quality, pen factors, certain breeds, feedyards, packers, day of the week the cattle were sold, and others.

Given the large number of regressors, the models were evaluated for potential degrading multicollinearity[6] using the regression-coefficient variance decomposition procedure of Belsley et al. This procedure yielded one potentially degrading collinear relationship for each of the two models, both between the intercept and dressing percentage. This is a result of the dressing percentage's being fairly constant across pens (see Table 2). Dressing percentage was significant for steers, suggesting that collinearity was not severe enough to alter conclusions for the steer model. For heifers, collinearity may have contributed to the dressing percentage's being insignificant.

[5]These seemingly low R-squared values are respectable for cross sectional data (i.e., by subtracting the market price from the transaction price, the only true time series component remaining in the models is the changing choice-to-select wholesale boxed beef price spread). When the same models were estimated with the AMS fed cattle price as a regressor, instead of differenced from the transaction price, R-squared values exceeded 0.90.

[6]Collinearity was judged potentially degrading if the condition index was greater than 30 and the variance decomposition proportions among two or more estimated coefficients were greater than 0.50 (Belsley et al.).

The average weight of cattle in the pen had a nonlinear influence on price as illustrated in Figure 1. Steers weighing less than 1000 lbs and more than 1300 lbs received discounts of at least $0.20/cwt compared to 1100 to 1200 lb steers. Heifers weighing less than 950 lbs and more than 1150 lbs were discounted at least $0.20/cwt relative to 1000 to 1050 lb heifers. Discounts for heavy cattle may reflect the increased costs associated with carcasses yielding cuts too large for standard boxed beef packaging.

The spread-select interaction variable suggests a small premium for an additional percent of cattle in a pen expected to grade choice. For each additional 10 percent of cattle expected to grade choice, at the average choice-to-select wholesale boxed beef carcass equivalent price spread, steers received a premium of $0.070/cwt[7] and heifers received a premium of $0.079/cwt. This premium reflects in part the increased value of choice beef to packers.

Expected dressing percentage affected price received for steers, with each 1 percent increase in dressing percentage increasing price by $0.23/cwt. Dressing percentage did not have a statistically significant influence on heifer prices. However, as noted earlier, heifer dressing percentage was highly correlated with the intercept term, thus, multicollinearity may have contributed to this conclusion. Finish uniformity of steers was important. Pens that were not uniform received $0.35/cwt discounts, reflecting increased costs incurred by packers in sorting carcasses. The percentage of yield grade 4 steers had an unexpected positive sign. This may be related to the time period. During May-November 1990, cattle supplies were tight, prices were relatively high, and feedyards remained current with few overfinished cattle marketed. Thus, an increased percentage of yield grade 4 cattle was sometimes associated with a pen's likelihood of grading choice. Also, the percentage of yield grade 4 cattle varied little across pens (Table 2).

The number of cattle purchased by an individual packer on a particular day from a feedyard had a small but significant positive influence on heifer price. For each additional 500 head of cattle purchased from a particular feedyard by a packer during a day, heifer price increased by $0.022/cwt. This price differential presumably reflects the reduction in procurement costs of purchasing large quantities of cattle from a single location.[8]

Days on feed, number of brands, and presence of bulls in the pen did not influence prices (brands were significant and unexpectedly positive for heifers). The presence of heiferettes in pens of heifers reduced average price by $0.26/cwt. Breed variables were generally insignificant with a few exceptions. Pens containing Charolais steers brought slight ($0.16/cwt) discounts and pens containing Simmental brought small ($0.21/cwt) premiums. Pens of steers labeled as "junk" received significant discounts of $2.46/cwt.

Generally, no price differences existed relative to the AMS western Kansas price between feedyards, with some exceptions. Also, PACKER 3 paid $0.11/cwt less for steers and PACKER 2 paid $0.25/cwt less for heifers than PACKER 1. Using July 1979 data, Ward (1982) found no significant packer price differentials in southwestern Kansas; however, packer price differences were present in his June 1989 study (Ward 1992). Packer price differences could reflect cattle quality differences not accounted for in the models.

