Effects of Producer-Provided Descriptions of Feeder Cattle and Conditions of Sale on Prices on a Tennessee Video Board Sale

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Abstract

The hedonic model was used to estimate the effects on feeder cattle price of various types of producer-provided information about the cattle and various conditions of sale specified by the seller in the sale catalog for a Tennessee video board sale. Data consisted of 3378 observations over the 1996-2008 period. OLS regression results indicate that several variables that have appeared significant in other studies were confirmed. In addition, producer specifications regarding weighing conditions, allowance for pencil shrink, size of the weight/price slide, and feed/water availability where cattle will be penned before weighing were also important. The effect of the weight/price slide depended upon weight of the cattle. This study failed to find that producer statements regarding electronic identification (EID), Process Verified Program (PVP), and health programs to which cattle had been subjected had significant effects on sale price.

Keywords: feeder cattle prices, cattle characteristics, conditions of sale, hedonic model.

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Few decisions are more important to feeder cattle producers than how to market their product. Research, professional observation, and conventional logic have confirmed that feeder animal characteristics such as gender, weight, breed, frame size, muscle score, and number and consistency of animals in the lot generally influence price per hundredweight (Buccola 1980, Sullivan and Linton 1981, Faminow and Gum 1986, Schroeder et al. 1988, Turner et al. 1991, McLemore et al. 1993, and Barham and Troxel 2007).

The advent of video board sales offers the opportunity for producers who sell larger groups of cattle to "merchandise" them by providing additional information about the cattle such as health and nutrition programs and various certifications, and by specifying conditions of sale such as weight/price slide, pencil shrink, and weighing conditions. Provision of this type of information is an attempt by the seller to differentiate his/her product to better match the needs of buyers and, thus obtain a higher price. This additional information provided by sellers, to the extent that it is accurate, credible, and important to buyers, should reduce asymmetry of information and improve overall efficiency of the market (Chymis et al. 2007). Information about cattle characteristics and conditions of sale are typically contained in a sale catalog provided to potential buyers electronically, along with a video of the cattle, in advance of the actual day of sale. Decisions about information included in the catalog are made by the seller in conjunction with the market agency.

The objective of this research was to estimate the effects on sale price of various types of producer-provided information about the cattle and various conditions of sale specified by the

producer in the video board sale catalog. Results should ultimately be useful to producers and market agencies in decisions about what information and conditions to specify.

Methods and Data

This research used the hedonic framework which views the value of a good as a function of the amounts of various characteristics embodied in the good and the inherent value of each characteristic to buyers. Origin of this concept is usually attributed to Lancaster (1966), and it was later extended by Rosen (1974). Ladd and Martin (1976) applied the methodology to inputs in agricultural production. Application of the concept to feeder cattle prices is well documented, usually involving OLS regression to estimate parameters of an equation expressing sale price as a function of animal characteristics and other factors that affect value of the lot (Sullivan and Linton 1981, Faminow and Gum 1986, Schroeder et al. 1988, Turner et al. 1991). Schroeder et al. (1988) expressed the relationship as follows (with some modification of subscripts):

$$(1) \qquad Price_{it} = \sum_{k} V_{kt} C_{ik} + \sum_{h} R_{ht} M_{ht}$$

where $Price_{it}$ refers to the sale price of lot of cattle i in time t, V_{kt} refers to value of animal characteristic k, C_{ik} refers to the amount of characteristic k in lot i, R_{ht} is the price effect of exogenous market force h, and M_{ht} is the level of market force h in time t. Estimated parameters V_{kt} and R_{ht} reflect the implicit values of each characteristic and market force, respectively, at the time of sale.

