Journal of Agribusiness 18,3(Fall 2000):331–344

Identifying Economic Risk in Cattle Feeding

Darrell R. Mark, Ted C. Schroeder, and Rodney Jones

Closeout data from two western Kansas commercial feedlots are examined to determine how cattle prices, feed costs, and animal performance impact the variability of cattle feeding profits. The relative impacts of these factors are studied across sex, placement weight, and placement month using standardized beta coefficients. Feeder cattle prices have a greater impact on profit variability for spring and fall placements. The effect of animal performance on variability of cattle feeding profits is greater for fall placements. Results suggest that fed cattle and feeder cattle prices should be emphasized in managing the overall risk in cattle feeding because they are the largest contributors to profit variability.

Key Words: cattle finishing profitability, cattle performance, feedlot closeouts, standardized beta coefficients

The variability of net returns to cattle feeding exposes cattle producers to significant levels of economic risk. For example, monthly average returns to finishing yearling steers in Kansas feedlots ranged from a loss of $175 per head to a profit of $120 per head between 1990 and 1998 (Jones, 1998). The riskiness of returns on individual pens of cattle is even greater than these averages reflect. Numerous factors influence cattle feeding profitability over time and across pens, including feeder cattle and fed cattle prices, feed prices, interest rates, and animal production performance. Given the substantial variation in returns and the myriad of profit determinants, producers need to understand how various factors contribute to the economic risk associated with feeding different types of cattle at various times of the year. Determining how factors contributing to profit risk vary by sex, placement weight, and placement month enables cattle feeders to implement risk management strategies tailored to the cattle they feed.

This research uses over 14,000 feedlot pens of cattle to examine how cattle prices, corn prices, interest rates, and cattle production performance influence profitability. The objectives of this study are to: (*a*) identify the relative importance of input and output market prices and cattle performance characteristics in explaining

Darrell R. Mark is USDA National Needs Fellow, Ted C. Schroeder is professor, and Rodney Jones is assistant professor, all in the Department of Agricultural Economics, Kansas State University. This paper was presented at the 1999 NCR-134 Conference on Applied Commodity Price Analysis, Forecasting, and Market Risk Management. The authors acknowledge the helpful comments of Kevin Dhuyvetter, Tom Marsh, and an anonymous reviewer on an earlier version of this manuscript. This is Contribution No. 00-493-J of the Kansas Agricultural Experiment Station.

profitability, and (*b*) analyze the differences in how these factors influence profitability for pens of cattle of various sex, placement month, and placement weight categories. This study updates previous cattle finishing profitability research (Langemeier, Schroeder, and Mintert, 1992; Schroeder et al., 1993) with a larger data set including both steer and heifer closeout data. To eschew interpretation problems associated with the use of coefficients of separate determination which were estimated in previous work, the current study uses different methodology wherein standardized beta coefficients are estimated and examined for differences across sex, placement weight, and placement month.

Previous Research

Early research primarily attributed cattle feeding profitability to a change in animal value and a return to feeding. Swanson and West (1963) asserted that profitability was influenced by more than the cattle price margin and feed cost. In a study involving Illinois Farm Bureau Farm Management Service records, they used coefficients of separate determination to find that cattle price margin (difference between fed cattle and feeder cattle price) explained 38% of profit variation, and feed cost per pound of gain explained 44% of variability. In a simulation of cattle feeding returns, Trapp and Cleveland (1989) found fed and feeder cattle price risk explained 65.5% and production risk explained 22.1% of profit volatility.

Langemeier, Schroeder, and Mintert (1992) and Schroeder et al. (1993) used coefficients of separate determination to quantify the degree to which various prices and cattle performance impacted cattle feeding profits. Fed cattle and feeder cattle prices explained approximately 50% and 25%, respectively, of the variation in profits over time. Corn prices were an important determinant of cattle feeding profitability, as were feed conversion and average daily gain. Albright, Schroeder, and Langemeier (1994) also used coefficients of separate determination to analyze the volatility of corn prices and cattle performance on cost of gain. Corn price, feed conversion, and average daily gain explained 65%, 27%, and 2%, respectively, of cost-of-gain variability.

This research builds on these studies by using a larger and more recent data set, which provides additional confidence in the results and relevance to recent production technology and economic conditions. Additionally, this research includes heifer feedlot performance and marketing data, and draws comparisons between steer and heifer results. Previous studies have focused primarily on steer feeding profitability. Coefficients of separate determination have been used in several prior studies to determine the proportion of variability in profit explained by individual factors. However, a problem that arises with coefficients of separate determination is that they are not constrained to be greater than zero, and they often have negative values that are difficult to interpret (e.g., Jones et al., 1996). To avoid problems inherent with coefficients of separate determination, this study utilizes standardized beta coefficients to compare the relative impacts of the primary cattle feeding profit determinants.