The day of the week the cattle were sold did not influence heifer prices although it did impact steer prices. Steers sold on Wednesday through Friday received $0.08/cwt to $0.25/cwt price discounts relative to the AMS western Kansas direct price compared to Monday sales. One would suspect that, relative to the local AMS price of which these individual pens may be a part, a day-of-the-week effect should not exist. The presence of a day-of-the-week effect may be a result of a thin market during these days (nearly 80 percent of the pens during the study were sold on Monday or Tuesday), or a systematic price difference late in the week between the feedyards in the survey and the AMS reported prices.[9]

Distance from the feedyard to the packing plant was not significant for steers, but had an unexpected

[7]The price differential for an increase in the percentage of cattle grading choice is the parameter estimate times the change in the percentage of cattle expected to grade select (100 minus the percent expected to grade choice) times the choice-to-select carcass price spread. For example, for steers the premium for a 10 percent increase in the cattle expected to grade choice gives a premium of $0.070/cwt = (-0.00103 SPREAD*SELECT parameter estimate (Table 3) times $6.85/cwt average choice-to-select price spread times -10 percent change in percentage of select grade cattle.

[8]Number of cattle in the pen was also used as a regressor in place of the total number of cattle purchased from the yard. This variable was not significant and was thus not retained.

[9]The day-of-the-week effect in this analysis must be interpreted differently from that found by Ward (1990) and Jones et al. because their dependent variables were transaction prices and their models have the nearby futures prices as regressors. Their models examine local transaction prices relative to the aggregate futures market price, so their day-of-the-week effects reflect basis movements.

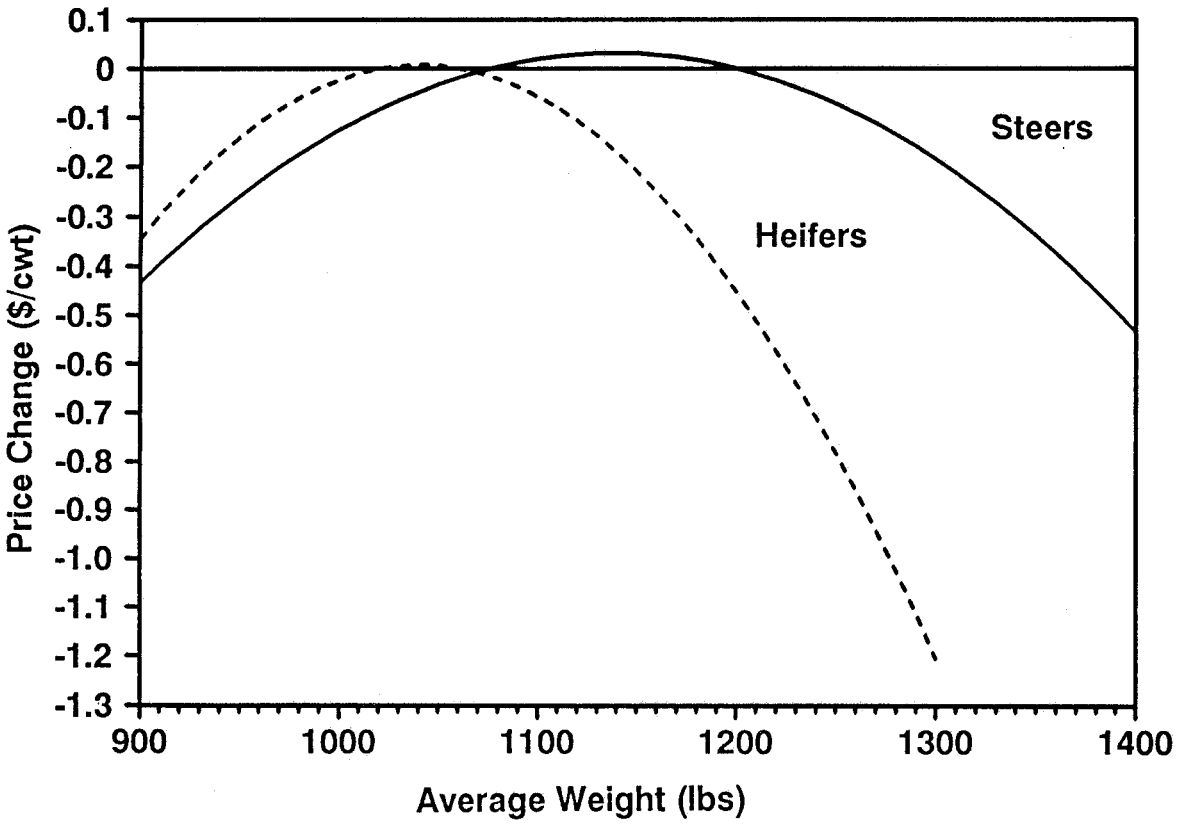


Figure 1. Estimated Price Changes Associated with Varying Cattle Weight Relative to Base Heifer Weight of 1060 lbs and Base Steer Weight of 1200 lbs

