Cost of Production Analysis for the Texas Cow-Calf Industry

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ABSTRACT

Selected summary cost of production data gathered in Texas using the NCBA-IRM-SPA guidelines were reported and utilized to estimate a cost function for the Texas cow-calf industry. Results indicate that the economic cost of production for the cow-calf industry averaged $102.59 per cwt. over the 1992-1998 time period. It was found that a 1% increase in the per acre price of grazing results in a 0.141% increase in total cost for Texas cow-calf producers. In addition, the analysis found that a 1% increase in the per pound price of raised and purchased feed results in an expected 0.055% increase in total cost for Texas cow-calf producers.

KEYWORDS: cost of production, cow-calf industry

The cattle industry in Texas currently faces financial difficulty that is of concern not only to beef cattle producers in the state, but also to policy makers responsible for the economic well being of Texas agriculture. The extremely dry conditions experienced in Texas during 1998 forced producers to make difficult choices with respect to how they should handle their current investments in breeding cattle. The drought of 1998 came only two years after the extremely dry spring and summer of 1996. In 1996, the drought was compounded with the lowest cattle prices since the mid-1970's along with grain and forage prices that were historically very high. These factors make estimation of the cost structure of the Texas cow-calf industry an important objective that will help producers as they evaluate herd investment/disinvestment decisions. As well, this study will support development of sound policy, particularly government responses to drought for the Texas beef cattle industry.

In addition to these recent problems in Texas, the U.S. beef industry has experienced a persistent decline in annual per capita consumption of meat since the mid-1970's, falling from a high of 94.4 pounds per capita in 1976 to 66.9 pounds per capita in 1997 (Economic Research Service-USDA). As a result of the continued decline in per capita consumption of beef throughout the 1980's, the National Cattlemen's Beef Association Concentration/ Integration Task Force commissioned a study of the beef cattle industry. This study (Johnson, et al.) determined that "The principal reason beef is losing ground to other meats is that its cost is rising relative to consumer costs for other meats. Only about

three percent of beef's recent loss in market share can be attributed to a change in consumer preference." (Johnson, et al. p. ii). The Johnson, et al. study challenged cattle producers to lower their costs of production to regain both domestic and international market share.

The need to determine current costs of production and to make comparisons of alternative production systems in order to lower future production costs became evident in the early 1990's. However, a standardized method of measuring production and financial performance for beef cow-calf producers did not exist at that time. As a first step in meeting this challenge, the National Cattlemen's Beef Association National Integrated Resource Management Coordinating Committee developed a set of standardized guidelines for production and financial analysis for cow-calf producers known as the National Cattlemen's Beef Association Integrated Resource Management Standardized Performance Analysis (NCBA-IRM-SPA) guidelines.

The objectives of this paper are to: 1) report annual cost of production data from the last six years gathered using the NCBA-IRM-SPA guidelines (National Cattlemen's Beef Association); and 2) utilize these data to estimate a cost function for the Texas cow-calf industry. These summary data provide baseline information that is of interest to producers, researchers, and policy makers. The estimation of an aggregate cost function for the Texas cow-calf industry will be of interest to policy makers and researchers in determining the impact of input price changes on the cost structure of the Texas cow-calf industry. This analysis will focus on the impact that changes in feed prices and grazing costs have on the cost structure of the Texas cow-calf industry, which is of primary concern when government relief measures for drought are considered.

Review of Literature

There are several cost of production studies focusing on U.S. livestock agriculture that have been conducted, mostly concentrating on the feedlot and meat packing sectors (Hallam). Weimar et al. applied economic engineering techniques and found substantial economies of size associated with feed and waste handling equipment. Ball and Chambers estimated a cost function to measure returns to scale and technological change in the beef processing industry, finding that the meat packing industry displayed increasing returns to scale as relatively high priced labor was replaced with machine technology. Cooke and Sundquist estimated differences in cost efficiency among various sized firms engaged in corn production by breaking unit costs into measures of technological change over time, regional competitive advantage, economies of scale, and changing input prices. However, the literature is sparse with regard to estimation of cost functions for cow-calf production in Texas. This study employs a cost function approach to examine the impact of changes in feed prices and grazing costs on the cost structure of the Texas cow-calf industry.

Model

Utilizing the guidelines developed by the NCBA-IRM-SPA Subcommittee (National Cattlemen's Beef Association), cost of production data for Texas cooperators were collected for the 1992 to 1998 time period. The SPA guidelines divide these performance data for the beef cow-calf enterprise into four general areas that include: 1) Reproduction

Performance, 2) Production Performance, 3) Grazing and Raised Feed Land Use and Productivity, and 4) Financial and Economic Performance.