Jones et al. (1996) tested the profitability and cost-of-gain models developed in previous studies for structural change over a 15-year time span. The relative influences various factors had on feeding profitability and cost of gain varied substantially over time. Expanding upon Jones et al., this study determines how the impacts of profitability determinants vary across sex, placement weight, and placement month.

Data Description

Two commercial feedyards in western Kansas provided closeout data for 14,183 pens of cattle finished from January 1980 through March 1997. The feedlot data included date in, date out, placement weight, finished weight, days on feed, feed conversion, average daily gain, feeding cost, purchase price, and selling price. These data were augmented with corn prices, interest rates, feeder cattle prices, and fed cattle prices. Nominal cost-and-return series in the data set were adjusted for inflation using the monthly consumer price index, 1982–84 = 100 (Federal Reserve Bank of St. Louis, 1980–98).

The corn price, obtained from the Kansas Agricultural Statistics Service (1980–98), was the average monthly southwestern Kansas price. Corn price for a particular pen of cattle was calculated by a simple average of monthly prices corresponding to months cattle were on feed. Interest rates on cattle feeding loans reported by the Federal Reserve Bank of Kansas City (1980–98) were used to calculate interest costs. Interest was assessed to all of the purchase cost of the feeder and to half of the feeding costs.[1]

Cattle purchase and selling prices were not available for numerous pens of cattle in the closeout data.[2] Unavailable purchase prices were computed from Dodge City, Kansas, feeder cattle auction market summaries in the placement week using a linear price slide across weights. Western Kansas direct fed cattle prices (live weight basis) were substituted for missing finished cattle selling prices. Feeder cattle purchase prices and fed cattle selling prices that were included in the data set were regressed on Dodge City auction market prices and western Kansas direct fed cattle prices, respectively, to validate the use of these proxy data. Regressing feeder cattle prices that were available in the feedlot data on the Dodge City market prices gave the following (standard errors are in parentheses):

$$\begin{aligned} &\mathit{ACTUAL\ FEEDER\ PRICE} = \\ &\quad \underset{(0.43)}{4.11} + \underset{(0.006)}{0.92}\,\mathit{DODGE\ CITY\ FEEDER\ PRICE} + \varepsilon, \\ &\qquad R^2 = 0.89, \quad \text{Observations} = 2{,}950. \end{aligned}$$

[1] Interest was assessed to half the feed costs to reflect the continuous purchases of feedstuffs during the time the pen of cattle was on feed.

[2] Feeder cattle are often from retained ownership programs or from customers who did not provide the feedyards with purchase prices. Feeder prices were missing for 78% of all pens. Fed cattle prices are missing when cattle were sold under contractual arrangements, and represented 25% of all pens in the data set from 1994–1997. (Prior to 1994, the number of fed cattle prices replaced could not be precisely determined due to data limitations, but represent less than 10% of pens sold.)

Table 1. Real Average Costs, Returns, and Performance by Sex and Placement Weight, January 1980–March 1997

	Steer Placement Weights (lbs.)			
Description	All	600–700	700–800	800–900
Observations (pens)	10,361	2,257	5,228	2,876
Placement Weight (lbs.)	755	661	751	838
	(67.72)	(26.71)	(27.73)	(27.24)
Days on Feed	131	151	130	118
	(20.46)	(19.23)	(16.92)	(15.16)
Death Loss (%)	0.98	1.51	0.86	0.77
	(1.69)	(2.54)	(1.37)	(1.23)
Sale Weight (lbs.)	1,178	1,127	1,171	1,231
	(72.89)	(62.60)	(62.57)	(63.42)
Fed Price ($/cwt)	56.47	58.52	56.72	54.41
	(9.22)	(10.06)	(8.78)	(8.87)
Average Daily Gain (lbs./day)	3.21	3.07	3.22	3.30
	(0.39)	(0.38)	(0.38)	(0.40)
Feed Conversion	8.41	8.28	8.34	8.63
(lbs. feed/lb. gain) [a]	(0.96)	(0.91)	(0.92)	(1.01)
Feeder Price ($/cwt)	59.50	63.03	59.86	56.08
	(10.37)	(10.89)	(9.64)	(10.17)
Feeder Cost ($/head)	447.75	416.62	449.06	469.80
	(78.66)	(72.39)	(72.92)	(85.24)
Corn Price ($/bu.)	2.16	2.28	2.16	2.06
	(0.60)	(0.68)	(0.59)	(0.54)
Feeding Cost ($/head) [b]	173.68	194.35	172.07	160.39
	(36.44)	(39.26)	(34.00)	(30.92)
Interest Rate (%)	11.51	11.86	11.58	11.10
	(2.03)	(2.21)	(2.02)	(1.84)
Interest ($/head)	23.22	26.58	23.12	20.76
	(7.76)	(8.76)	(7.27)	(6.78)
Total Costs ($/head)	648.69	643.16	647.99	654.29
	(97.62)	(101.04)	(92.89)	(102.89)
Gross Returns ($/head)	663.27	657.90	662.68	668.55
	(100.49)	(105.42)	(95.86)	(104.44)
Profit ($/head)	14.59	14.75	14.69	14.26
	(49.67)	(50.73)	(50.21)	(47.83)