positive sign for heifers. Most of the feedyards were within 40 miles of the packing plants, making this impact small. The number of bids received per pen increased steer transaction price relative to the average price in the region. Each additional bid increased price by $0.07/cwt. The number of bids reflects demand for individual pens. Other studies (Ward 1988) also found significant price responses to number of bids. Delivery lag did not affect transaction price. This result contrasts with Ward (1992) and Jones et al., in which a positive relation was found between delivery lag and price. However, our result is not inconsistent with these previous findings. The models in previous studies used transaction prices as the dependent variable and futures prices as an independent variable and, as such, they essentially modeled local basis, whereas the models used here compare individual transaction prices to the local average price.

### Asking Prices

An important aspect of fed cattle pricing is that the feedyard generally initiates the price negotiation by presenting an asking price for each pen. The asking price is the feedyard manager's estimate of the market value of the pen. The importance of the asking price is evidenced by the fact that approximately 65 percent of the pens sold for their asking price. Feedyard managers frequently hold pens until requested prices are met. Interestingly, almost 7 percent of the pens had lower asking prices than transaction prices. This sometimes results when a packer buys several pens from the feedyard at the same time for the same price (some lower and some higher than the feedyard's asking price).

To determine how the transaction price premiums and discounts of various cattle traits were related to asking prices, models explaining asking prices were estimated. Regression models identical to those for transaction prices were estimated for asking prices. The dependent variables were the asking price for pens of steers minus the AMS western Kansas direct steer price and the asking price for heifers minus the AMS western Kansas direct heifer price. The parameter estimates from these models are reported in Table 4.

The asking price models reveal that several of the factors affecting transaction prices can be attributed to asking price differentials. The choice-to-select carcass price spread, percentage select interaction term has a similar magnitude and significance to the transaction models. Discussion regarding this vari-

Table 4. Parameter Estimates of Factors Affecting Asking Price Differentials of Fed Cattle[a]

| Dependent Variable = ASKING PRICE - MARKET PRICE ($/cwt) | | | | |
|---|---|---|---|---|
| | Steers | | Heifers | |
| Independent Variable | Estimate | t-statistic | Estimate | t-statistic |
| Quality Factors | | | | |
| WEIGHT | -0.00633 | -0.79 | -0.0217 | -2.13** |
| WEIGHT SQUARED | $2.5 \cdot 10^{-6}$ | 0.75 | $-1.05 \cdot 10^{-5}$ | -2.22** |
| SPREAD*SELECT | -0.00112 | -4.69** | -0.00144 | -5.23** |
| DRESSING | 0.374 | 2.34** | -0.143 | -0.85 |
| YLDGRADE 4 | 0.065 | 2.58** | -0.002 | -0.07 |
| FINISH UNIF | -0.359 | -2.19** | 0.371 | 1.64 |
| WEIGHT UNIF | 0.039 | 0.85 | 0.008 | 0.15 |
| Quality F-Statistic | 6.48** | | 5.33** | |
| Pen Factors | | | | |
| CATTLE NUMBER | $3.33 \cdot 10^{-5}$ | 0.70 | $4.88 \cdot 10^{-5}$ | 0.82 |
| DAYS ON FEED | 0.0015 | 1.60 | 0.0023 | 2.20** |
| BRANDS | 0.027 | 0.61 | -0.004 | -0.09 |
| BULLS | -0.164 | -1.12 | | |
| HEIFFERETTES | | | -0.264 | -2.00** |
| Pen F-Statistic | 1.15 | | 2.64** | |
| Breeds | | | | |
| ANGUS | -0.011 | -0.10 | 0.102 | 0.71 |
| CHAROLAIS | -0.254 | -2.30** | 0.182 | 1.34 |
| SIMMENTAL | 0.336 | 2.93** | -0.167 | -0.85 |
| LIMOSIN | -0.085 | -0.61 | -0.007 | -0.03 |
| EXOTIC X | 0.044 | 0.42 | 0.078 | 0.59 |
| HEREFORD | 0.146 | 0.63 | 0.346 | 0.87 |
| HERF ANG X | 0.135 | 1.32 | 0.064 | 0.45 |
| HOLSTEIN | 0.141 | 0.65 | | |
| ENG EXOTIC X | -0.073 | -0.64 | 0.127 | 0.87 |
| BRAHMAN | -0.131 | -0.65 | -0.525 | -2.27** |
| MIXED | -0.000 | -0.00 | -0.152 | -0.92 |
| JUNK | -2.371 | -6.08** | -0.400 | -1.92 |
| Breeds F-Statistic | 5.15** | | 1.56 | |
| Feedyard (Default = YARD 1) | | | | |
| YARD 2 | 0.121 | 1.37 | 0.295 | 3.23** |
| YARD 3 | 0.222 | 2.93** | 0.073 | 0.68 |
| YARD 4 | 0.153 | 1.72* | 0.038 | 0.43 |
| YARD 5 | 0.412 | 4.22** | 0.343 | 3.27** |
| YARD 6 | 0.213 | 1.63 | 0.176 | 1.01 |
| YARD 7 | 0.105 | 1.01 | 0.072 | 0.60 |
| YARD 8 | 0.569 | 3.45** | -0.251 | -0.96 |
| YARD 9 | -0.173 | -1.07 | -0.052 | -0.51 |
| YARD 10 | -0.282 | -1.58 | -0.046 | -3.28** |
| Feedyard F-Statistic | 4.56** | | 5.50** | |

