Value of Minimum Sire Accuracy Traits in Bred Heifer Price

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Selected Paper prepared for presentation at the Agricultural & Applied Economics Association's 2011 AAEA & NAREA Joint Annual Meeting, Pittsburgh, Pennsylvania, July 24-26, 2011

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Abstract

The product life cycle of the new value added marketing strategy that a quality heifer program created in adding, a new product (heifers with additional value characteristics) is explored. The new product that will be examined is related to the Show-Me Select Heifer Replacement program. The Tier II program has essentially created a new product (higher quality bred heifers) by using minimum EPD accuracies for calving ease along with expected calf and carcass performance measurements. The hedonic study shows that that the Tier II heifers receive a premium compared to traditional Show-Me-Select heifers. The first year Tier II heifers came on the market in 2008 they received a discount of $24 as compared to regular Show-Me-Select Heifers. However, the following year the Tier II heifers received a premium of $138 while dropping to a premium of $46 in 2010. It appears since the Tier II program is in an infancy stage where premium values are still being determined.

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Introduction

By definition physical attributes of animals are bundled together, which makes it difficult for buyers or sellers to determine the value of a specific attribute. These attribute levels are either determined through genetics or management. Overtime management practices may lead to new or new levels of genetic characteristics being added to heifers, which in essence create a new product. Products have a natural profit life cycle in the aspect that profits will increase as sales increase, and as time goes on the competitive environment will drive profits to zero. This suggests the need for products to evolve over time into new products, e.g., product line extensions, so that positive profits continue to occur in the competitive economic setting. It is vital to understand the length of the product life cycle so that the ingenuity process timeline can be known in order to get new products into the market at the optimal time in order to preserve positive profits. A product's life cycle can be explored by examining the value of a new characteristic as a product changes over time.

Product life cycles or brand lines extensions have been rarely explored in the livestock sector. Product life cycles are investigated heavily in the area of marketing. This study will explore the product life cycle of the new value added marketing strategy that a quality heifer program created in adding, a new product (heifers with additional value characteristics). The premiums will be shown for this stacked value added product. The premiums will allow us to explore the product life cycle of this new product.

The new product that will be examined is related to the Show-Me Select Heifer Replacement program. Standards must be met with respect to management, production and genetics in order for heifers to qualify to be sold in Show-Me-Select sanctioned sales[1]. This program has been in existence since 1997. Over 84,000 heifers have been sold in Show-Me-Select sales over the program's life.

The program evolved in 2008, when the program created a higher quality standard for heifers known as the Tier II. If heifers' sires meet expected progeny difference accuracies, the heifer can be sold as a Tier II heifer. However, if the heifer doesn't qualify for the Tier II classification, it can still be sold as Show-Me-Select heifer if it meets the other basic requirements. The Tier II program has essentially created a new product (higher quality bred heifers) by using minimum EPD accuracies for calving ease along with expected calf and carcass performance measurements. Managing for minimum EPD accuracies is used to increase the probability of creating a higher quality offspring. EPD accuracies are indicators of reliability in EPD estimates. The higher the accuracy, the higher the probability that the offspring will meet an estimated EPD level. The value of the new Tier II added-value product attribute will be explored, along with the traditional characteristics of the Show-Me-Select heifers, to determine buyers' willingness-to-pay and how fast buyers react to the availability of a new animal attribute.

Producers who understand the value of specific heifer characteristics can make better culling and replacement decisions which affects the operation's profitability. Hedonic analysis can estimate the marginal implicit value of heifer characteristics. If a producer knows the consumer's relationship between purchases and product characteristics, they will be better able to maximize profit since they could aim to put appropriate amounts of characteristics in their products (Ladd & Suvannunt, 1976; Parcell, Franken, Cox, Patterson, & Randle, 2010). Cattle producers could use that information to better manage the type of offspring to produce in order to receive the most in profits.

Literature Review

One study examines the product and profit life cycle of a quality heifer program (Show-Me Select Heifers). Gedikoglu and Parcell (2009) found that marketing is vital to value added programs in order for the program to generate premiums and profits in the long-run. They found that the simulated price premiums were close to the actual premiums (Gedikoglu & Parcell, 2009).