Notes: All costs and returns are expressed in 1982–84 dollars. The numbers in parentheses are standard deviations.

[a] Feed conversion is expressed on an as-fed basis.

[b] Feeding cost includes feed costs, processing, and yardage.

A similar regression of fed cattle prices against the western Kansas direct prices only for the most recent years (1994–1997) resulted in the following (standard errors are in parentheses):

Table 1. Extended

	Heifer Placement Weights (lbs.)			
Description	All	600–700	700–800	800–900
Observations (pens)	3,822	2,133	1,355	334
Placement Weight (lbs.)	700 (64.52)	653 (27.73)	738 (26.72)	839 (27.02)
Days on Feed	124 (18.55)	130 (17.28)	118 (16.78)	109 (16.76)
Death Loss (%)	1.06 (1.64)	1.15 (1.69)	0.92 (1.56)	0.99 (1.57)
Sale Weight (lbs.)	1,058 (71.64)	1,025 (48.56)	1,084 (64.98)	1,167 (71.66)
Fed Price ($/cwt)	53.80 (7.28)	54.72 (7.08)	53.18 (7.31)	50.47 (7.22)
Average Daily Gain (lbs./day)	2.87 (0.35)	2.83 (0.33)	2.90 (0.35)	2.98 (0.43)
Feed Conversion (lbs. feed/lb. gain) [a]	8.80 (1.02)	8.63 (0.98)	8.92 (1.00)	9.45 (1.09)
Feeder Price ($/cwt)	55.25 (8.72)	56.15 (8.46)	54.71 (8.83)	51.73 (8.89)
Feeder Cost ($/head)	385.76 (66.08)	366.78 (56.90)	403.75 (65.74)	433.99 (76.48)
Corn Price ($/bu.)	2.03 (0.50)	2.08 (0.52)	1.97 (0.46)	1.93 (0.44)
Feeding Cost ($/head) [b]	148.36 (26.73)	154.61 (25.44)	141.44 (25.50)	136.50 (28.73)
Interest Rate (%)	11.06 (1.70)	11.33 (1.73)	10.83 (1.61)	10.25 (1.49)
Interest ($/head)	17.87 (4.37)	18.58 (4.27)	17.17 (4.17)	16.17 (4.83)
Total Costs ($/head)	556.17 (70.08)	544.26 (63.45)	566.29 (70.79)	591.16 (87.43)
Gross Returns ($/head)	567.90 (71.89)	559.92 (66.02)	575.08 (73.28)	589.70 (92.03)
Profit ($/head)	11.73 (42.52)	15.66 (41.36)	8.79 (41.98)	−1.46 (48.18)

$$\begin{aligned}&ACTUAL\ FED\ PRICE = \\ &\underset{(0.39)}{4.50} + \underset{(0.006)}{0.93}\, WESTERN\ KANSAS\ DIRECT\ FED\ PRICE + \varepsilon, \\ &R^2 = 0.91, \quad \text{Observations} = 2{,}451.\end{aligned}$$

Slope coefficients near one and high correlations indicate the proxy price series approximate the purchase and sales prices quite well.

The data are summarized in table 1 by sex and placement weight. Sale weight tends to increase with placement weight and is higher for steers than for heifers. Average daily gain is higher for steers and increases with placement weight. Feed conversion increases as placement weight increases and is higher for heifers. Feeding costs and interest costs decrease as placement weight increases and are higher for steers. Gross returns increase with placement weight and are higher for steers. Average profit per head ranged from \$14.26 to \$14.75 for steers, and from a loss of \$1.46 to a profit of \$15.66 for heifers (1982–84 dollars). Average profits were about the same across placement weight for steers and decreased with placement weight for heifers. Profit standard deviations exceed \$40 per head for every category, revealing considerable economic risk in cattle finishing.