This basic model was modified by adding a term to represent conditions of sale specified for the i^{th} lot of cattle, $W_{jt}S_{ij}$. S_{ij} represents the level of the j^{th} condition of sale specified for the i^{th} lot of cattle. W_{jt} represents the market value of the j^{th} condition of sale in time t. The model then becomes:

$$(2) \qquad Price_{it} = \sum_{k} V_{kt} C_{ik} + \sum_{j} W_{jt} S_{ij} + \sum_{h} R_{ht} M_{ht} .$$

Data

To empirically estimate equation (2), data on sale prices and information specified on individual lots of cattle were taken from sale catalogs for the Lower Middle Tennessee Cattle Association Video Board Sale managed by Tennessee Livestock Producers, Inc. Sales are currently held monthly except for February and July. Data were available for the 1996 to 2008 period for a total of 3378 useable observations on individual lots of cattle sold. Most of the lots were from Tennessee although cattle located in surrounding states were well-represented (1086 lots). The average number of head per lot was 64 and the average weight was 739 lbs per head resulting in an average lot weight of 47,296 lbs. Average weights for lots ranged from 375 to 1025 lbs. Sixty-one percent of the animals were steers and 62 percent were black or black baldy.

To remove the effects of changes in the general level of cattle prices over the 13-year period, the sale price of each lot was indexed by dividing it by the mean sale price for that year. Indexed sale price was regressed on 47 independent variables using OLS (SAS Reg procedure). Estimated regression coefficients should be interpreted as percentage effects because the dependent variable was an index.

Discussion of Variables

Quantitative representation of the variables in the model and the hypothesized signs are presented in Table 1. Consistent with previous studies mentioned above, regressor variables included gender, weight, frame size, muscle score, lot size and consistency, breed, flesh score, blemishes such as horns and eye problems, and corn and live cattle futures prices. In addition, regressors were included to represent health and nutrition programs, electronic identification (EID), process verification (PVP), beef quality assurance program (BQA), allowance for pencil

shrink, weight/price slide, weighing conditions, when and how cattle will be gathered, pen conditions where cattle will be held before weighing, distance from the location of cattle to a typical feedlot destination, and appropriate interactions as indicated in Table 1.

Regressors in the first list in the previous paragraph are well-established in the literature as having important effects on price. In this study, estimated average weight for each lot was converted to its reciprocal to allow for nonlinearity of the weight/price relationship (Faminow and Gum 1986). Thus, the expected sign on the estimated weight parameter is positive. The frame size/muscling variables were entered as proportion variables with the Medium and Large frame #1 Muscling category omitted causing the expected signs for the other categories to be negative. Lot size was transformed to a natural logarithm to allow for nonlinearity in the lot-size/price relationship (Faminow and Gum 1986). Breeds (except for Brahman) were represented by a set of five proportion variables with the black and black baldy category omitted causing the expected signs of the other categories to be negative. Brahman influence was represented as proportion Brahman breeding (proportion "ear," e.g. 1/8) times the percent of animals showing Brahman breeding. For example, if 50 percent of the animals showed 1/8 "ear," the variable would have a value of 0.0625.

The variables in the second list above may require explanation. Animals that have already been implanted may have lower potential for additional rapid growth and may be discounted by buyers. Cattle that have been subjected to a specific standardized health program should be better able to withstand the stress of relocation and be of greater value to buyers. Cattle that are "home-raised" may have less ability to withstand stress and exposure to new environments and may be discounted by buyers. Use of Beef Quality Assurance practices by the seller should provide additional value to the buyer as should Process Verified Program

certification. Presence of registered Electronic Identification tags should provide additional value for the buyer because the finished cattle will have more flexibility for the export trade.

Weighing conditions will affect the pay-weight for the buyer. Cattle weighed on the farm will be heavier than those hauled some distance before weighing because of loss of body fluids and excrement during handling and hauling. Cattle weighed on the truck after a haul will show a higher weight because of excrement remaining on the truck. From the buyer's perspective the ideal weighing condition is for cattle to be loaded on a truck, hauled some distance, unloaded and weighed on the ground. The latter was the most common weighing condition specified by sellers in the data (70 percent). Weighing conditions were represented by two dummy variables, one representing on-farm weighing and the other representing on-truck weighing after a haul. Both dummy variables were hypothesized to have negative signs compared to the omitted category representing weighing on the ground after a haul. The number of miles hauled before weighing was also included as a continuous variable with a positive expected sign.

