An Evaluation of Purebred Bull Pricing: Implications for Beef Herd Management

By Rebecca Atkinson, Dwight R. Sanders, Karen Jones, and Ira J. Altman

Abstract

The selection of herd bulls is important in determining profitability of commercial ranchers and cow-calf operators as well as purebred producers. In this research, the key attributes of bulls – based on visual, performance, and ultrasound data – are valued using a traditional hedonic pricing model. The data are collected from the annual bull test trial and sale at Southern Illinois University Carbondale. The results suggest that buyers at the SIUC Beef Evaluation Station are willing to pay more for bull characteristics associated with calving ease and weaning weights. For instance bulls with a combination of both lower birth weight Expected Progeny Differences (EPDs) and high yearling weight EPDs than average can command premiums of over $1,150 per head or 67 percent above the average sale price. Farm managers can use this information in the selection of herd bulls while purebred operators can attempt to select for the most valuable traits.

Introduction

Herd bulls can influence over 90 percent of the genetic changes in a commercial beef herd (White, Zollinger, and Colyer, 1993). Heritable traits such as calving ease, milk production, and ultimately weaning weights can have a significant influence on farm profitability. Indeed, investing in a quality bull can be one of the most economical ways for farm managers to increase the value of their production (Cleere, 2006). Therefore, the selection of a herd bull is an important decision for commercial ranchers, farm managers, and cow-calf operators. Likewise, purebred producers may want to emphasize certain traits when marketing and selecting bulls. Here, we use a unique data set from the Southern Illinois University Carbondale (SIUC) Bull Test Station to identify and value those traits which command a market premium. A hedonic pricing model is estimated to place a marginal value or "price" on each measurable characteristic.




Rebecca Atkinson is an Assistant Professor of Animal Science, MC – 4417, Southern Illinois University, Carbondale, Illinois, 62901, phone: 618 453-5000, e-mail: ratkinsn@siu.edu. Dr. Atkinson specializes in beef nutrition and earned a Ph.D. from the University of Wyoming in 2006. Dr. Atkinson has organized and administered the SIUC Bull Test Station since 2006.

Dwight R. Sanders is a Professor of Agribusiness Economics, Mailcode 4410, Southern Illinois University, Carbondale, Illinois, 62901, phone: 618 453-1711, fax: 618 453-1708, e-mail: DwightS@siu.edu. Dr. Sanders has held forecasting and risk management positions with The Pillsbury Company and Darden Restaurants, Inc.

Karen Jones is an Associate Professor of Animal Science, MC – 4417, Southern Illinois University, Carbondale, Illinois, 62901, phone: 618 453-2329, e-mail: kljones@siu.edu. Dr. Jones specializes in genetics and reproductive physiology. Dr. Jones organized and administered the SIUC Bull Test Station from 2004-2006 and continues to act as a consultant.

Ira J. Altman (contact author) is an Assistant Professor of Agribusiness Economics, Mailcode 4410, Southern Illinois University, Carbondale, Illinois, 62901, phone: 618 453-1711, fax: 618 453-1708, e-mail: IAltman@siu.edu. Dr. Altman's research interests include renewable energy markets and the development of biomass supply chains.

Hedonic pricing models have been widely used in the literature to price the expected performance differences of an animal's future offspring or EPD's (Expected Progeny Differences). Simply put, an EPD quantifies how strong a particular characteristic is expected to materialize in a particular animal's offspring. The value of EPDs has been assessed for carcass characteristics in bred heifers (Parcell, et al.), racing potential in thoroughbred yearlings (Vickner and Koch, 2001), milking traits of dairy bulls (Richards and Jeffrey, 1995), market value of milk components (Gillmeister, Yonkers, and Dunn, 1996), feeder cattle characteristics (Coatney, Menkhaus, and Schmitz, 1996), as well as the quality factors in grains (Brorsen, Grant, and Rister, 1984). A few published studies have focused on the value of characteristics in purebred beef bulls. For instance, Dhuyvetter, Jones, Turner, and Marsh (2005) use a hedonic pricing model to estimate the market values assigned to EPDs as well as marketing factors such as order of sale, picture in sale catalog, and the retention of semen rights. The data for the study were from 1993 and intended to evaluate the relative efficacy of what at that time was a new performance predictor – EPDs. Here, we improve upon past studies by using visual, performance, and ultrasound data to measure a bull's potential.