Model and Procedure

Profit per head was calculated by subtracting the cost of the feeder (purchase price × placement weight) and the total feeding cost from gross returns (sale price × sale weight). Total feeding cost varies with feed prices, interest rates, and animal performance. Therefore, profits per head are a function of sale price, purchase price, corn price, interest rate, and animal performance. Feed conversion and average daily gain (ADG) are used to quantify animal production performance.

Regression analysis was used to explain how these factors affect cattle feeding profits per head (*PROFIT*) over time and across pens. This relationship is expressed as:

$$(1) \qquad PROFIT = f(FED\ PRICE,\ FEEDER\ PRICE,\ CORN\ PRICE,\ INTEREST\ RATE,\ FEED\ CONVERSION,\ ADG).$$

FED PRICE is expected to be positively related to profit, whereas *FEEDER PRICE*, *CORN PRICE*, and *INTEREST RATE* are expected to be negatively related to profit. As *FEED CONVERSION* decreases (i.e., improves), profit is expected to increase. Similarly, as *ADG* increases (i.e., improves), profit is expected to increase. The model above nearly specifies an accounting identity. Because the objective is to examine the relative impacts of the output and input prices and performance on profitability, a more formal analysis of the technology is not necessary.

The objective of this study is to determine the relative impacts of these various factors on cattle feeding profits. Ordinary least squares (OLS) regression coefficients are difficult to compare because the units of the independent variables differ; therefore, standardized beta coefficients were computed. This is accomplished by normalizing each of the variables to have a mean of zero and variance of one (Pindyck and Rubinfeld, 1998). Regressing these normalized independent variables on the normalized dependent variable yields unitless coefficients called standardized beta coefficients. The model in equation (1) with normalized variables takes the following form:

(2) $$\frac{Y_i - \overline{Y}}{s_Y} = \sum_j \beta_j^* \frac{X_{ij} - \overline{X}_j}{s_{X_j}} + \varepsilon,$$

where Y is the dependent variable, s is the standard deviation, X_j is the jth independent variable (j=*FED PRICE*, *FEEDER PRICE*, …, *ADG*), and β_j^* is the standardized beta coefficient for the jth independent variable. Pindyck and Rubinfeld (1998) show this is equivalent to multiplying the OLS beta coefficient by the ratio of the standard deviation of the independent variable to the standard deviation of the dependent variable:

(3) $$\beta_j^* = \beta_j \frac{s_{X_j}}{s_Y}.$$

From equation (2), a standardized beta coefficient of, say 0.93, indicates that for a one standard deviation change in the independent variable, the dependent variable changes from the mean by 0.93 standard deviations (Neter, Wasserman, and Kutner, 1985). (In the remainder of the article, the change relative to the mean is assumed but not stated for convenience.) By re-scaling the variables in this manner, the standardized beta coefficients can be directly compared with one another. This is particularly useful here because of the differences in magnitudes and units of the fed, feeder, and corn prices, as well as the interest rates and performance variables.

The analysis proceeded in several steps. Equation (1) was initially estimated separately for six categories of cattle segregated by sex (steer and heifer) and placement weight (600–700, 700–800, and 800–900 pounds), and standardized beta coefficients were calculated. These models provide a relatively aggregated summary of how impacts of major profit determinants vary relative to each other across placement weight and sex. To identify more details regarding profit determinants, the model was also estimated for groups of cattle segregated by sex, placement weight, and placement month (the 800–900 pound heifers were not included due to insufficient observations in several months). Therefore, standardized beta coefficients for each independent variable were estimated for 60 (5 sex-weight categories × 12 months) different groups of cattle.

Next, the following model was developed to determine how these standardized beta coefficients from the second set of 60 models systematically change across sex, placement weight, and placement month:

(4) $$\beta_j^* = f(HEIFER, SEVWT, EIGWT, FEB, MAR, \ldots, DEC),$$

where *HEIFER* is a dummy variable representing sex (steer = 0, heifer = 1); *SEVWT* and *EIGWT* are dummy variables representing cattle weighing between 700–800 and 800–900 pounds at placement, respectively, and are equal to one if the placement weight of the cattle is in the category and zero otherwise (600–700 pounds is the default); and *FEB*, *MAR*, …, *DEC* are dummy variables representing placement month equaling one if the cattle were placed during that month and zero otherwise (January is the default). The expected relationships between the standardized beta coefficients and the independent dummy variables vary for each of the jth standardized beta coefficients; therefore, this discussion is relegated to the results section.