Pencil shrink is a percentage by which pay-weight is reduced to allow for the shrinkage that will occur during handling and transportation. Other things equal, a larger pencil shrink will reduce the pay-weight for the buyer and should encourage the buyer to offer a higher price. The level of pencil shrink specified is usually coordinated with weighing conditions specified. In the data, pencil shrink ranged from 0 to 5 percent with a mean of 1 percent.

A weight/price slide is usually specified in the sale catalog as a way to reassure buyers that average actual pay-weight will be near the estimated average weight (Brorsen et al. 2001). If actual average pay-weight exceeds estimated weight by more than a tolerance (usually 10 lbs), sale price is reduced by a specified number of cents per pound above tolerance weight.

Weight/price slides specified in the data ranged from 0 to 10 cents and averaged 4 cents per pound.

If the seller specifies that the buyer must take the heaviest cattle from a larger group to make a 50,000-pound load, the buyer will tend to discount the sale price of the cattle due to the prospect of having to accept heavier cattle. If the buyer is allowed to choose any cattle to make a load from a larger group, he/she should be willing to pay a higher price. The "heavy end" and "buyer's choice" specifications were represented by dummy variables.

When cattle are gathered and penned affects the level of stress and shrink they undergo in the exchange process. Sellers may provide information on how cattle will be gathered by indicating that they will be gathered the morning of weighing or the night before weighing, or sellers may omit any reference to when they will be gathered. Two dummy variables were used to represent when cattle will be gathered: gathered the morning of weighing and gathered the night before. The first was expected to have a negative sign and the second a positive sign compared to the omitted category of "no information."

How cattle are driven when gathered also affects stress and shrink. Cattle may be driven on foot, on horseback, or by all-terrain vehicle. The seller may also provide no information. Three dummy variables were used to represent the three alternative specifications compared to "no information." On foot was expected to show a negative sign consistent with a lower level of shrink, while horseback and ATV were expected to have positive signs consistent with higher levels of shrink.

Feed and water conditions in the pen where cattle will be kept before weighing will also affect pay-weight. Sellers may specify that the pen will have no feed and water or that feed and water will be available, or they may provide no information. Three dummy variables were used

to represent dry lot, hay and water, and feed and water. The first was expected to have a positive sign while the latter two were expected to have negative signs compared to "no information."

Location of the cattle sold through the video board sale varied substantially within Tennessee and among surrounding states. It was hypothesized that distance between the location of the cattle and their final destination would affect the price buyers were willing to pay. However, destinations of cattle sold were not available in the data. To represent the typical feedlot destination, Garden City, KS, was chosen. Distance between current location and Garden City ranged from 97 to 1420 miles with a mean of 1010. The expected sign was negative.

Interaction variables were included to account for the differential effects of weight on price between the spring and fall seasons with the signs hypothesized to be negative for spring and positive for fall. Winter and summer were the omitted category. Interaction variables were also included to account for the effects of corn futures prices and live cattle futures prices on the relationship between weight and sale price. A positive sign was expected for corn futures times weight and a negative sign was expected for live cattle futures times weight (Dhuyvetter and Schroeder 1999).

An interaction effect was also expected between the weight/price slide and animal weight because the slide is less important for heavier weight lots of cattle. That is, the typical market discount per pound due to weight decreases as weight increases. The hypothesized sign was negative.

Results and Discussion

Regression results showed an R^2 of 0.47, an $\overline{R}^2$ of 0.46, and an overall F value of 62.63. Estimated parameters, standard errors, and variance inflation factors are shown in Table 2. Analysis of the results to detect multicollinearity indicated that problems existed only in cases

where the variables were constructed to represent interactions. Interactions involving weight and other variables accounted for all of the variance inflation factors that exceeded 10. In all cases except one (reciprocal of weight) where VIF exceeded 10, the parameter estimate was statistically significant at the $\alpha = 0.01$ level.