SIUC Bull Test Station

SIUC has held an annual bull test trial since 1975 and is entering its thirty-fifth year of operation in fall of 2009. The facilities test the gain and feed conversion of up to seventy-two bull calves for a 112-day test period using a Calan-gate system which allows for the precise verification and measurement of each individual bull's feed intake. The objectives at the bull test station are to evaluate the ability of bulls to gain rapidly, measure the amount of feed required per pound of gain, and to provide a location where cattle breeders can purchase superior performance-tested bulls with excellent genetics.

Upon arrival to the test station bulls are fed a receiving ration during a 21 day adjustment and training period (to the Calan-gates). The bulls are then fed a high concentrate low roughage growing ration on a free choice basis for the 112-day test period. Both rations are formulated to meet the National Research Council's requirements for growing bulls.

Data

The sale price (per head) for each bull at the SIUC bull test sale is recorded along with the characteristics that can influence price. Cleere (2006) identifies four selection tools for evaluating and choosing bulls: visual characteristics (e.g., breed and frame size); performance records (e.g., birth weight and EPDs); ultrasound measurements (e.g., ribeye area and back fat thickness); and genetic markers. The latter, genetic markers, are not widely available and are excluded from this analysis. Instead, the focus is on the visual characteristics, performance records, and ultrasound measurements presented in Table 1. Marketing-related data – such as sale order, placement in catalog, and seller – were not considered in this analysis as each annual sale is relatively small (48 head on average) and catalog entries are nearly identical.

Data are collected from the nine annual SIUC Bull Test sales from 2001-2009 for a total of 436 animals. As shown in Table 1, Angus comprise the majority of the bulls with 66 percent (286 head), followed by Charolais (8%), Simmental (8%), and polled Hereford (5%). The remaining breeds make up a small minority of the sales with only Red Angus and Limousin having more than three percent of the total. Despite the small numbers, the diversity of breeds is important in determining the relative values assigned to individual breeds. Sale prices may reflect breed preferences due to reputation or the ability to market calves into branded beef programs such as Certified Angus Beef (CAB).

The other visual characteristics recorded include frame score, scrotal circumference, and pelvic area. The frame score is an index based on the animal's hip height and age. The scrotal circumference is associated with future semen production and the pelvic area predicts calving ease in the bull's daughters. Generally, cow-calf operators will prefer a moderate to large frame, more fertile animals, with adequate pelvic area to promote calving ease in retained heifers. So, a positive price relationship is expected with these three visual characteristics.

The performance characteristics reported in Table 1 will also likely influence the sale price of the bulls. Higher birth weights can be associated with calving problems. So, birth weights will likely have a negative relationship with sale prices, while a higher yearling weight is desirable and should result in a higher sale price. An ideal bull produces calves with low birth weights (calving ease) and high yearling weights (more pounds of feeder calves sold). As a result, the average daily gain and the feed efficiency (feed:gain) should be rewarded with a higher sale price, all else equal.

The remaining performance characteristics are the EPDs. These numbers can be positive or negative, and they reflect the difference in expected performance of the future offspring of an animal (Greiner, 2009). For example a bull with a birth weight EPD of +5 would be expected to produce calves, on average, that weighed four pounds more than a bull of the same breed with a birth weight EPD of +1. Given the calving difficulty associated with large calves, it is expected that buyers will discount bulls expected to produce heavy calving weights (high birth weight EPDs).