Table 2. Regression Results of Factors Affecting Cattle Feeding Profit by Sex and Placement Weight

	Steer Placement Weights (lbs.)					
	600–700		700–800		800–900	
Variable	OLS	STB	OLS	STB	OLS	STB
Intercept	18.80	0.00	30.19	0.00	36.81	0.00
FED PRICE	10.60	2.10	10.89	1.91	11.67	2.16
FEEDER PRICE	−6.53	−1.40	−7.33	−1.41	−8.38	−1.78
CORN PRICE	−46.55	−0.62	−42.44	−0.50	−40.22	−0.45
INTEREST RATE	−5.31	−0.23	−4.64	−0.19	−5.15	−0.20
FEED CONVERSION	−15.64	−0.28	−14.49	−0.27	−12.78	−0.27
ADG	28.05	0.21	22.29	0.17	19.17	0.16
R^2	0.9429		0.9549		0.9574	
Observations	2,257		5,228		2,876	

Notes: All parameter estimates are statistically significant at the 0.01 level. OLS = ordinary least squares coefficient and STB = standardized beta coefficient.

Results

The OLS and standardized beta coefficients from the regression model in equation (1) estimated for the six sex-weight categories are presented in table 2.[3] All coefficients were statistically significant at the 0.01 level, and all R^2 values were above 0.90. As expected, fed cattle price and ADG are positively related to feeding profits, whereas the remaining variables negatively affect profitability. The standardized beta coefficients provide meaningful comparisons of the impact of the variability of the independent variables on the dependent variable (profit per head). They do not, however, account for correlation or covariance between related independent variables. Because multicollinearity was not problematic in the models, the use of standardized beta coefficients is appropriate.

Because approximately 78% and 25% of the feeder cattle and fed cattle prices, respectively, were replaced by appropriate cash market proxies, the variability in feeder cattle purchase prices and fed cattle selling prices may have been reduced. This may especially be true for the impact of feeder cattle prices on profitability.

[3] Regression diagnostics were examined on all the models. Variance inflation factor tests suggested small amounts of collinearity between fed cattle and feeder cattle prices and feed conversion and ADG. This was not dealt with in any formal way, and could result in biases in estimated standardized betas. White's (1980) consistent covariance estimator was used to adjust the standard errors of the coefficients for general heteroskedasticity. Given the large cross-sectional, time-series nature of the panel data set, the potential for autocorrelation could exist across several dimensions. For example, errors could be correlated across time, pen, feedlot, etc. However, the data do not follow a strict time sequence; i.e., one day may have several observations (placements) followed by several days with no observations. Therefore, correcting for autocorrelation if it were present is not straightforward.

Table 2. Extended

	Heifer Placement Weights (lbs.)					
	600–700		700–800		800–900	
Variable	OLS	STB	OLS	STB	OLS	STB
Intercept	33.95	0.00	31.00	0.00	49.36	0.00
FED PRICE	9.55	1.64	10.28	1.79	11.67	1.75
FEEDER PRICE	−6.38	−1.31	−7.34	−1.54	−8.88	−1.64
CORN PRICE	−37.93	−0.48	−35.26	−0.39	−39.47	−0.36
INTEREST RATE	−4.74	−0.20	−4.49	−0.17	−3.44	−0.11
FEED CONVERSION	−12.68	−0.30	−11.47	−0.27	−11.16	−0.25
ADG	20.95	0.17	18.23	0.15	12.37	0.11
R^2	0.9587		0.9557		0.9545	
Observations	2,133		1,355		334	

Although the fed cattle and feeder cattle price standardized beta coefficients may be somewhat smaller in absolute value due to use of proxy data, they remain the largest contributors to profit variability. The fed cattle price standardized beta coefficient for 600–700 pound steers is 2.10, indicating that for a one standard deviation increase in fed cattle price, profit per head increases by 2.10 standard deviations (table 2). As expected, fed cattle price has a similar impact across placement weights within the same sex. The feeder cattle price coefficient increases (in absolute value) as placement weight increases (from –1.40 to –1.78 for steers placed at 600–700 pounds versus 800–900 pounds), reflecting increased importance of feeder cattle costs when placing heavier cattle.

Corn price, interest rate, feed conversion, and ADG all have smaller impacts on profitability, with most standardized betas less than 0.50. The standardized beta coefficients for steers tend to be slightly greater than the corresponding coefficients for heifers. Steers are typically fed longer, gain more weight, and have greater rates of gain than heifers. Together, these factors contribute to steers having greater profit variability than heifers (table 1).

