Price Determinants of Performance-tested Bulls Over Time in Tennessee

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Introduction

Bull purchasing decisions for a cow-calf producer can be complex for several reasons, but the primary reason is because it impacts both short- and long-run profitability. The bull contributes half of the genetic makeup of every calf he sires, which influences the bull's calves sold from a herd and the heifers retained as replacement breeding stock. These two factors lend credence to the importance of selecting bulls that produce cost-competitive, high-quality calves for the feedlot and females whose genetic makeup will influence the breeding herd for many years. Most feedlot managers look to purchase cattle they expect to have a high average daily gain, low feed-to-gain ratio, high dressing percentage and superior carcass quality because these characteristics improve the likelihood of profitability. Similarly, cow-calf producers select replacement females based on maternal characteristics and the expectation of calf performance.

When purchasing a bull through an auction, bull buyers generally determine the value of the bull by evaluating phenotypic traits (age, structure, frame, birthweight, breed, etc.), performance measurements (average daily gain, weaning weight, yearling weight), and expected progeny differences (EPDs) (birth weight, calving ease, weaning weight, yearling weight, carcass quality, etc.), which are estimates of how future progeny will perform, on average, for a given trait. A producer's willingness to pay for a bull will vary based on these value-determining factors and how the bull fits the producer's breeding program.

Several studies have evaluated the impact of EPDs on the price of bulls (Dhuyvetter et al. 1996; Chvosta, Rucker, and Watts 2001; Jones et al. 2008; Vestal et al. 2013; Brimlow and Doyle 2014). However, none of these studies evaluated the value that cow-calf producers in Tennessee or the southeastern United States place on certain bull characteristics. Thus, evaluating the value Tennessee cow-calf producers place on certain traits could provide insight into regional differences in bull trait values and assist seedstock producers in meeting the demands of bull buyers in the region.

Additionally, Tennessee and Kentucky have implemented cost-share programs that reimburse producers for the purchase of breeding livestock meeting a specific EPD profile. The Tennessee Department of Agriculture (TDA) offers partial cost reimbursement for bulls through the Tennessee Agricultural Enhancement Program (TAEP) (TDA, 2017). A producer can qualify for up to $1,200 annually in cost share for bull genetics but cannot exceed 50 percent of the bull value. For TAEP reimbursement, bulls are categorized as balanced, calving ease or terminal. All three bull categories must meet minimum standards for calving ease and growth EPDs, while balanced and calving ease bulls must also meet minimum maternal EPD characteristics. These programs were structured to assist producers in improving the genetics of their herds and increase the value of the calves. However, it is unclear if the cost-share program has truly acted as a cost-share program or if it has simply inflated bull prices. Thus, it is important to evaluate if cost-share dollars are being retained by the bull purchaser or if those dollars are being passed on to the bull seller.

The objective of this study was to estimate Tennessee cow-calf producers' value of phenotypic traits, performance measurements and EPDs over time, while also evaluating how a partial-cost reimbursement program for bulls sold in Tennessee impacts sale prices. These findings provide purebred seedstock producers with information on the value of individual bull selection criteria, as well as provide information to state policy makers as to how the reimbursement program influences bull prices.

Bull Sale Overview

The University of Tennessee Bull Testing Station at the Middle Tennessee AgResearch and Education Center in Spring Hill, Tennessee, has held an annual sale of performance-tested bulls since 1970. Breeders deliver bulls to the test station in August, and the bulls are provided a two-week adjustment period before starting an 84-day weight gain test. At the end of the test period, bulls are weighed to calculate total weight gain and average daily gain. Additionally, measurements of hip height, frame score and sale weight are recorded and included in the sale catalog, along with pretest information such as birthweight and weaning weight. The sale catalog also

includes EPDs and ultrasound data such as fat thickness, ribeye area and intramuscular fat.

Estimation and Data

Table 1 provides an explanation of the variables included in this study, while **Table 2** provides the summary statistics of those variables. Sale data for this study is from 2006-2016 and only includes Angus bulls, since very few of the bulls sold during this time period were breeds other than Angus. **Figure 1** contains the annual average price paid for bulls sold through the University of Tennessee Bull Testing Station from 2006-2016. **Table 3** shows annual bull trait averages of the animals sold in the University of Tennessee Bull Testing Station during the study period.