Table 4. cont.

| Independent Variable | Steers | | Heifers | |
|---|---|---|---|---|
| | Estimate | t-statistic | Estimate | t-statistic |
| Packer-Buyer (Default = Packer 1) | | | | |
| PACKER 2 | -0.249 | -0.98 | 0.008 | 0.09 |
| PACKER 3 | -0.130 | -1.55 | 0.016 | 0.18 |
| PACKER 4 | -0.070 | -1.10 | -0.013 | -0.12 |
| PACKER 5 | -0.032 | -0.49 | 0.058 | 0.71 |
| Packer-Buyer F-Statistic | 0.87 | | 0.24 | |
| Day-of-the-Week (Default = Monday) | | | | |
| TUESDAY | -0.054 | -0.92 | 0.067 | 1.07 |
| WEDNESDAY | -0.057 | -0.81 | -0.141 | -1.78* |
| THURSDAY | -0.067 | -0.70 | 0.174 | 1.62* |
| FRIDAY | -0.420 | -3.48** | 0.106 | 0.84 |
| Day F-Statistic | 3.03** | | 2.98** | |
| Other Factors | | | | |
| DISTANCE | 0.002 | 1.63 | 0.004 | 3.82** |
| BID NUMBER | 0.003 | 0.10 | 0.087 | 2.44** |
| DELIVERY LAG | -0.020 | -1.80* | -0.027 | -1.99** |
| Other F-Statistic | 1.89 | | 7.18** | |
| INTERCEPT | -19.650 | -1.74** | -2.334 | -0.20 |
| Adj. R-Square | 0.23 | | 0.20 | |
| RMSE ($/cwt) | 0.58 | | 0.54 | |
| Equation F | 6.58** | | 4.39** | |
| Observations | 810 | | 566 | |

[a]Single and double asterisks indicate statistically different from zero at the 0.10 and 0.05 levels, respectively.

able is deferred to the next section. Dressing percentage, finish uniformity, and percentage of yield grade 4 cattle have similar effects across transaction and asking price models. The presence of heiferettes in pens of heifers reduced asking prices by amounts similar to transaction prices. The discount for Charolais and the premium for Simmental steers were similar in the asking price model and in the transaction price model. The discount for steers sold on Friday was also similar as feedyards reduced asking prices relative to the western Kansas AMS price. The number of bids received had a positive impact on heifer asking prices but no impact on steer asking prices.