To discern more details regarding factors influencing the relative importance of profit determinants, the standardized beta coefficients were estimated in more disaggregated form for both steers and heifers, across placement weight, and placement month (except 800–900 pound heifers which were omitted because of insufficient observations in several months). The explanatory power of these regressions was similar to the aggregated models in table 2, with R^2s above 0.90 and statistically significant variables. To condense the results of these 60 regressions (12 months × 5 sex-weight groups) and explain differences in the coefficients, their standardized beta coefficients were used as dependent variables in models presented in equation (4).

Table 3. Parameter Estimates from Regressing Standardized Betas on Factors Affecting Cattle Feeding Profit by Sex, Weight, and Placement Month

Dummy Variable	Fed Price		Feeder Price		Corn Price	
	Coefficient	*p*-Value	Coefficient	*p*-Value	Coefficient	*p*-Value
Intercept	1.9254	0.0001	−1.1073	0.0001	−0.5504	0.0001
HEIFER	−0.2972	0.0003	0.0100	0.8662	0.1418	0.0001
SEVWT	−0.0348	0.6512	−0.0979	0.1031	0.1156	0.0001
EIGWT	0.1105	0.2807	−0.3926	0.0001	0.1749	0.0001
FEB	0.4027	0.0204	−0.5017	0.0003	−0.1028	0.0331
MAR	0.4342	0.0129	−0.6028	0.0001	−0.1426	0.0038
APR	−0.0282	0.8671	−0.2159	0.1009	−0.0717	0.1324
MAY	−0.2547	0.1356	−0.1355	0.2987	−0.0384	0.4159
JUN	0.0703	0.6771	−0.3626	0.0073	−0.1750	0.0005
JUL	0.1527	0.3670	−0.4424	0.0013	−0.1080	0.0256
AUG	0.2141	0.2079	−0.4838	0.0005	−0.0724	0.1284
SEP	0.2840	0.0970	−0.4990	0.0003	−0.1532	0.0020
OCT	0.3794	0.0285	−0.5423	0.0001	−0.2119	0.0001
NOV	0.2523	0.1392	−0.1409	0.2802	−0.1119	0.0209
DEC	0.0804	0.6339	0.0518	0.6898	−0.0576	0.2241
R^2	0.5641		0.6848		0.7167	
Observations	60		60		60	

Note: The intercept for each regression is the standardized beta coefficient for 600–700 pound steers placed on feed in January.

Table 3 presents the results obtained from regressing each set of 60 standardized beta coefficients on dummy variables representing sex, placement month, and placement weight. The default category (intercept for each regression in table 3) is the standardized beta coefficient for 600–700 pound steers placed on feed in January.

Comparing the intercepts reveals that fed and feeder cattle prices have the largest (absolute value) impact on profits, and interest rates and ADG have the smallest (absolute value) impact for 600–700 pound steers placed in January. The other independent variables are dummy variables that adjust the average standardized beta coefficient to a group of cattle with that particular characteristic, ceteris paribus. For example, the fed cattle price standardized beta coefficient for 600–700 pound steers placed in January is 1.9254, and for 600–700 pound heifers placed in January is 1.6282 (1.9254 – 0.2972).

Fed cattle price has the largest impact on profit per head, followed by feeder cattle prices, corn prices, feed conversion, interest rates, and average daily gain (table 2). The (absolute value of the) standardized beta coefficients for fed cattle price are between 1.25 and 1.5 times greater than feeder cattle price betas, and approximately

Table 3. Extended

Dummy Variable	Interest Rate		Feed Conversion		Average Daily Gain	
	Coefficient	*p*-Value	Coefficient	*p*-Value	Coefficient	*p*-Value
Intercept	−0.1469	0.0001	−0.2199	0.0001	0.1549	0.0001
HEIFER	0.0174	0.1577	−0.0401	0.0049	−0.0215	0.0998
SEVWT	0.0332	0.0088	0.0142	0.3004	−0.0150	0.2493
EIGWT	0.0441	0.0086	0.0066	0.7129	−0.0301	0.0825
FEB	−0.0018	0.9473	−0.0088	0.7679	−0.0114	0.6855
MAR	−0.0919	0.0012	−0.0461	0.1282	−0.0279	0.3263
APR	−0.0781	0.0051	0.0655	0.0327	0.0320	0.2596
MAY	−0.1041	0.0003	0.0524	0.0846	0.0204	0.4703
JUN	−0.1458	0.0001	0.0275	0.3598	0.0791	0.0072
JUL	−0.1472	0.0001	−0.0098	0.7441	0.0155	0.5845
AUG	−0.0964	0.0007	−0.0328	0.2758	0.0453	0.1137
SEP	−0.0937	0.0010	−0.0523	0.0851	0.0869	0.0034
OCT	−0.0640	0.0199	−0.0726	0.0186	0.1167	0.0001
NOV	−0.0316	0.2396	−0.0404	0.1810	0.0870	0.0033
DEC	−0.0003	0.9910	−0.0451	0.1362	0.0277	0.3282
R^2	0.6860		0.5641		0.5734	
Observations	60		60		60	

four times greater than corn price standardized beta coefficients.[4] This implies that in order to manage factors that have historically contributed most to cattle feeding profit risk, producers should focus on managing fed and feeder cattle price risk.