A dairy bull hedonic study have been used to identify value of EPD characteristics along with bull popularity and the probability of whether the semen would be in short supply (e.g., Richards & Jeffrey, 1995). They suggest that hedonic pricing is a superior method of identifying the value of characteristics than a lifetime profit index. They argue that the representative average farm cost and returns data used to create a lifetime profit index likely does not represent all producers. They also point out that in lifetime indexes that average costs are used, while producers should be more concerned with marginal costs associated with genetic improvements. Richards & Jeffrey (1995) suggest that the hedonic model implicitly includes the lifetime contribution of the sire's offspring.

Previous research on price-characteristic relationship has been cow-calf pairs (e.g. Parcell, Schroeder & Hiner, 1995) and purebred bull (e.g. Dhuyvetter, Schroeder, Simms, Bolze & Geske, 1996). This research follows prior research by Parcell, Schroeder & Hiner, 1995; Parcell, Dhuyvetter, Patterson & Randle, 2006) where each study examined important characteristics (heifer characteristics, calf and carcass expected characteristics, and market factors) impacting heifer/cow price variation.

It has been found that females bred by artificial insemination receive a premium (Parcell et al., 1995, Parcell et al, 2006, Parcell, Schaefer, Patterson, John, Kerley & Haden, 2008). Females that will calve within a short span receive a premium (Parcell et al., 2006; Parcell et al, 2010). Synchronized AI heifers received a premium of $25-$80 per head (Parcell et al., 2010; Parcell et al., 2008). Parcell et al. (2006) found that buyers are willing to pay a higher premium for pens bred to the same sire. A heifer that is bred to an Angus sire has found to have a price premium (Parcell et al., 1995, Parcell et al., 2006).

A heifer's weight has been found to influence price (Parcell et al., 1995, Parcell et al., 2006) with weight normally being be expressed in a quadratic or squared weight term. However, Parcell et al. 2006 found a linear relationship between weight and price which is due to the program qualification of the heifers in their study. Parcell et al. (2006) specified birth weight in a natural logarithm functional in order that lower expected birth weights may be discounted relative to higher expected birth weights; however, the study did not find discounts for higher birth weights due to the nature of the data having minimum requirements for the EPD. Calf carcass characteristics have been found significant in explaining price which have included carcass weight, marbling and ribeye area (Parcell et al., 2006) with marbling and milk being specified in a logarithmic form so lower scores are discounted in that study.

Pen size has been commonly used as a predictor of animal value (Bailey, Peterson & Brorsen, 1991; Faminow & Gum, 1986; Parcell et al., 1995, Schroeder, Mintert, Brazle & Grunewald, 1988; Turner, McKissick & Dykes, 1993; Ward, 1992). Typically, buyers prefer larger lots and lots with heifers bred to the same sire paying the highest during the mid-point of the sale (Parcell et al., 2006)

Conceptual Framework

Hedonic price modeling can be used to estimate the marginal implicit value of product characteristics from variation in price among heterogeneous products. Lancaster (1971) and Rosen (1974) are often credited with deriving the theoretical underpinnings of the modern hedonic pricing models, but evidence of application of the hedonic model conceptual format can be traced to Court (1939) and further back to Waugh (1916).

The hedonic frameworks suggest that a heterogeneous product can be represented as an aggregation of homogenous characteristics (Chwelos, Berndt & Cockburn, 2004). Through hedonic modeling, a heterogeneous good can be viewed through its characteristic make-up. Grliche (1971) and Pakes (2001) have identified that the hedonic regression is a reduced form of optimizing behavior. Hedonic prices are implicit prices of product characteristics which are revealed through the prices of differentiated products (Rosen, 1974).