Several factors important in transaction price differentials did not impact asking prices. The average weight of steers did not influence asking prices, as feedyard managers were less concerned with large carcasses than were packers. The number of cattle purchased by the packer from the feedyard on a given day did not influence asking prices as expected because the feedyard manager presents the asking prices prior to knowing how many pens any packer may purchase that day. Overall, comparison of the asking and transaction price models indicates that, aside from the few factors that the feedyard manager does not know prior to the price negotiation, the feedyard's asking price was consistent with the transaction price. This means that feedyards generally received what they asked for the cattle. Construed another way, feedyard managers were aware of the market and set asking prices consistent with current conditions.

### Percent Choice Impact

Evaluating market performance requires a comparison of the premiums and discounts paid by packers for quality factors with the value of these factors

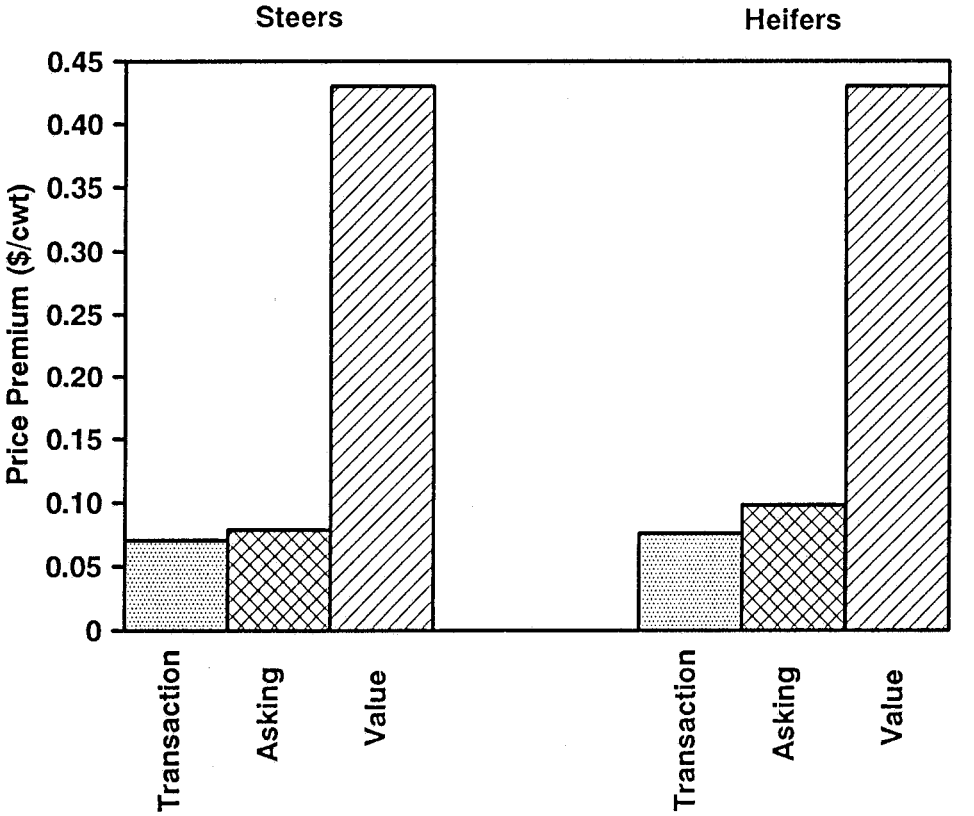


Figure 2. Estimated Transaction Price, Asking Price, and Packer Value Differentials of a 10 Percent Increase in the Number of Cattle Grading Choice, at Average Choice and Select Boxed Beef Carcass Prices.

to the packer. Because demand for fed cattle is derived from the demand for wholesale beef, wholesale beef prices can be used to evaluate end-use value. The most straightforward comparison is between the farm value of the percentage of cattle expected to grade choice and the estimated wholesale beef value. Wholesale value differentials between choice and select grade beef were estimated using USDA boxed beef cutout carcass equivalent prices.

Figure 2 shows the impact on transaction price, asking price, and packer value of a 10 percent increase in the number of cattle in a pen expected to grade choice with the average price spread between choice and select beef during the study period. The pen-weighted average prices for steers were $121.71/cwt for choice grade 700 to 850 lb boxed beef carcass equivalents and $114.86/cwt for 700 to 850 lb select beef.[10] For heifers the pen-weighted choice grade price was $121.50/cwt and the select grade price was $114.70/cwt. These weighted-average carcass prices and the parameter estimates for the interaction terms for the choice-select price spread times the percentage of select grade cattle in the pen (Tables 3 and 4), were used to calculate the value of a 10 percent increase in the estimated number of animals expected to grade choice.