Weaning weight and yearling weight EPDs reflect the expected differences in these weights due to the genetic impact of the bulls, not external factor such a milking ability of the cow or rations fed. For example, a bull with a yearling weight EPD of +50 is expected to produce a yearling calf that weighs 30 pounds more than a like bull with a yearling weight EPD of +20. All else equal, cow-calf producers will prefer heavier weaning weights to maximize the pounds of feeder calves sold. Likewise, a higher price will be paid for higher yearling weight EPD's which are also reflective of feedlot performance (Greiner, 2009).

Maternal milk EPDs are a measure of the relative milk production of a bull's daughter as captured by the difference in weaning weights of grandprogeny (calves by daughters). So, a bull that produces superior daughters in terms of milk production might have a maternal milk EPD of +20 versus an alternative bull with a maternal milk EPD of +10 (indicating a 10 pound lighter weaning weight for second generation calves compared to those of the superior bull). While higher milk production is generally desirable, it often comes with additional animal maintenance costs (Greiner, 2009). Therefore, it is not clear that buyers will be willing to pay a higher or lower price for greater maternal milk EPDs in bulls.

The final selection criteria for evaluating bulls are collected by ultrasound and include exterior or rib fat thickness, ribeye area, and intramuscular fat. Rib fat thickness or exterior fat is indicative of a lower yielding carcass and should receive a price discount. Conversely, a large ribeye area indicates a higher yielding carcass and one that has a greater proportion of high-value primal cuts (loin and rib). Larger ribeye area should receive higher prices among bulls sold. Intramuscular fat is a proxy for marbling, where meat with greater marbling is more likely to grade higher (choice or prime grade versus select). Bulls with greater intramuscular fat should bring higher prices as buyers expect this trait to be passed along to progeny.

Along with the above physical criteria, data are collected for the local market or slaughter value for bulls. The local market value is calculated as the weight per pound multiplied times the USDA reported price for slaughter bulls in southeast Missouri. The southeast Missouri auctions (Fruitland and Patton) are the closest livestock auctions to Carbondale, Illinois (60 and 72 miles, respectively). The slaughter market value for the bulls at these locations represents the lowest economic value for the animals and controls for year-to-year fluctuations in the overall cattle market. That is, a buyer at the Bull Test sale could always purchase the bulls and simply truck them to these auctions for re-sale. Hence, the auction or slaughter values serve as a way to track the minimum value of the bulls as well as controlling for year-to-year changes in overall market conditions. The slaughter value along with sale prices and age are presented in the lower portion of Table 1. In the next section, a model for valuing the characteristics is presented.

Hedonic Pricing Model

A hedonic pricing model is simply a regression model that values the incremental or marginal contribution of a product's characteristics to its overall or total value. Simplistically, the total value of a product (dependent variable) is regressed against the quantity of each characteristic contained within the product (independent variables). The estimated coefficients are the marginal value or "price" of each characteristic. A simple expression of the estimated model is as follows,

$$\text{(1)} \qquad \text{Sale Price}_{i,t} = \alpha_1 + \theta_1 SlaughterValue_{i,t} + \sum_{i=1}^{n} \beta_i Characteristic_i + \varepsilon_{i,t}$$

Where, the Sale Pricei,t is the sale price for bull i in year t; Slaughter Valuei,t is the local slaughter value of animal $_i$ in year $_t$; and Characteristici is the measure of the visual, performance, and ultrasound characteristics for animal $_i$ as presented in Table 1. The unexplained variance or residual is captured in the error term, $\varepsilon_{i,t}$.

Equation (1) is estimated using ordinary least squares. The residuals display heteroskedasticity; so, the variance-covariance matrix is re-estimated using White's heteroskedastic consistent estimator. Because of missing data points, there were 83 unusable observations resulting in a final model estimated over a sample of 353 bulls.