The fed cattle price standardized beta coefficient is 0.30 smaller for heifers relative to steers (table 3), consistent with table 2. The standardized beta coefficients for 700–800 and 800–900 pound steers relative to 600–700 pound steers are not statistically different (table 3). Relative to January placements, all other placement months (except April and May) have larger fed cattle standardized beta coefficients; however, the parameter estimates are only statistically significant (0.10 level) in February, March, September, and October. Months with statistically significant parameters correspond to months where fed cattle prices are typically increasing (Jones, Mintert, and Albright, 1997). This indicates that fed cattle prices have a greater influence on profitability when those prices typically increase.

The feeder cattle price standardized beta coefficient is not statistically different for steers versus heifers (table 3), i.e., feeder cattle prices impact profitability

[4] Because feeder cattle demand is derived from expected fed cattle and corn prices, the impact of feeder cattle price variability on profitability might be overstated, and the variability of corn and fed cattle prices on finishing profits may be understated.

similarly for steers and heifers. The standardized beta coefficient of feeder cattle price increases as placement weight increases because feeder steer cost becomes an increasingly larger portion of total costs of producing a finished steer as placement weight increases (table 1). Therefore, producers should be aware of the increasing importance of managing feeder cattle price risk as they place heavier-weight cattle on feed. Seasonally, the influence of feeder cattle prices on profitability tends to be greater in all placement months except December relative to January, and is highest for spring and fall placements (table 3).

Profits might be expected to be less impacted by corn prices for steers than heifers because steer performance (feed conversion, ADG) is higher relative to heifers. However, the total amount of gain for steers is typically 60 pounds greater than that for heifers, and steers are on feed for one to three weeks longer (table 1). This causes total feeding costs to be higher for steers. Because feeding costs are influenced by corn price changes, the impact of corn price variability on profits is greater (in absolute value) for steers than for heifers (table 2).

Buccola (1980) found that feed price changes impacted light-weight feeder cattle prices more than heavy-weight feeder cattle prices, suggesting corn prices have less influence on profit per head as placement weight increases. Tables 2 and 3 show the standardized beta coefficients for corn prices decrease in absolute value as placement weight increases. This results from feed cost becoming a smaller proportion of total cost of finishing a steer as placement weight increases, and is consistent with findings reported by Langemeier, Schroeder, and Mintert (1992).

Seasonally, the corn price standardized beta coefficients are greater in all placement months relative to January, and are statistically significant in seven of these months (0.10 level). The magnitude of the parameters indicates that the corn price standardized beta coefficient is largest for October placements relative to other months, indicating that corn price variability has the largest influence on cattle feeding profitability for placements during that month.

The impact of variability of interest rates is lower for heifers relative to steers (table 3). This is a reflection of total feeder costs and feeding costs being lower for heifers; thus interest expenses are a smaller proportion of total expense incurred from producing a finished heifer relative to a finished steer (table 1). The influence of interest rates on profitability decreases as placement weight increases. This could be a function of heavier placements being on feed for shorter time periods and total interest expense decreasing as placement weight increases, leading to lower variability in interest rates for those groups of cattle (table 1). Seasonally, interest rates appear to impact feeding profitability most for cattle placed during summer months (table 3).

Feed conversion affects profitability more when feeding heifers than steers (table 3). This is likely because feed conversion tends to be higher and more variable for heifers than steers (table 1). The impact of feed conversion on profitability declines as placement weight increases, although this relationship is not statistically significant. Feed conversion typically has less influence on profitability for summer placements (when feed conversion is seasonally low) and increases for fall placements (when feed conversion seasonally increases, reflecting poorer performance caused by winter weather conditions).

Average daily gain influences profitability slightly more for steers than for heifers (statistically significant at the 0.10 level) (table 3).[5] Langemeier, Schroeder, and Mintert (1992) found that average daily gain had a larger impact on profitability for heavier-weight placements relative to lighter placements, and asserted that an improvement in average daily gain reduced cost of gain and therefore increased profits. As seen in tables 2 and 3, results of this study contradict those of previous studies. Here, the standardized beta coefficient of average daily gain decreased slightly as placement weight increased. The reason for this finding is that average daily gain is more important for lighter-weight placements because they are on feed for longer periods of time. Seasonally, the average daily gain influence on profit per head increases during summer months when average daily gain is typically highest (Jones, Mintert, and Albright, 1997).

