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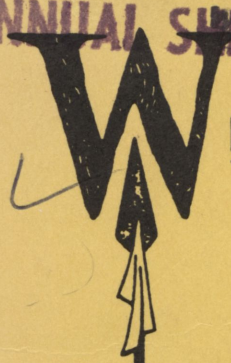
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PRICE VARIABILITY OF FEEDER CATTLE, SLAUGHTER COWS
AND SLAUGHTER BULLS AT SOUTH DAKOTA LIVESTOCK AUCTIONS
Richard Shane and Larry Janssen*

PRICING VARIABILITY OF FEEDER CATTLE, SLAUGHTER COWS
AND SLAUGHTER BULLS AT SOUTH DAKOTA LIVESTOCK AUCTIONS

Abstract: Auction market pricing of feeder cattle and calves, slaughter cows and slaughter bulls are examined for seven South Dakota auction locations. Pricing factors examined include auction location, time, lot size, weight, sex and breed. Feeder cattle pricing models ($R^2=0.73$) performed better than pricing models for slaughter cows or bulls.

Introduction

Livestock prices are established through various market channels, such as terminal markets and auction markets. Auction sales account for 74% of all cattle purchases and 64% of all cattle sales by South Dakota producers (1).

The major purpose of this research was to determine which factors, controllable or noncontrollable, have a significant impact on cattle prices established at auction market outlets in South Dakota. Factors to be tested include location, time, sex, weight, breed and lot size.

Previous studies have emphasized feeder cattle pricing at auction markets located in Kansas, Arizona, Tennessee and West Virginia (2,3,4,5,6,8). This study examines auction market pricing of feeder cattle, slaughter cull cows and slaughter cull bulls at seven South Dakota auction market locations. Auction market pricing of cull slaughter cattle has not been reported in most previous studies.

Feeder cattle pricing studies cited above have emphasized the importance of weight, sex and breed as animal characteristics that have a significant impact on price per hundredweight (cwt). Depending on the time period examined, heifers of comparable weight receive \$5 - 7\$ less per cwt. (6% - 10% lower price) than steers. Heavier weight classes received price discounts relative to lighter weight classes. Some studies (4) have found that the sex*weight interaction effect is statistically significant, while other studies have not. Earlier studies in the 1970's (3,5) indicated that black - white face feeders commanded price premiums relative to Herefords, while more recent studies (2,4,6) indicate that exotic breeds and Charolais feeders also command price premiums over Herefords.

Other animal characteristics examined in selected studies include horns, fill, grade, frame and muscling characteristics. Amount of fill and frame - muscling characteristics were usually significant variables. Shrunken animals (less fill) commanded higher prices than medium fill or full fill cattle (4,5,8). Heavier muscled and large frame feeder cattle commanded price premiums over medium muscled and small - medium frame feeder cattle in the two recent Kansas auction market studies (4,8).

Lot size and auction location are important marketing characteristics that are related to price/cwt. In general, the above studies showed that price per cwt increased as lot sizes increased from one head to 40 - 60 head with the strongest price increases for lot sizes from one to ten head. Price differentials by auction location reflected spatial differences in livestock market demands and possible differences in auction market size and "reputation".

Time of sale (season) and order of sale (order of lots sold on a given sale day) are also important marketing characteristics that affect price. Most studies have examined auction market prices over several weeks during a specific season and have found price variation across the time period examined. Cattle lots sold early or late on sale day generally received lower prices per hundredweight than cattle lots sold in the middle time periods.

South Dakota Cattle Auction Pricing Study

The South Dakota cattle auction pricing study presented in this report contains most of the major variables found in other studies. This study includes price analysis of feeder cattle, slaughter cull cow and slaughter cull bull sales and represents an extension of cattle types examined in auction market pricing studies. Data on sale prices and selected characteristics of animals sold were obtained for each lot of feeder cattle, slaughter cows and slaughter bulls sold at seven auction market locations in the second week of the months of January, May, August and November 1981. The auctions were located in the South Dakota cities of Watertown, Huron, Yankton, Kimball, Belle Fourche, St. Onge and Sturgis. These auctions are representative of relatively large volume and medium volume cattle auctions in South Dakota. During the study period, calf sales were most important in the western South Dakota auction locations of Belle Fourche and Sturgis, while feeder steer and heifer sales were more prominent in the other auctions. Slaughter cow and bull sales exceeded 13% of cattle sale value at auctions located in Sturgis, Belle Fourche, and Watertown.