Results

The estimated coefficients for equation (1) are presented in Table 2 along with the corresponding standard errors, t-statistics, and p-values (two-tailed, t-test). The estimated model had an adjusted R-squared value of 0.42. As shown by the slaughter value variable, the year-to-year fluctuations in market prices are important and bulls sold from the SIUC Bull Test basically move in tandem with their values in slaughter. The estimated coefficient, 1.48, is statistically different from zero at the 10 percent level; so, if market values decrease by $100 per head, then the average bull sold will decrease by $148 per head. It is important to note that the estimated coefficient is not statistically different from 1.00 which suggests that the average bull test sale price essentially moves with the market, all else equal.

The breed values are tested with Angus as the base case and the other breed variables are dummy or binary variables. For example, the variable Simmental equals one if the animal is a Simmental and equals zero otherwise. The estimated coefficients on the breed variables can be interpreted as the breed's average dollar per head premium or discount relative to Angus, holding all other variables constant. Among the breed variables, only three of the estimated coefficients are statistically significant at the 10 percent level. Charolais bulls received a $313 premium to Angus, while Angus crossed with Simmental and Gelbvieh receive discounts of $774 and $724 per head, respectively. The discounts for the Angus-cross bulls may be a statistical anomaly resulting from the paucity of observations or it could be due to uncertainty amongst buyers in regards to the traits carried by a cross-breed bull. The premium for Charolais bulls is a bit unusual given the commonly accepted notion that "black" cattle are preferred. However, the estimated premiums for Charolais are consistent with the findings of Dhuyvetter, Jones, Turner, and Marsh (2005).

The other visual characteristics of the bulls, frame score, scrotal circumference, and pelvic area have the expected positive signs on the estimated coefficients. However, only the frame score is statistically significant at the 10 percent level. The estimated coefficient suggests that a one unit increase in the frame score increases the sale price by $93, all else equal. The scrotal circumference and pelvic area have positive coefficients, as expected, but they do not have a statistically significant impact on price. This may be because they are visually more difficult to appraise.

The first two performance measures, birth weight and adjusted yearling weight, have the expected signs and they are statistically significant (10% level). Each additional pound of birth weight decreases a bull's sale price by $10, reflecting the expected losses due to calving difficulty. Conversely, each incremental pound of adjusted yearling weight – an indicator of total pounds of calves sold and feedlot performance – increases the sale price by $1.58. These findings are directionally consistent with the estimates made by Holt, Fields, Prevatt, and Kriese-Anderson (2004) and Smith (2007).

The feed performance measures specifically associated with the SIUC bull test – average daily gain and feed efficiency (feed to gain) – have the expected signs. As expected, the average daily gain is a statistically (10% level) and economically important performance measure, where a one pound per day increase in the gain raises a bull's sale price by $209. Surprisingly, buyers did not discriminate among the bulls' efficiency in achieving daily gains. While the estimated coefficient on the feed-to-gain ratio is positive, it is not statistically different from zero. Given the escalating price of feed in recent years, it is not clear why efficiency was not reflected in the sale prices.

EPDs are widely used to evaluate breeding stock. However, among the four EPDs available for the Bull Sale, only two were statistically important (10% level) in determining sale price. The EPDs for weaning weight and maternal milk are not statistically important. For weaning weights, this may be due to the relatively high correlation (0.93) with yearling weight EPDs. For maternal milk, the lack of significance may stem from the trade-off between the benefits and costs of additional milk production.

As expected, buyers discounted bulls that have EPDs predicting high birth weight calves. Each one pound increase in birth weight EPD lowered a bull's sale price by $126. For instance, the average birth weight EPD in our sample was +2.3. The highest birth weight EPD was +7.0. All else constant, the bull with the highest birth weight EPD would bring $592 less than the average bull [(7.0-2.3) x 126 = 592].