Table 1. Description of the Dependent and Independent Variables Used in the Hedonic Price Model for Bulls Sold in Tennessee From 2006-2016

Variable	Description
Sale price	Price of bull sold
Projected growth EPD	The difference between the Weaning Weight EPD and Birth Weight EPD in pounds, which is a proxy for projected growth rate of the calves sired by a bull.
Calving ease direct EPD	Predicts the average differences in percentages in ease with which a sire's calves will be born when bred to first-calf heifers. Higher values indicate greater calving ease.
Milk EPD	Predictor of the differences in average weaning weight of a sire's daughter's progeny due to milking ability
Average daily gain	Average daily gains during 84-day gain test (pounds)
Weight	Weight at sale (pounds)
Frame score	Hip height, in inches, at 365 days converted to frame size or body type on a 1-9 scale where 1 is extremely small and 9 is extremely large and late maturing.
Cost reimbursement eligible	= 1 if the bull is eligible for Tennessee Agricultural Enhancement Program cost-share payment, 0 otherwise

Source: Boyer, C.N., K. Campbell, A.P. Griffith, K.L. DeLong, J. Rhinehart, and D. Kirkpatrick. 2019. "Price Determinants of Performance Tested Bulls Over Time." *Journal of Agricultural and Applied Economics* 51(2):304-314. doi:10.1017/aae.2019.3.

Table 2. Summary Statistics for Bulls Sold in Tennessee from 2006-2016

Variable	Number of Observations	Mean	Standard Deviation	Minimum	Maximum
Sale price ($/head)	1,098	2,790	1,146	700	8,250
Projected growth EPD (lb)	1,089	49.15	8.64	-2.06	78.50
Calving ease direct EPD (%)	1,072	5.51	3.87	-11.00	59
Milk EPD (lb)	1,092	25.24	5.78	0.26	85
Average daily gain (lb/day)	1,097	4.57	0.56	3.07	6.39
Weight (lb)	1,097	1,367	145.86	951	1,790
Frame score (scale 1-9)	1,098	6.05	0.58	5.00	7.80
Cost reimbursement eligible (binary variable, 0 or 1)	1,098	0.76	0.43	0	1

Source: Boyer, C.N., K. Campbell, A.P. Griffith, K.L. DeLong, J. Rhinehart, and D. Kirkpatrick. 2019. "Price Determinants of Performance Tested Bulls Over Time." *Journal of Agricultural and Applied Economics* 51(2):304-314. doi:10.1017/aae.2019.3.