Conclusions

Fed cattle prices and feeder cattle prices have greater impact on cattle feeding profitability than corn prices, interest rates, and animal performance. This suggests that risk management efforts should be focused on managing price risk in those markets to reduce riskiness associated with cattle feeding. However, these other factors explain economically important amounts of profit variability, so producers should also continue to monitor exposure to risk in these areas.

The factors hypothesized to influence profitability were studied across sex, placement weight, and placement month. In general, as placement weight increases, feeder cattle prices impact profitability more, whereas corn prices, interest rates, and animal performance influence profitability less. Feeder cattle price variability has a greater impact on profitability for spring and fall placements, and corn price variability typically has the largest influence on profits for third-quarter placements. Feed conversion has the greatest influence on profitability for fall/winter placements, while ADG affects profits most for late fall placements.

Results of this research are important for cattle feeders, cow-calf producers retaining ownership of their calves, extension personnel, and investors. Because fed cattle and feeder cattle prices are the largest contributors to cattle profit variability, these areas should be emphasized in managing the overall risk in cattle feeding.

---

[5] Variability of ADG across pens is considerably less than ADG across animals within a pen. Therefore, it is likely that ADG has a larger impact on profitability than pen-level data suggest.

References

Albright, M. L., T. C. Schroeder, and M. R. Langemeier. (1994). "Determinants of cattle feeding cost-of-gain variability." *Journal of Production Agriculture* 7, 206–210.

Buccola, S. T. (1980). "An approach to the analysis of feeder cattle price differentials." *American Journal of Agricultural Economics* 62, 574–580.

Federal Reserve Bank of Kansas City. (1980–1998). *Survey of Agricultural Credit Conditions* (various issues). Kansas City, MO.

Federal Reserve Bank of St. Louis. (1980–1998). *Consumer Price Index for All Urban Consumers* (various issues). Federal Reserve Economic Data, St. Louis, MO.

Jones, R. (1998). "Cattle finishing budgets and returns." In *Ag Update: Monthly Marketing/Farm Management Newsletter* (various monthly issues). Agricultural Experiment Station and Cooperative Extension Service, Department of Agricultural Economics, Kansas State University, Manhattan.

Jones, R., J. Mintert, and M. Albright. (1997, June). "Seasonality in steer feeding profitability, prices, and performance." Pub. No. C-734, Agricultural Experiment Station and Cooperative Extension Service, Department of Agricultural Economics, Kansas State University, Manhattan.

Jones, R., J. Mintert, M. Langemeier, T. Schroeder, and M. Albright. (1996). "Sources of economic variability in cattle feeding." In *Proceedings of the NCR-134 Conference on Applied Commodity Price Analysis, Forecasting, and Market Risk Management* (pp. 336–348). Held in Chicago, IL, April 1996. Stillwater, OK: Oklahoma State University Press.

Kansas Agricultural Statistics Service. (1980–1998). *Agricultural Prices* (various issues). Topeka, KS.

Langemeier, M., T. Schroeder, and J. Mintert. (1992). "Determinants of cattle finishing profitability." *Southern Journal of Agricultural Economics* 24, 41–47.

Neter, J., W. Wasserman, and M. H. Kutner. (1985). *Applied Linear Statistical Models*, 2nd ed. Homewood, IL: Richard D. Irwin, Inc.

Pindyck, R. S., and D. L. Rubinfeld. (1998). *Econometric Models and Economic Forecasts*, 4th ed. Boston, MA: Irwin/McGraw-Hill.

Schroeder, T. C., M. L. Albright, M. R. Langemeier, and J. Mintert. (1993). "Factors affecting cattle feeding profitability." *Journal of the American Society of Farm Managers and Rural Appraisers* 57, 48–54.

Swanson, E. R., and V. I. West. (1963). "Statistical analysis of feeder cattle returns." *Journal of Farm Economics* 45, 146–150.

Trapp, J. N., and S. D. Cleveland. (1989). "An analysis of the sources of profit volatility in cattle feeding." In *Proceedings of the NCR-134 Conference on Applied Commodity Price Analysis, Forecasting, and Market Risk Management* (pp. 161–176). Held in Ames, IA, April 1989. Ames, IA: Iowa State University Press.

White, H. (1980). "A heteroskedasticity-consistent covariance matrix estimator and a direct test for heteroskedasticity." *Econometrica* 48, 817–838.