The yearling weight EPD is also statistically significant at the 10 percent level. The estimated coefficient shows that for each one pound increase in the yearling weight EPD a bull's value increases by $13. In our sample, the yearling weight EPD varies from +13 to +115 with an average of +71, suggesting a potential price difference of $572 [(115-71) x 13] between the highest and average bull based on the expected yearling weights associated with the bulls' progeny. This estimate is similar to the $15 value placed on yearling weight EPD by Holt, Fields, Prevatt, and Kriese-Anderson (2004). The economic value placed on yearling weight EPDs most likely reflects the desirability for cow-calf operators to sell heavier calves.

The final three estimated coefficients reflect the value assigned to ultrasound data for rib fat, ribeye area and intramuscular fat (marbling). Other researchers (see Holt, Fields, Prevatt, and Kriese-Anderson, 2004) have failed to find significant price impacts due to these factors. Likewise, our results show that buyers of purebred bulls do not rely heavily on ultrasound data when pricing herd bulls. The estimated coefficients have the expected signs on additional rib fat (negative) and ribeye area (positive), while intramuscular fat has an unexpected sign (negative). However, only the coefficient on ribeye area is even marginally significant with a p-value of 0.12. While carcass traits such as these are clearly important for grading and valuing slaughter animals, buyers of purebred bulls give them very little emphasis. Even though these traits are medium to highly heritable it may be that the buyers (mostly cow-calf operators) do not place much emphasis on them because they do not receive a direct benefit from carcass quality. Rather, they may concern themselves with characteristics which directly impact their operation, such as calving ease.

Summary and Discussion

A hedonic pricing model is estimated for 353 bulls sold from 2001-2009 at the SIUC Bull Test sale. The model holds market or slaughter bull values constant and estimates the incremental value of the bulls' visual, performance, and ultrasound characteristics. A few consistent themes reveal themselves through the data.

Buyers at the SIUC Bull Test sale are predominantly commercial cow-calf operators who are purchasing a herd bull. So, they are most likely selling weaned (400-500 lb.) or yearling (700-800 lb.) feeder calves for placement into feedlots. Jones and Simms (1997) list four primary factors that impact profitability in cow-calf operations: 1) production costs; 2) percent of cows weaning a calf; 3) selling weight of calves; and 4) prices received for calves. The selection of a herd bull can directly impact two of these profitability factors: percent of cows weaning a calf and selling weight of calves. A bull that promotes calving ease can increase the percent cows weaning a calf (percent calf crop). Likewise, a bull that produces heavier weaning or yearling weight calves can increase the total output (weight of calves) sold by the cow-calf operator. In short, the cow-calf operator wants a calf that is born small but grows quickly. This theme is clearly reflected in the pricing factors estimated with the SIUC Bull Test data.

The Angus breed – known for ease of calving – was the most frequent sold at the SIUC Bull Test. Only purebred Charolais bulls command a premium to Black Angus. The estimated hedonic model found a consistent tendency for buyers to discount high birth weights. Each bull's own birth weight as well as their birth weight EPD was associated with lower sale prices. Each additional pound of own birth weight lowered a bull's sale price by $10.

All else equal, bulls with larger frames (frame score) and the ability to gain weight quickly (average daily gain) also brought higher auction prices. Bulls that showed an ability to gain weight quickly commanded a premium of $165 for each incremental pound of average daily gain. Similarly, those characteristics associated with larger sized yearling calf weights brought a premium in the auction. The bull's own adjusted yearling weight as well as the yearling weight EPD was positively associated with higher sale prices. For instance, each incremental one pound increase in yearling weight EPD's was worth a marginal $13 in the final sale price. A combination of lower than average birth weight EPD and higher than average yearling weight EPD could add $1,164 to the top bull price compared to the average bull. These valued characteristics are all consistent with the factors impacting profitability of traditional cow-calf producers.

It may not be surprising that ultrasound measures – associated with carcass quality – were not particularly important in pricing. The rewards to higher quality carcasses generally flow to the feedlot operator or the packer. The cow-calf operator who does not retain ownership through the finishing process is not directly rewarded for carcass merits. However, they are directly impacted by factors that determine their percentage calf crop and feeder calf weights. So, not surprisingly, our data suggest that these are the bull characteristics that are valued most highly in the marketplace.