Variables that were statistically significant at the $\alpha = 0.05$ level or better and carried the hypothesized sign included gender, corn and live cattle futures prices, lot size, weight range, the three frame/muscling categories, flesh, three of the breed variables, weighing condition (GF), pencil shrink, weight/price slide, heavy end, mixed lot, lot-dry, the weight/spring and weight/fall interactions, the weight/corn futures and weight/live cattle futures interactions, and the weight/weight slide interaction. The lack of statistical significance of the reciprocal of weight is probably explained by the influence of the significant weight interaction variables. While neither of the dummy variables representing whether cattle were gathered the night before or the morning of weighing were significant, an F test on the joint significance of the two variables showed that, taken together, the pair was significant at the $\alpha = 0.01$ level. Gathering the night before weighing was preferable to buyers.

Other variables of particular interest that showed non-significant effects at the $\alpha = 0.05$ level included Electronic Identification (EID) and Process Verified Program (PVP). Both programs have been promoted to producers as having positive effects on value to buyers. There was no evidence from this analysis that this contention was valid. The health program variable also was not statistically significant ($\alpha = 0.05$), which seems to contradict conventional wisdom (Lawrence and Yeboah 2002).

The single variable that was statistically significant at the $\alpha = 0.05$ level or better and carried a counterintuitive sign was Beef Quality Assurance (BQA). The negative coefficient

indicates that producers who claimed BQA received a 1.1 percent lower sale price on average. No logical explanation presents itself. Six other variable coefficients that showed counterintuitive signs were not significantly different from 0 at the $\alpha = 0.05$ level.

While the positive effect of pencil shrink on sale price is indicated by the highly significant coefficient, the magnitude (0.63899) of the coefficient appears small. The implication is that for each 1 percent increase in allowance for pencil shrink, a 0.64 percent increase in sale price occurs on average. This means that on average the reduction in pay-weight exceeds the associated increase in price, resulting in lower revenue.

Weight/price slide also had a positive significant effect ($\alpha = 0.01$). However, a negative significant ($\alpha = 0.01$) interaction term between weight and weight/price slide tends to offset the positive impact of higher slides on price. For example, at mean weight in the data set (739 lbs), a 1 cent per pound increase in the weight/price slide will result in a 1.3 percent decrease in sale price or ((739)(0.01)(-0.00992)) + ((0.01)(6.03580)) = -0.01294. However, at 500 lbs, the net effect is a 1.1 percent increase in sale price, while at 1000 lbs, the net effect is a 3.9 percent decrease in sale price. These results seem to indicate that buyers are positively influenced by increased weight/price slides only for lighter weight cattle. This may be due to the fact that the effect of increased weight on price per pound decreases as weight increases.

Conclusions

Some of the results of this study confirm conclusions of other researchers. Gender, corn and live cattle futures, lot size and consistency, frame and muscling, fleshiness, breed, and weight were important determinants of feeder cattle sale price per hundredweight on a Tennessee video board sale. The effects of weight on price depend on season and corn and live cattle futures prices. Other variables that have not been explored extensively by other researchers

including producer specifications regarding weighing conditions, allowance for pencil shrink, size of the weight/price slide, and feed/water conditions where cattle will be penned before weighing were also important. The effect of the size of the weight/price slide depended upon the weight of the cattle. This study failed to find that producer statements regarding electronic identification (EID), Process Verified Program (PVP), and health programs to which cattle had been subjected had significant effects on sale price. Producer statements that the Beef Quality Assurance program had been used showed a significant counterintuitive negative effect on sale price.

Table 1. Name, Description, and Hypothesized Sign for Variables Included in the Regression Model.