Data collected from files at each auction location included cattle type and sex, weight, breed, lot size, price/cwt and time of sale. The Statistical Analysis (SAS, 1982) multiple regression procedures (REG and GLM) were used to estimate the coefficients and provide the summary statistics. The GLM procedure was used to obtain the type III partial sums of squares and resultant F-test which allows for testing the significance of adding subsets of categorical (dummy) variables within each model.

Two alternative statistical models were developed for feeder cattle. In each case, price per hundredweight was the dependent variable and the unit of observation was one lot of cattle. In the first model (dummy variable model), all sets of explanatory variables are specified as categorical variables. Explanatory variable sets include month of sale, auction location, weight class by sex, lot size and breed. In the second model, weight and lot size are specified as continuous variables, while remaining sets of explanatory variables remain specified as categorical variables.

Statistical models developed for slaughter cows and for slaughter bulls included month of sale, auction location, weight class, lot size and breed as categorical variables to explain variation in price per hundredweight per lot sold. Additional model specifications were examined for each type of cattle; however, the models reported are the simplest and contain the essential findings.

Mean values of the dependent variable (price/cwt) and selected independent variables are reported by type of cattle sold in Table 1. The mean values of categorical variables (month, lot size, breed, sex) can be interpreted as the proportion of lots sold that are in a specific category.

Table 1. Mean Values of Selected Variables in South Dakota Cattle Auction Price Models

Variable	Model Type ^a	Feeder Calves and Cattle	Slaughter Cows	Slaughter Bulls
	Tables Referenced:	2-3	4	4
<u>Dependent</u> Price/cwt	Both	\$63.75	\$43.60	\$54.17
<u>Independent</u>				
Month: January	Both	0.274	0.212	0.104
May	Both	0.233	0.402	0.297
August	Both	0.214	0.295	0.523
October	Both	0.279* ^e	0.091*	0.076*
Lot Size				
1	D	0.087*	0.711*	0.878*
2-4	D	0.163	0.189	0.099
5-9	D	0.196	0.060	0.023 ^h
10-19	D	0.224	0.040 ^h	---
20-29	D	0.108	---	---
30-49	D	0.113	---	---
50+	D	0.109	---	---
Lot Size: Nbr ^c	CD	0.203	0.800	0.921
Breed: ^d				
Hereford	Both	0.306*	0.453*	0.435*
Dairy	Both	0.060	0.176	0.061
Angus	Both	0.117	0.147	0.250
Bwf	Both	0.102	0.049	0.080
Exotic	Both	0.043	0.051	0.070
Xbrd	Both	0.372	0.124	0.104
Sex:				
Steer	CD	0.642*	---	---
Heifer	CD	0.358	---	---
Weight: Cwt	CD	6.02	11.64	16.07
Number of Lots Sold		677	566	212

^aCD = continuous-dummy variable model; D = dummy variable model; Both - CD and D models

^bType of Cattle:

1. Feeder calves and cattle are steers and heifers, 200 to 899 lb.
2. Cull cows sold for slaughter, 800 lb. and above.
3. Bulls sold for slaughter, 900-2200 lb.

^cNbr = 1/Number of head sold per lot

^dBwf = black-white face, Angus-Hereford crossbred cattle

^eVariables marked by an * are included in the intercept term of the model.

Price Analysis of Feeder Cattle and Calves

Data from seven auction barn locations in South Dakota were used to estimate the impact of specified variables on price/cwt for feeder cattle and calves weighing 200 - 899 pounds.

Results from the two statistical models were nearly identical with an adjusted R^2 of 0.73. The price mean was \$63.75/cwt and the root mean square error (RMSE) was equal to \$3.61 - \$3.62 per cwt (Tables 2 and 3). The F-value indicates that the models are each significant at the 0.01 probability level. The remaining values in the table indicate how price per hundredweight changes as different factors are considered.

The intercept value of \$64.13 in Table 2 can be interpreted as the average price per cwt for the base animal - a single Hereford steer, 200 - 399 lb., sold in October at Huron-Magness auction barn. All numbers below the \$64.13 in the parameter estimate column indicate how much must be added or subtracted from the base animal price if the animal's description, time of sale or auction location is changed. For example, a 450 lb. dairy heifer sold in May at Watertown would have an expected price of \$48.80/cwt. Relative to the base situation, the price would be reduced \$10.13 for heifer and weight class, reduced \$7.56 for dairy, reduced \$0.95 for location and increased \$3.31 for sale in May.

The coefficients of all sets of explanatory variables (month of sale, auction location, weight class - by - sex, lot size and breed) each are collectively significant at the 0.01 probability level. Average sale prices for January, May, and August all are significantly higher than sale prices in October, 1981. St. Onge is the only auction location where sale prices are significantly different than those at Huron-Magness (base auction for this data set). The weight class - by - sex categorical variables indicate that as weight increases, price/cwt decreases and heifer prices are \$5.89 - \$8.01 lower than steer prices within each weight class.