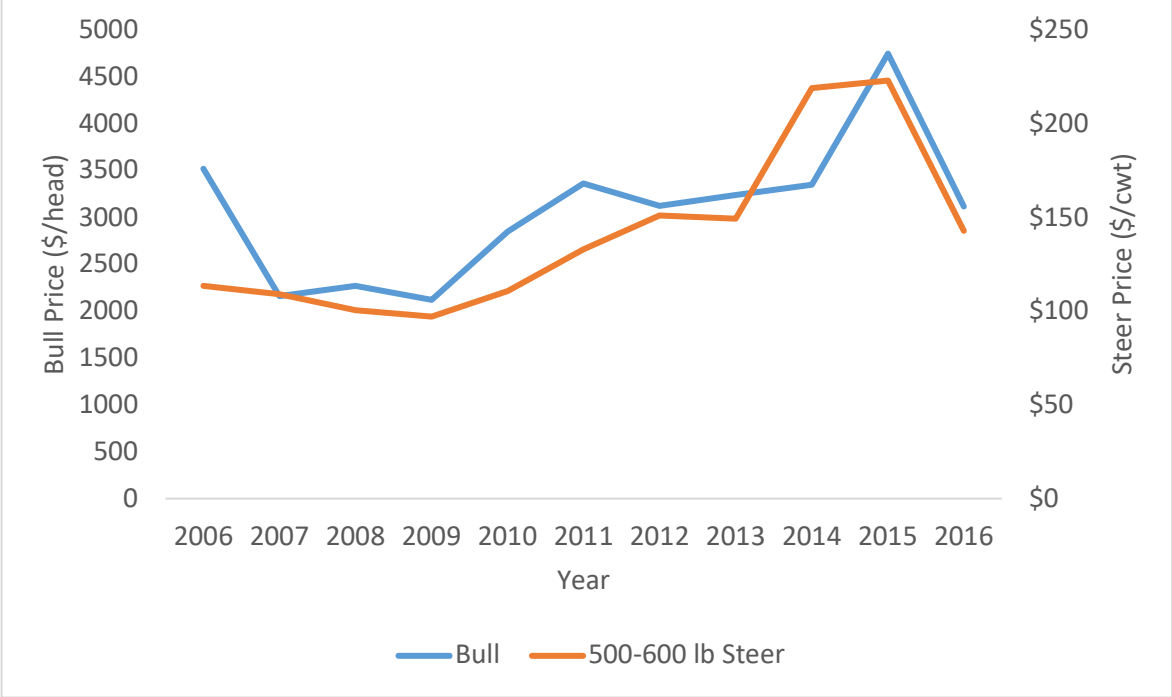

Figure 1. Average Price Paid (Per Head) for a Bull Sold in the University of Tennessee Bull Testing Station Sale from 2006-2016 by Year and Average, 500-600 Pound Steer Price ($/cwt).

Table 3. Average Values of Bull Traits Sold in University of Tennessee Bull Test from 2006-2016 by Year

	Projected growth EPD (lb)	Calving ease direct EPD (%)	Milk EPD (lb)	Average daily gain (lb)	Weight (lb)	Frame score (scale 1-9)	Cost reimbursement eligible (0 or 1)
2006	41.43	4.73	22.66	4.42	1,383	6.21	0.71
2007	42.27	5.22	22.22	4.24	1,355	6.19	0.56
2008	45.33	5.71	24.04	4.32	1,379	6.11	0.62
2009	48.83	5.89	24.47	4.84	1,404	6.02	0.12
2010	48.75	5.62	25.47	4.85	1,429	6.39	0.76
2011	50.94	5.72	25.40	4.85	1,366	6.26	0.99
2012	49.86	6.00	26.79	4.57	1,306	6.02	0.93
2013	52.54	5.42	28.38	4.66	1,355	5.90	0.98
2014	54.11	5.49	28.44	4.51	1,346	5.85	0.97
2015	58.96	4.46	25.18	4.80	1,359	5.85	0.99
2016	54.28	6.28	24.91	4.39	1,378	5.59	0.94

Source: Boyer, C.N., K. Campbell, A.P. Griffith, K.L. DeLong, J. Rhinehart, and D. Kirkpatrick. 2019. "Price Determinants of Performance Tested Bulls Over Time." *Journal of Agricultural and Applied Economics* 51(2):304-314. doi:10.1017/aae.2019.3.

Results

The growth EPD, which was formulated by subtracting the birthweight EPD from the weaning weight EPD, was significant for all but two years evaluated (2006, 2009). A 1-pound increase in the growth EPD increased the average bull price up to $53 per head, depending on the year (Table 4).

Table 4. Impact of Bull Traits on Average Sale Price ($/head) by Year

	Projected growth EPD (lb)	Calving ease direct EPD (%)	Milk EPD (lb)	Average daily gain (lb)	Weight (100 lb)	Frame score (0.1 change)	Cost reimbursement eligible (0 or 1)
2006	12	106***	-14	-49	245***	53***	447***
2007	33***	78***	36**	1,244***	134***	79***	107
2008	43***	119***	35**	701***	269***	68***	40
2009	15	72***	46***	29	271***	98***	91
2010	53***	89***	11	411***	97**	38***	84
2011	22***	69***	14	197**	198***	38***	204
2012	26***	36***	-8	394***	335***	39***	60
2013	25***	100***	21	220**	371***	25***	323
2014	33***	88***	8	171**	205***	31***	214
2015	21***	93***	17	369**	185**	45***	935***
2016	23**	42***	18	428***	341***	42***	38

Asterisks (***, **) denote significance at the 0.01 and 0.05 levels, respectively.
Source: Boyer, C.N., K. Campbell, A.P. Griffith, K.L. DeLong, J. Rhinehart, and D. Kirkpatrick. 2019. "Price Determinants of Performance Tested Bulls Over Time." *Journal of Agricultural and Applied Economics* 51(2):304-314. doi:10.1017/aae.2019.3.