Variable	Description	Hypothesized sign
Sale price index	Lot sale price divided by mean annual lot sale price ($/cwt) - dependent variable	n.a.
Gender	1 if steer, 0 if heifer	+
Weight	Reciprocal of estimated mean weight of animals in lot (lbs)	+
Corn futures	Price of the nearby corn futures contract ($/bu)	-
Cattle Futures	Price of the live cattle futures contract 150 days out ($/cwt)	+
Lot size	Natural logarithm of the number of head in the lot	+
Weight range	Range in estimated weight of individual animals (lbs)	-
Frame/Muscling (ML2)	Proportion of animals in lot with Medium and Large frames and #2 muscling	-
Frame/Muscling (S1)	Proportion of animals in lot with Small frames and #1 muscling	-
Frame/Muscling (ML3)	Proportion of animals in lot with Medium and Large frames and #3 muscling	-
Flesh	Mean flesh score of animals in the lot (1 to 10)	-
Breed (RRB)	Proportion of animals in the lot that are Red Angus or Red Angus baldy	-
Breed (CHX)	Proportion of animals in the lot that are Charolais or Charolais cross	-
Breed (H)	Proportion of animals in the lot that are Hereford	-
Breed (SMX)	Proportion of animals in the lot that are Simmental or Simmental cross	-
Breed (Oth)	Proportion of animals in the lot that are breeds other than those specified	-
Breed (BRA)	Proportion “ear” (Brahman breeding) multiplied times the proportion of animals showing “ear”	-

Table 1 continued. Name, Description, and Hypothesized Sign for Variables Included in the Regression Model.

Variable	Description	Hypothesized sign
Supplement	1 if supplement was fed to animals, 0 otherwise	-
Implanted	1 if animals were implanted, 0 otherwise	-
Beef Quality Assurance	1 if Beef Quality Assurance management practices were used, 0 otherwise	+
Electronic Identification	1 if electronic animal identification tags are visible, 0 otherwise	+
Home-raised	1 if animals were born on the farm, 0 otherwise	+
Process Verified Program	1 if Process Verified Program was used, 0 otherwise	+
Horns	Proportion of the lot with horns	-
Weighing condition (GF)	1 if cattle will be weighed on the ground at the farm, 0 otherwise	-
Weighing condition (T)	1 if cattle will be weighed on the truck after a haul, 0 otherwise	-
Haul	Miles animals will be hauled before being weighed	+
Pencil shrink	Percent pencil shrink allowed (decimal)	+
Weight/price slide	Price reduction allowed if actual weight of animals is above estimated weight by more than tolerance (cents/lb)	+
Heavy end	1 if specified that buyers must take heaviest animals from a larger group to make a load (50,000 lbs), 0 otherwise	-
Pinkeye	Proportion of the animals showing evidence of pinkeye	-
Mixed lot	1 if a lot contains both steers and heifers, 0 otherwise	-

Table 1 continued. Name, Description, and Hypothesized Sign for Variables Included in the Regression Model.

Variable	Description	Hypothesized sign
Gathered morning of weighing	1 if cattle will be gathered the morning of weighing, 0 otherwise	-
Gathered night before weighing	1 if cattle will be gathered the night before weighing, 0 otherwise	+
Lot - dry	1 if cattle will be held in dry lot before weighing, 0 otherwise	+
Lot - hay/water	1 if cattle will be held in lot with hay and water before weighing, 0 otherwise	-
Lot - feed/water	1 if cattle will be held in lot with feed and water before weighing, 0 otherwise	-
Driven on foot	1 if cattle will be driven on foot, 0 otherwise	-
Driven on horseback	1 if cattle will be driven on horseback, 0 otherwise	+
Driven on ATV	1 if cattle will be driven on all-terrain vehicle, 0 otherwise	+
Buyer's choice	1 if buyer may choose load (50,000 lbs) from a larger group, 0 otherwise	+
Health program	1 if a specific health program was used by the producer, 0 otherwise	+
Distance	Miles cattle are located from Garden City, KS	-
Weight/spring interaction	Estimated weight (lbs) times 1 if February through May, 0 otherwise	-
Weight/fall interaction	Estimated weight (lbs) times 1 if August through November, 0 otherwise	+
Weight/corn futures interaction	Estimated weight (lbs) times the corn futures price ($/bu)	+

Table 1 continued. Name, Description, and Hypothesized Sign for Variables Included in the Regression Model.