Lot size is also a categorical variable with all lot size coefficients significant at the 0.01 probability level. A lot size of 2 - 4 head received \$1.39/cwt more than a single animal. The coefficients for lot sizes of 5 - 49 head are very similar to each other, indicating that as buyers are assembling a load of 30 - 50 head, the price paid per lot is not affected very much as long as 5 or more head commands a substantial price premium over smaller lot sizes.

Compared to Herefords, dairy calves and feeders bring a substantially lower price/cwt (-\$7.56) while exotic breeds command a significantly higher price (+\$1.83).

Results from the second model specification shown in Table 3 are very similar to the previous model results for the month, auction and breed categorical variables. In this model specification, lot size and weight are continuous variables, sex is a category variable and the sex*weight interaction term is a differential slope variable. Results from this model indicate that heifer prices are an average of \$8.43/cwt lower than steer prices and prices are further discounted \$1.70/cwt as weight increases. The coefficients for sex (heifer) and weight are significant ($p < 0.01$) while the

Table 2. Feeder Cattle Price Variation for Selected Marketing Factors at Selected South Dakota Auctions, 1981, Dummy Variable Model.^a

	<u>Variables</u>	<u>Parameter Estimate</u>	<u>Standard Error</u>
	Intercept ^b	64.13	0.98*** ^c
Month	January	9.94	0.44***
	May	3.31	0.44***
	August	5.70	0.46***
Auction	Watertown	-0.95	0.72
	Yankton	-0.20	0.60
	Kimball	1.02	0.63
	St. Onge	1.69	0.51***
	Belle Fourche	0.47	0.54
	Sturgis	0.78	0.55
Sex/Weight	Heifer 200-399	-8.01	1.40***
	Steer 400-499	-2.69	0.86***
	Heifer 400-499	-10.13	0.90***
	Steer 500-599	-4.89	0.86***
	Heifer 500-599	-10.78	0.94***
	Steer 600-699	-6.99	0.91***
	Heifer 600-699	-13.37	0.96***
	Steer 700-799	-8.41	0.93***
	Heifer 700-799	-12.91	1.00***
	Steer 800-899	-8.53	0.95***
Heifer 800-899	-15.99	1.13***	
Lot Size	2-4	1.39	0.60**
	5-9	2.32	0.60***
	10-19	2.72	0.61***
	20-29	2.94	0.69***
	30-49	2.73	0.68***
	≥50	4.03	0.68***
Breed	Dairy	-7.56	0.68***
	Angus	0.06	0.50
	Bwf	0.45	0.55
	Exotic	1.83	0.75***
	Xbrd	0.23	0.36

$R^2 = 0.741$ Price Mean = \$63.75 N = 677

$\bar{R}^2 = 0.729$ RMSE = 3.62 F-value = 59.56***

^aIncludes sale of steer and heifer calves and feeder cattle, 200-899 lb.

^bIntercept includes October, Huron Magness Auction, Hereford, steer calves of 200-399 lb.

^cProfitability level of significance for coefficient,

Hc: $X_i = 0$

*** = 0.01, ** = 0.05, * = 0.10

Table 3. Feeder Cattle Price Variation for Selected Marketing Factors at Selected South Dakota Auctions, 1981, Continuous/Dummy Variable Model.^a

	<u>Variables</u>	<u>Parameter Estimate</u>	<u>Standard Error</u>
	Intercept ^b	72.31	0.94****
Month	January	9.71	0.43***
	May	3.98	0.42***
	August	5.56	0.44***
Auction	Watertown	-1.30	0.70*
	Yankton	-0.26	0.60
	Kimball	0.64	0.62
	St. Onge	1.58	0.51***
	Belle Fourche	0.42	0.54
	Sturgis	0.41	0.55
Sex	Heifer	-8.43	1.30***
Weight	Cwt	-1.70	0.13***
Interaction	Cwt*heifer	0.33	0.21
Lot Size	Nbr ^c	-3.57	0.56***
Breed	Dairy	-8.03	0.66***
	Angus	0.01	0.50
	Bwf	0.39	0.54
	Exotic	1.78	0.73***
	Xbrd	0.19	0.36

$R^2 = 0.738$ Price Mean = \$63.75 N = 677

$\bar{R}^2 = 0.730$ RMSE = 3.61 F-value = 102.76***

^aIncludes sale of steer and heifer calves and feeder cattle, 200-899 lb.