Primary and secondary measures of performance for each of the four areas of interest listed above are established in the SPA guidelines. This paper will focus on a subset of these measures, presenting data on selected primary measures for each area of performance listed above. For the area of Reproduction Performance, the primary measure used in this study is calf crop percentage. This measure is calculated by dividing the number of calves weaned in the particular production cycle by the number of cows that were exposed to a bull (by either natural or artificial service) and intended to be bred to calve in that particular production cycle. For the area of Production Performance, the primary measures used are actual weaning weights and pounds of calf weaned per exposed female. For the area of Grazing and Raised Feed Land Use and Productivity, the number of acres used for grazing, raising feed, and crop aftermath (crop residue) per exposed female are presented along with the amount of raised or purchased feed fed per breeding cow. For the area of Financial and Economic Performance, the total economic pre-tax cost per cwt. of weaned calf adjusted for non-calf revenue and percent return on assets are presented. Total economic pre-tax cost per hundredweight of production adjusted for non-calf revenues is defined as total operating costs plus total financial returns and economic opportunity costs less non-calf revenues (usually cull cow and bull sales) divided by total hundredweight of weaned calves produced. For financial measurement development, information is taken directly from the firm's income statement. Economic measurements include the firm's financial costs, while also taking into account the opportunity cost of resources used in the cow-calf enterprise. Opportunity costs are the value of the foregone alternative products the resources that were employed in weaned calf production could have produced (Leftwich). This distinction allows the producer and researcher to monitor progress of the individual firm using financial analysis, while economic measures allow for comparisons between firms and industries.

The model for the cost function developed in this study assumes that Texas cow-calf producers act as cost minimizers, behaving as shown in Equation

$$(1) \quad \text{minimize } C = \sum_{i=1}^{n} w_i x_i$$
$$\text{subject to } f(x_1,....x_n) = y_0$$

where C is total cost, w_i is the price for factor x_i, and y_0 is output at a parametrically assigned level (Silberberg). Given these conditions, the cost function (C^*) may be written as a function of input prices and output, when the input quantities (x_i^*) used are employed at cost minimizing levels, presented in equation (2) below.

$$(2) \quad C = \sum_{i=1}^{n} w_i x_i^*(w_1...w_n, y_0) = C^*(w_1,...w_n, y_0)$$

Empirical Results and Discussion

The selected results for Texas producers who participated in the Standardized Performance Analysis program between 1992 and 1998 are shown in Table 1. There are 187 observations included in the summary statistics shown in Table 1. Each observation represents the results from one herd for one production cycle.

Table 1. Selected Summary Statistics for Production and Economic Measures Based on Standardized Performance Analysis for Texas Herds, 1992-1998.

Performance Measure	Minimum	Average	Maximum
Grazing, raised feed, and crop aftermath acres per exposed female	1.7	19.3	108.7
Pounds of raised/purchased feed fed per breeding cow	55	1,483	6,722
Calf crop or weaning percentage	54.8	82.4	100.0
Average weaning weight	318.0	525	691.0
Pounds weaned per exposed female	195.0	431.8	586.0
Economic Pretax Cost Non-calf Revenue Adjusted per cwt	$51.42	$102.59	$259.44
Percent Return on Assets - market value	(21.4)	1.3	26.6

The results for grazing, raised feed, and crop aftermath (crop residue) acres per exposed female range from a minimum of 1.7 acres per exposed female to a maximum of 108.7 acres per exposed female. These results are indicative of the wide variety of climatic conditions in Texas, ranging from high rainfall areas in the Eastern part of the state which support dense stocking rates to the arid regions in the Trans-Pecos region that support extensive grazing operations. The average grazing, raised feed, and crop aftermath (crop residue) acres per exposed female of 19.3 acres illustrates the high level of capital needed to support the cow-calf industry in Texas. The use of raised and purchased feed ranged from 55 to 6,722 pounds per breeding cow, with an average of 1,483 pounds of raised and purchased feed fed per breeding cow. The wide range in the use of raised and purchased feed is primarily linked to differences between intensive and extensive grazing systems, but was also impacted by drought conditions that occurred within the observed period. Reproductive performance in the cooperating herds ranged from a low of 54.8% calf crop, to a high of 100%, with an average of 82.4%. Many factors impacted the reproductive efficiency of the observed herds, including age and genetic composition of the cows within the herd, grazing systems and other management programs such as herd health along with nutritional levels that were affected by drought conditions that occurred within the observed period. Productive performance reflected by weaning weights for the cooperating herds averaged 525 pounds per weaned calf, and ranged from a low of 318 pounds to a high of 691 pounds. Productive performance reflected by pounds weaned per exposed female ranged from a low of 195 pounds to a high of 586 pounds, with an average of 431.8 pounds.