A 1 percent increase in calving ease direct EPD increased the average price of bulls between $36 per head and $119 per head, depending on the year (Table 4). Calving ease direct was the only EPD significantly impacting price every year of the study. Given the findings for the projected growth and calving ease direct EPDs suggests that cow-calf producers in the southeast United States value bulls that produce lighter calves at birth, which generally reduces calving stress.

A one-pound increase in milk EPD resulted in an increase in the average price of bulls in three out of the 11 years studied (2007-2009). However, this EPD measurement has not significantly influenced the price of bulls since 2010, which would insinuate that producers are placing less emphasis on a high milk EPD.

Performance and phenotypic variables were important factors to bull buyers as average daily gain (all years except 2006 and 2009), sale weight and frame score were significant and positively related to sale price in this study. These results demonstrate that bull buyers value larger bulls over smaller bulls, and they value bulls that can gain weight faster. An increase in average daily gain by 1 pound resulted in the average bull price increasing up to $1,244 per head (2007) (Table 4).

Sale weight and frame score were significant every year of the study. However, the influence of a change in sale weight and frame score on the average price of a bull varied by year. In 2013, a change in sale weight impacted the average sale price the most ($371 per head), but it was also the year producers valued a change in the frame score the least ($25 per head) (Table 4). Overall, seedstock producers should expect to receive a higher price for physically larger bulls and more mature bulls ready to start breeding females.

Lastly, TAEP partial-cost reimbursement payments were found to increase the price of bulls in 2006 by $447 per head and in 2015 by $935 per head (Table 4). The TAEP reimbursement program did not significantly impact the price of bulls in any of the other years analyzed based on the study model. At first glance, these results would indicate that most of the $1,200 reimbursement payment was retained by cow-calf producers and not passed on in the way of higher bull prices to bull sellers. However, the calculated growth EPD and the calving ease direct EPD, which are both important criteria for bulls qualifying for the TAEP cost-share, were significant most years and increased the value of bulls. Thus, these two EPDs may be capturing value that otherwise could be contributed to the cost-share program. The two years when the TAEP payment increased, bull prices were the first year for bull genetics through TAEP (2006) and when cattle prices were historically high (2015). Visually analyzing bull prices in Figure 1, bull

prices were highest in 2015, which was most likely because of the record high calf values. This suggests that in periods of high commodity prices, cost-share payments could result in higher farm input costs in auctions such as breeding stock purchases.

Conclusion

This research evaluates bull buyers' value for phenotypic traits, performance measurements and EPD measurements using 11 years of bull sale data in Tennessee, while also evaluating how a cost reimbursement program for bulls influences the sale price. Calving ease direct EPD, sale weight and frame score influenced the price of bulls in every year of the study. An increase in these traits resulted in a higher bull price on average, which suggests that cow-calf producers in this region value large, mature bulls that produce calves that result in fewer difficult births. Similarly, projected growth EPD and average daily gain increased the sale price of bulls in every year but 2006 and 2009. Lastly, the cost-share reimbursement program significantly increased bull price in only two of the 11 years evaluated.

Overall, seedstock producers in Tennessee should focus on producing large frame, growth-oriented bulls that produce calves that will reduce the occurrence of calving stress. Tennessee policy makers can use this information to evaluate if the TAEP cost-share dollars are being retained by the cow-calf producer or if they are being transferred to seedstock producers in the form of higher bull prices. Based on the findings of this study, it would appear that cow-calf producers retain the cost-share payment more frequently than it is passed to purebred seedstock producers. However, it can be difficult to fully separate the cost-share payment from other variables.

The authors understand that these results are based on one bull sale in Tennessee and may not be representative of all the bulls sold in Tennessee. Additionally, the estimated value of the reimbursement payment might be causing the value of EPDs to be underestimated since TAEP qualification depends on EPD values for calving ease, growth and maternal characteristics.

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