^bIntercept includes October, Huron Magness Auction, Steer, and Hereford.

^cNbr = 1/Number of head sold per lot

^dProfitability level of significance for coefficient,

Ho: $\xi_i = 0$

*** = 0.01, ** = 0.05, * = 0.10

coefficient for the interaction of weight - by - sex is nonsignificant ($p > 0.10$). This finding indicates that price discounts for heifers and for weight are separable; increased weight does not significantly increase the price differential between heifers and steers.

The lot size variable is estimated as the reciprocal of lot size ($1/\text{number of head sold}$) and assumes a positive value less than or equal to one. Since the sign of the lot size coefficient is negative, a larger lot size means a higher price.

In the dummy variable model, the intercept coefficient of \$64.13 was a direct estimate of the sale price/cwt for the base animal. In this model, the intercept coefficient of \$72.31 has to be adjusted for the reciprocal lot size coefficient (-\$3.57) and weight (-\$1.70 per cwt). The estimated price range for a 200 - 399 lb. base steer calf is \$62.94 - \$66.34 per cwt and is an estimated \$64.64/cwt for a 300 lb. calf.

Feeder cattle and calf results from this study are in general agreement with findings from other feeder cattle pricing studies. Weight class and sex are the principal sources of cross - sectional price variation, followed by lot size, auction location and breed. Price premiums for exotic breeds, which were also shown in the recent Kansas studies (4,8), support the beef.

Price Analysis of Slaughter Cull Cows and Slaughter Cull Bulls

The marketing of slaughter cull cows and slaughter cull bulls is primarily the consequence of breeding herd decisions. Once the producer has decided to cull the animal, the principal decisions are the length of feeding period and type of ration necessary to market the animal at the appropriate weight and condition. In many cases, the cows and bulls are sold a few days (or weeks) after culling and marketed solely for "salvage value". In most cases, cull cows and bulls are sold in small lot sizes of 1 - 9 head.

Data from the same seven auction barns in South Dakota were used to estimate the impacts of selected explanatory variables (month of sale, auction location, weight class, lot size and breed) on sale prices of cull cows and sale prices of cull bulls. In the statistical model for slaughter cull cow prices, the price mean was \$43.60/cwt, with an adjusted R^2 of 0.386 and RMSE of \$2.86. The price mean for slaughter bulls was \$54.17/cwt, with an adjusted R^2 of 0.466 and RMSE of \$2.94 (Table 4). A likely reason for the relatively low performance of these models was the lack of information on age, condition, and frame of animals sold.

Month of sale, auction location and weight were statistically significant ($p < 0.05$) variables in the slaughter cow and slaughter bull models. The monthly price pattern was similar for cows and bulls with lowest prices in October and highest prices in August. Heavier cow weights were negatively related to sale price/cwt. while heavier bull weights were positively related to sale price/cwt.

Increased lot size was an important variable in the slaughter bull model, but was not statistically significant in the slaughter cow model.

Table 4. Slaughter Cow and Slaughter Bull Price Variation at Selected South Dakota Auctions, 1981, Dummy Variable Model.

Variable	Slaughter Cows ^a		Slaughter Bulls ^a		
	Parameter Estimate	Standard Error	Parameter Estimate	Standard Error	
Intercept ^b	38.38	0.70***d	46.50	1.44***	
Month	January	5.85	0.50***	4.84	1.08***
	May	5.48	0.47***	6.25	0.90***
	August	7.12	0.48***	8.36	0.88***
Auction	Watertown	-0.07	0.67	-4.33	1.36***
	Yankton	-1.05	0.75	-0.82	1.51
	Kimball	-1.85	0.89**	0.12	1.64
	St. Onge	2.01	0.60***	-1.30	1.14
	Belle Fourche	0.45	0.58	0.07	1.14
	Sturgis	1.20	0.60**	-2.06	1.14*
Class ^c	A	-1.52	0.34***	0.96	0.80
	B	-1.40	0.37***	0.62	0.78
	C	-1.41	0.39***	2.20	0.80**
	D	-0.94	0.55*	3.08	0.95***
Lot Size	2-4	-0.53	0.34	1.84	0.79**
	5-9	-0.50	0.54	1.15	1.39
	≥ 10	-0.79	0.63	---	---
Breed	Dairy	0.14	0.45	-0.05	0.98
	Angus	-0.12	0.37	1.55	0.52**
	Bwf	0.55	0.60	1.36	1.22
	Exotic	1.25	0.58**	0.31	0.88
	Xbrd	0.57	0.40	0.27	0.89

R ² =	0.409	0.519
\bar{R}^2 =	0.386	0.466
Price Mean =	\$43.60	\$54.17
RMSE =	\$ 2.86	\$ 2.94
F-value =	17.95***	9.75***
N =	566	212

^aIncludes sale of cull cows, 800 lb. and above. Includes sale of bulls, 1,000 lb. and above.