Variable	Description	Hypothesized sign
Weight/cattle futures interaction	Estimated weight (lbs) times the live cattle futures price ($/cwt)	-
Weight/weight slide interaction	Estimated weight (lbs) multiplied by the weight/price slide (cents/lb)	-

Table 2. OLS Regression Results: Parameter Estimates, Standard Errors, and Variance Inflation Factors

Variable	Parameter Estimate	Standard Error	Variance Inflation Factor
Intercept	0.87027**	0.03839	0
Gender	0.07335**	0.00264	1.47123
Weight (reciprocal)	2.96823	20.39788	18.39350
Corn futures	-0.11109**	0.01185	108.29275
Live cattle futures	0.00626**	0.00069	61.94561
Lot size (ln)	0.01479**	0.00266	2.02122
Weight range	-0.000085**	0.000025	1.77828
Frame/Muscling (ML2)	-0.07243**	0.01366	1.84357
Frame/Muscling (S1)	-0.17543**	0.04035	1.23180
Frame/Muscling (ML3)	-0.13784*	0.05687	1.25499
Flesh	-0.01351**	0.00240	1.56858
Breed (RRB)	-0.02172*	0.00844	1.25340
Breed (CHX)	-0.01627**	0.00466	1.25955
Breed (H)	-0.01495	0.01691	1.11109
Breed (SMX)	-0.02892*	0.01473	1.09542
Breed (Oth)	-0.03027	0.03047	1.04878
Breed (BRA)	-0.00673	0.03910	1.36468
Supplement	-0.00523	0.00297	1.27713
Implanted	0.00222	0.00236	1.22252
Beef Quality Assurance	-0.01113**	0.00335	1.47417
Electronic Identification	0.00632	0.01003	1.40313

Table 2 continued. OLS Regression Results: Parameter Estimates, Standard Errors, and Variance Inflation Factors

Variable	Parameter Estimate	Standard Error	Variance Inflation Factor
Home-raised	0.00170	0.00312	2.07227
Process Verified Program	-0.01447	0.00875	1.49260
Horns	0.00915	0.02886	1.13552
Weighing condition (GF)	-0.01080*	0.00511	1.58760
Weighing condition (T)	-0.00494	0.00388	2.34441
Haul	0.00014	0.00011	1.69482
Pencil shrink	0.63899**	0.22517	3.13833
Weight/price slide	6.03580**	0.52667	66.54787
Heavy end	-0.00903**	0.00295	1.66271
Pinkeye	-0.01130	0.04423	1.03018
Mixed lot	-0.01326**	0.00400	1.54956
Gathered morning of weighing	-0.01527	0.01064	6.46894
Gathered night before weighing	0.00630	0.01186	6.75007
Lot - dry	0.00515*	0.00233	1.16862
Lot - hay/water	-0.00644	0.00660	1.50422
Lot - feed/water	0.02404	0.03186	1.06444
Driven on foot	-0.00819	0.01157	1.38818
Driven on horseback	-0.00894	0.01213	1.07232
Driven on ATV	0.03830	0.03188	1.06627
Buyer's choice	-0.00212	0.00472	1.13457

Table 2 continued. OLS Regression Results: Parameter Estimates, Standard Errors, and Variance Inflation Factors

Variable	Parameter Estimate	Standard Error	Variance Inflation Factor
Health program	0.00479	0.00634	1.33031
Distance	-0.000014	0.0000103	2.02421
Weight/spring interaction	-0.000033**	0.0000043	1.62023
Weight/fall interaction	0.000032**	0.0000037	1.71771
Weight/corn futures interaction	0.000121**	0.0000155	137.52065
Weight/cattle futures interaction	-0.0000041**	0.0000009	137.02812
Weight/weight slide interaction	-0.00992**	0.000778	62.38320

* Indicates that the estimated coefficient is statistically significantly different from 0 at the $\alpha = 0.05$ level.

** Indicates that the estimated coefficient is statistically significantly different from 0 at the $\alpha = 0.01$ level.

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