References

Brorsen, B.W., W.R. Grant, and M.E. Rister. "A Hedonic Price Model for Rough Rice Bid/Acceptance Markets." *American Journal of Agricultural Economics*. 66(1984):156-163.

Cleere, J. "Bull Selection: An Investment in Your Beef Herd's Future." *The Cattleman*. October, 2006. (http://www.thecattlemanmagazine.com/issues/2006/1006/bullselection.asp).

Coatney, K.T., D.J. Menkhaus, and J.D. Schmitz. "Feeder Cattle Price Determinants: An Hedonic System of Equations Approach." *Review of Agricultural Economics*. 18(1996):193-211.

Dhuyvetter, K., R. Jones, T. Turner, and T. Marsh. "Economic Values Associated with Expected Progeny Differences (EPD) for Angus Bulls at Auction." *Beef Cattle Research*. 943(2005): 79-85.

Dhuyvetter, K.C., T.C. Schroeder, D.D. Simms, R.P. Bolze Jr., and J.Geske. "Determinants of Purebred Beef Bull Price Differentials." *Journal of Agricultural and Resource Economics*. 21(1996):396-410.

Gillmeister, W.J., R.D. Yonkers, and J.W. Dunn. "Hedonic Pricing of Milk Components at the Farm Level." *Review of Agricultural Economics*. 18(1996):181-192.

Greiner, S. "Understanding Expected Progeny Differences, EPDs." Virginia Cooperative Extension Publication 400-804, May 1, 2009.

Holt, John D. Deacue Fields, J. Walt Prevatt, Dr. Lisa Kriese-Anderson. "Producer Valuation of Herd Bull Characteristics." American Agricultural Economics Association Annual Meeting. Denver, Colorado. 1-4 July 2004.

Jones, R.D., and D.D. Simms. "Improving Cow-Calf Profitability through Enterprise Analysis." Kansas State University Experiment Station, Publication MF-2259, April, 1997.

Lawrence, John D. and Godfred Yeboah. "Estimating the Value of Source Verification of Feeder Cattle." *Journal of Agribusiness*. 20(2002):117-129.

Marsh, John M.. "Impacts of Declining U.S. Retail Beef Demand on Farm-Level Beef Prices and Production." *American Journal of Agricultural Economics*. 85(2003).

McDonald, R. Allen and Ted C. Schroeder. "Fed Cattle Profit Determinants Under Grid Pricing." *Journal of Agricultural and Applied Economics*. 35(2003):97-106.

NRC. 1996. Nutrient Requirements of Beef Cattle. 7th ed. Natl. Acad. Press. Washington, DC.

Parcell, J.L., K.C. Dhuyvetter, D.J. Patterson, and R. Randle. "The Value of Carcass Characteristic EPD's in Bred Heifer Price." Proceedings of the NCCC-134 Conference on Applied Commodity Price Analysis, Forecasting, and Market Risk Management, St. Louis, Missouri (http://www.farmdoc.uiuc.edu/nccc134).

Richards, T.J., and S.R. Jeffrey. “Hedonic Pricing of Dairy Bulls- An Alternative Index of Genetic Merit.” Alberta Agricultural Research Institute Project 94M658, Project Report 95-04, University of Alberta.

Smith, J. “Hedonic Pricing of Bulls.” *SS-AAEA Journal of Agricultural Economics*. 2007. Article 3.

Vickner, S., and S.I. Koch. “Hedonic Pricing, Information, and the Market for Thoroughbred Yearlings.” *Journal of Agribusiness*. 19(2001):173-189,

Walburger, Allan and Kenneth Foster. “Using Censored Data to Estimate Implicit Values of Swine Breeding Stock Attributes.” *Review of Agricultural Economics*. 16(1994):259-268.