^bIntercept term includes October, Huron-Magness auction, Hereford and lowest weight class of slaughter cows (800-999 lb.) and slaughter bulls.

^cDefinition of weight classes:

Slaughter cows: A = 1000-1099 lb., B = 1100-1199 lb., C = 1200-1399 lb., D = ≥ 1400 lb.

Slaughter bulls: A = 1300-1499 lb., B = 1500-1699 lb., c = 1700-1899 lb., D = 1900-2299 lb.

^dProbability level of significance of coefficient,

H₀: Xi = 0

*** = 0.01, ** = 0.05, * = 0.10

Exotic breeds were the only breed of cull cows with a significantly higher price/cwt than Herefords. Angus bulls were the only breed that commanded a significantly higher average price than Hereford bulls.

A likely reason for the relatively low performance of these models was the lack of information on age, condition, and frame size of animals sold. Future studies of cull cattle should include these variables.

Summary and Conclusions

Auction market pricing of feeder cattle and calves, slaughter cull cows and slaughter cull bulls was examined in this study. Data were collected at seven South Dakota auction market locations for the second week of January, May, August and November 1981. Factors examined included location, time, sex, weight, breed and lot size.

Feeder cattle pricing models ($R^2=0.73$) indicated that weight class and sex are the principal sources of cross-sectional price variation, followed by lot size, auction location and breed. Higher prices per cwt are associated with lower weight classes, steers and larger lot sizes (approaching truck load size lots). Price premiums for exotic breeds support the changing preferences of cattle feeders and consumers for leaner types of beef. These findings are in general agreement with other recent feeder cattle auction pricing studies.

Performance of pricing models for slaughter cows ($R^2=0.38$) and slaughter bulls ($R^2=0.48$) was considerably lower than feeder cattle pricing models. Month of sale, auction location and weight were statistically significant variables. Heavier cow weights were negatively related to sale price per cwt while heavier bull weights were positively related to sale price. Additional variables such as age, condition and frame size should be included in future studies of slaughter cows or slaughter bulls.

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An Analysis of Factors Affecting Prices in Video Cattle Auctions

DeeVon Bailey and Monte C. Peterson

Increasingly, large numbers of cattle are being priced through video auctions. In 1987, for example, the Superior Livestock Auction (SLA), the nation's largest satellite video cattle auction, sold over 270,000 head of cattle. Indeed by 1990, the SLA is projected to be the largest cattle auction of any kind (Scharlier).

Many buyers and sellers as well as institutions are concerned about the economic viability of video auctions as opposed to the more traditional auctions. For example, in 1986 the state of North Dakota refused a business license to the SLA because new cattle auctions could be licensed only if an economic need or benefit could be demonstrated. At that time no statistical evidence was available for analyzing either the efficiency or increased revenues associated with video cattle auctions. In addition, buyers and sellers using video auctions are concerned about the accuracy of the video presentation and description, relative prices, buyer participation, and delivery of the cattle priced on the system.

The purpose of this paper is to analyze the performance of the SLA during 1987 to ascertain the relative efficiency of video cattle markets as pricing mechanisms. The components influencing prices in the SLA auction are examined by regression analysis to determine if any differences in pricing mechanisms exist between video and traditional auction markets. Past research results are used to compare some of the general influences of lot characteristics, market information, and terms of trade on prices in a video market relative to traditional auction markets. The following section reports the data source and methodology used to complete these analyses.

Data and Procedure

Presentation of cattle for sale through a video auction consists of two components--the video or visual component and the sales catalogue or written component. Clarity and precision of these two components are critical if the cattle are to be represented adequately. While the importance of the quality of the visual presentation of cattle sold on video auctions was not possible to test, the seller's description and terms of trade were available from SLA's sales catalogues.

The sales catalogue data and prices bid for each lot of cattle for 1987 were gathered from the SLA in Brush, Colorado. In that year over 335,000 head were offered for sale via 14 satellite video cattle auctions. Eighty-one percent of the cattle offered for sale were sold and were shipped an average of 264 miles for delivery.

Video auctions are unique because most terms of trade are available to the researcher for analysis. This allows examination of the impact of these terms of trade including pencil shrink, slide, days to delivery and timing on price. In addition, other characteristics not normally known in traditional auctions are available for analysis. For example, the regional location and birth place of the cattle are known. Also, it was possible to obtain the location to which cattle sold on the video auction were shipped.