For each 10 percent increase in the number of cattle expected to grade choice, the transaction price increased by $0.070/cwt for steers and by $0.079/cwt for heifers (Figure 2). Similarly, the asking prices for steers and heifers increased by $0.076/cwt and $0.098/cwt, respectively, for a 10 percent increase in the number of cattle expected to grade choice. Using the average expected dressing percentages of 63.4 (lbs carcass per cwt live weight) for steers and 63.3 for heifers (Table 2), a 10 percent increase in the number of cattle in a pen grading choice would increase the packer's wholesale value by approximately $0.43/cwt live weight (e.g., for steers 63.4 dressing percentage times $6.85/cwt choice-to-select price spread times 10 percent). Both the asking prices and transaction prices of fed cattle reflected less than 25 percent of the estimated

[10]Pen-weighted average boxed beef prices are the means of the daily boxed beef prices over the study period weighted by the number of pens sold each day.

increase in packer value associated with an increase in the percentage of cattle grading choice. Further, although the asking prices had slightly higher premiums for increases in choice cattle, they were similar to the transaction price premiums. Feedyards essentially got what they asked for in terms of price adjustments for grade differences. The magnitudes of the steer and heifer premiums for choice cattle are consistent with those estimated by Ward using 1989 data from southwest Kansas and southeast Colorado.[11]

Why fed cattle price differentials associated with grade changes did not reflect more of the wholesale value differences is unclear. Attempts to minimize transaction costs may be a factor. Marketing several pens of cattle at once may be a necessity for feedyard managers just as purchasing several pens at once may be cost-effective for packers. Monitoring current market prices to establish general asking prices and bids may be more important to both parties than determining individual pen value differentials. Negotiation and inspection costs to ultimately determine each pen's grade value differential may be excessive. Finally, accurate carcass quality determination from live cattle traits is difficult, and errors in this appraisal would likely reduce the estimated price impacts of changing quality. To test this would require actual quality grade data to compare with the estimates made by the analyst. Such data were not available.

## CONCLUSIONS

This study investigated the factors affecting transaction price differentials for fed steers and heifers in southwestern Kansas during May through November 1990. Transaction prices were significantly affected by average weight, the percentage of cattle expected to grade choice, the select-to-choice carcass price spread, finish uniformity, breed, the number of head purchased from the feedyard by a single buyer during the day, the packer, the feedyard, the day of the week the cattle were sold, and the number of bids.

Feedyards often received what they asked for cattle. Sixty-five percent of the pens were sold for their asking price. Much of what affects transaction prices similarly explained asking prices. A few exceptions are worth noting. Factors that feedyards do not concern themselves with, such as average weight (steers only), or what they do not know at the initiation of the price negotiation, such as number of cattle purchased by a single packer on a given day, did not influence asking price. Whether feedyard managers actually influence price through setting asking prices or whether they are just good at approximating what the packer will bid for a pen is not clear. The feedyard manager could be expected to inflate the asking price relative to current market prices in attempts to capture more of the packer's reservation price. However, this likely would leave the feedyard with market-ready cattle stranded on the show-list late in the week. In addition, conversations with feedyard managers indicated that if they asked what were considered "excessively" high prices, packers often would not make counter offers. Nonetheless, it is important that the transaction price often equals the asking price.

Both transaction prices and asking prices adjusted to the percentage of cattle expected to grade choice. Thus, this grade factor affected fed cattle prices. However, both asking and purchase prices only reflected about 25 percent of the estimated wholesale value differentials. Perhaps marginal transaction costs of time spent evaluating pen quality exceeds added revenues. Additionally, because carcass quality grade is difficult to accurately judge on live animals, any errors in this appraisal could also reduce the estimated price impact. The collector of the data used here generally spent 10 minutes examining the quality associated with each pen (from inside the pen). This may be more time than typical buyers or yard managers feel they can afford.

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[11]The price impact of a 10 percent increase in the number of cattle grading choice was also tested using models with the dependent variables specified in levels as opposed to differences from the local cash price and having futures prices as a regressor similar to Ward's (1990) models. The estimated impacts were essentially the same as those reported.

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