White, G.R., and W.A. Zollinger, and G. Colyer. “Choosing and Managing Young Bulls.” Oregon State University Extension Publication, EC 1035, June 1993.

Table 1. Summary statistics, SIUC bull sale, 2001-2009

	Characteristic	Mean	Standard Deviation	Maximum	Minimum	Expected Impact on Sale Price
Visual/Breed	Angus (head)	286				+
	Simmental (head)	33				-
	Charolais (head)	35				-
	Gelbvieh (head)	9				-
	Red Angus (head)	18				-
	Limousin (head)	17				-
	Angus x Simmental (head)	10				-
	Angus x Gelbvieh (head)	4				-
	Hereford (head)	20				-
	Shorthorn (head)	4				-
	Frame Score (index)	6.13	0.87	8.60	4.00	+
	Scrotal Circumference (cm)	38.67	2.92	49.00	32.00	+
	Pelvic (square cm)	173.94	21.55	249.00	123.00	+
Performance	Birth Weight (lbs.)	82	9	110	46	-
	Adjusted Yearling Weight (lbs.)	1297	114	1601	1026	+
	Average Daily Gain (lbs./day)	4.53	0.57	5.96	2.88	+
	Feed:Gain Ratio (lbs.)	5.97	0.61	8.78	4.57	+
	Birth Weight (EPD)	2.3	1.6	7.0	-2.9	-
	Weaning Weight (EPD)	38.6	10.5	64.0	5.0	+
	Yearling Weight (EPD)	71.0	18.6	115.0	13.0	+
	Maternal Milk (EPD)	18.2	7.0	34.0	-3.0	?
Ultrasound	Rib Fat (inches)	0.41	0.15	0.92	0.12	-
	Ribeye Area (square inches)	14.98	1.56	19.35	10.40	+
	Intramuscular Fat (percent)	3.48	1.12	7.11	1.07	+
Other	Age (weeks)	59	4	67	50	
	Sale Price (head)	1723	685	7000	700	
	Slaughter Value (head)	749	103	1017	464	

Table 2. Estimated coefficients and statistics, SIUC hedonic pricing model, 2001-2009

	Characteristic	Coefficient Estimate	Standard Deviation	t-statistic	p-value
	Constant Term	-4150.50	727.95	-5.70	0.0000
Market	Slaughter Value	1.48	0.29	5.03	0.0000
Visual/Breed	Simmental	-294.35	142.50	-2.07	0.0397
	Charolais	312.55	179.71	1.74	0.0829
	Gelbvieh	-153.19	148.55	-1.03	0.3032
	Red Angus	-157.92	130.61	-1.21	0.2275
	Limousin	36.77	246.93	0.15	0.8817
	Angus x Simmental	-773.54	196.39	-3.94	0.0001
	Angus x Gelbvieh	-724.40	145.62	-4.97	0.0000
	Hereford	30.22	132.54	0.23	0.8198
	Shorthorn	449.79	668.76	0.67	0.5017
	Frame Score	92.69	51.11	1.81	0.0707
	Scrotal Circumference	18.09	11.71	1.54	0.1234
	Pelvic	1.53	1.79	0.86	0.3918
Performance	Birth Weight	-9.57	4.19	-2.28	0.0232
	Adjusted Yearling Weight	1.58	0.39	4.01	0.0001
	Average Daily Gain	208.61	72.87	2.86	0.0045
	Feed:Gain Ratio	47.33	54.29	0.87	0.3839
	Birth Weight (EPD)	-125.68	27.28	-4.61	0.0000
	Weaning Weight (EPD)	-7.45	9.30	-0.80	0.4238
	Yearling Weight (EPD)	13.38	5.73	2.34	0.0201
	Maternal Milk (EPD)	1.91	5.75	0.33	0.7398
Ultrasound	Rib Fat	-241.92	277.31	-0.87	0.3836
	Ribeye Area	35.72	22.91	1.56	0.1200
	Intramuscular Fat	-22.12	30.55	-0.72	0.4696