Economic performance measured by economic cost of production per cwt. of weaned calf averaged $102.59 per cwt., ranging from a low of $51.42 per cwt. to a high of $259.44 per cwt. The economic cost of production includes opportunity costs on owned capital, which generally exceeds the financial cost of production. The economic cost of production may be thought of as the level that the market price for calves must reach to hold capital in the cow-calf industry over the long term, and the level that would need to be exceeded for capital to be drawn into the cow-calf industry for expansion of the herd.

Financial performance measured by the percent return on the market value of assets averaged 1.3% for the participating herds, ranging from a low of −21.4% to a high of 26.6%. These results are representative of the low rates of return generally seen in production agriculture in the United States.

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Table 2. Summary Statistics for Data Utilized in the Cost Function Estimation.

Variable	Mean	Maximum	Minimum	Standard Deviation
Feed Price ($/lb.)	$0.11	$0.73	$0.01	$0.10
Grazing Price ($/acre)	$12.19	$89.59	$0.79	$13.61
Other ($/head)	$202.00	$672.24	$7.79	$96.18
Total Pounds Weaned per herd	330,596	6,140,400	5,049	706,335
Total Economic Cost per herd	$270,014.46	$4,769,465.40	$5,727.00	$573,475.17

Table 3. Regression Results (Ordinary Least Squares).

F-Value	1275.82
R^2	0.9656
Adjusted R^2	0.9648

	Beta Values	Standard Errors	P-values
Intercept	−1.136769	0.251119	0.0001
Grazing Price	0.141127	0.024629	0.0001
Feed Price	0.054687	0.023842	0.0229
Other	0.311393	0.034999	0.0001
Pounds Weaned	0.936724	0.015677	0.0001

To estimate the cost function developed in Equation 2 above, total production in pounds weaned and total economic cost were taken from the Standardized Performance Analysis results. Grazing prices for each observation were calculated by dividing the total economic grazing cost for each observation by the total number of grazing acres within each observation. Feed prices were calculated by dividing the economic cost of raised and purchased feed fed by the total pounds of raised and purchased feed fed for each observation. Remaining costs were grouped into a general category entitled Other. One hundred-eighty-seven observations were used for estimation purposes. Summary statistics for all variables are shown below in Table 2.

The logarithmic transformation of equation 2 (shown below in equation 3) was estimated using ordinary least squares regression with the proc reg procedure of PC-SAS for Windows Version 6.12. (SAS). The model results for this regression are shown in Table 3.

(3) ln(TotalCost) = ln(Grazing Price) + ln(FeedPrice) + ln(Other) + ln(PoundsWeaned)

The overall fit of the model is acceptable, with an adjusted R^2 value of 0.9648 and a highly significant F statistic. The parameter estimate (Beta Value) for price of grazing (GRAZING PRICE) is statistically significant at the P>0.0001 level. The parameter estimate of 0.141127 indicates that as the price of grazing increases by 1% on a per acre basis, the total cost structure of Texas producers increases by approximately 0.14%. The parameter estimate for price of feed (FEED PRICE) is statistically significant at the P>0.0229 level. The parameter estimate of 0.054687 indicates that as the price of raised and purchased feed increases by 1% on a per pound basis, the total cost structure of Texas producers increases by approximately 0.055%.

Using the parameter estimate for FEED PRICE as an illustration, the reported increase in average hay prices from $56 per ton to $83 dollars per ton from September

1997 to September 1998 (Texas Agricultural Statistics Service) would result in a 2.6% increase in total costs for Texas producers. Evaluated at the sample mean of the data utilized in this study, it would then be expected that the average firm's total economic cost of production per hundredweight. would increase by $8.89 as a result of this change in the level of feed prices.

Conclusions and Need for Further Research

The objectives of this paper were to report selected summary cost of production data gathered in Texas using the NCBA-IRM-SPA guidelines and to utilize these data to estimate a cost function for the Texas cow-calf industry. Results indicate that the economic cost of production for the cow-calf industry averaged $102.59 per cwt. over the 1992-1998 time period. Given this cost level, it can be concluded that calf prices that are available in the spring of 1999 are not yet at levels high enough to encourage herd expansion. Average profitability as measured by return on assets at market value was 1.3%, reinforcing the hypothesis that cow-calf producers in Texas are engaged in an enterprise that underperforms relative to many alternative investments.

Estimation of a cost function for the Texas cow-calf industry provided reasonable results. These results should aid policy makers in assessing the impact of changing grazing and feed prices on the cost structure of Texas cow-calf producers. It was found that a 1% increase in the per acre price of grazing results in a 0.141% increase in total cost for Texas cow-calf producers. In addition, the analysis found that a 1% increase in the per pound price of raised and purchased feed results in an expected 0.055% increase in total cost for Texas cow-calf producers.

Further research is warranted to examine regional differences in cost of cow-calf production within Texas. Increased sample size should allow the data to be partitioned by geographic regions that are more and less dependent on raised and purchased feed in cow-calf production leading to regional parameter estimates that would be of use to both policy makers and producers.

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