A consumer’s utility depends upon the amounts of specific characteristics in the products they purchase (Ladd & Suvannunt, 1976). The consumer selects a variety of products that gives a mixture of product characteristics to maximize their utility (Ladd & Suvannunt, 1976). Ladd & Suvannunt (1976) show that consumers’ demand for products depend on a product’s characteristics, prices and income. They explain that the price of a product equals the aggregated values of the product’s characteristics. The marginal value of each characteristic of a product equals the marginal implicit price of a characteristic multiplied by the marginal yield of the characteristic (Ladd & Suvannunt, 1976). If a premium is shown for certain characteristics and is more than large enough to cover the cost of incorporating the characteristic into the product, then the producer will adapt his product and marketing strategies to meet the market demand (Waugh, 1928).

The hedonic theoretical model for agricultural commodities is grounded with the research of Ladd & Martin (1976). Following from the work of Ladd & Martin and Ladd and Suvannunt (1976), the hedonic model framework will be extended to quality differentiated bred heifers to analyze hedonic model parameter stability. Bred heifers will be considered an input in order to produce calves.

Ladd and Martin (1976) explain that the input prices equals the summation of characteristic values. The characteristic value is found by multiplying the yield of the characteristic by the value of one unit of the characteristic (Ladd & Martin, 1976). The demand of a product is affected by the characteristics of the product (Ladd & Martin, 1976). Ladd and Martin's (1976) model is a neoclassical firm model that defines the production function as the amount of input characteristics needed for the production process. This model allows one to look at products that are heterogeneous (Ladd & Martin, 1976). Heterogeneity in products can be created by putting different amounts of characteristics in a product or one product containing a characteristic the other products do not have (Ladd & Martin, 1976). It can also arise if all of the products contain unique characteristics (Ladd & Martin, 1976). They look at the product as a collection of characteristics (Ladd & Martin, 1976).

The Ladd and Martin (1976) theoretical model will be used. First, the variables of the framework will be defined.

v_{ih}= quantity of the i^{th} input in the h^{th} product

r_i = price paid for the ith input

p_h= price received for product h

q_h= quantity of the hth output produced

x_{jih}= amount of characteristic j provided one unit of input i into product h

x_{jh}= total quantity of characteristic j into product h

This framework assumes that x_{jih} are parameters the producer cannot control. Where Equation 1, represent the production function for product *h*,

(1) $q_h = F_h(x_{1\cdot h}, x_{2\cdot h}, \ldots, x_{m\cdot h})$.

Equation 1 states that the output of *h* is influenced by the quantities of input characteristics. The total quantity of a characteristic can be influenced by characteristics of inputs that create that characteristic. Where this is defined in Equation 2 as,

(2) $x_{j\cdot h} = X_{jh}\left(v_{1h}, v_{2h}, \ldots, v_{nh}, x_{j1h}, x_{j2h}, \ldots., x_{jnh}\right)$.

Where the production function is expressed in Equation 3 as,

(3) $q_h = G_h(v_{1h}, v_{2h}, \ldots, v_{nh}, x_{11h}, x_{12h}, \ldots., x_{mnh})$.

The firm's profit maximizing function is defined in Equation 4 as,

(4) $\pi = \sum_{h=1}^{H} p_h\, F_h(x_{1\cdot h}, x_{2\cdot h}, \ldots, x_{m\cdot h}) - \sum_{h=1}^{H}\sum_{i=1}^{n} r_i v_{ih}$.

From the profit function, first order conditions can be expressed in Equation 5 as,

(5) $dF_h/\, dv_{ih} \;= \sum_j (dF_h \,/\, dx_{j\cdot h})(dx_{j\cdot h}/\, dv_{ih})$ that

$d\pi/dv_{ih} \;= p_h \sum_{j=1}^{m}(dF_h \,/dx_{j\cdot h})\,(dx_{j\cdot h}/dv_{ih}) - \; r_i = 0$

Where Equation 6 is found by rearranging Equation 5 to solve for r_i as,

(6) $r_i = p_h \sum_j (dF_h / d\, x_{j\cdot h})(dx_{j\cdot h}/dv_{ih})$.

$\partial x_{j.h}/\partial v_{ih}$ is the marginal yield of characteristic j of the hth product from the ith input; $\partial F_h/\partial x_{j.h}$ is the marginal physical product from one characteristic unit j used to create the hth product; and $p_h \partial F_h/\partial x_{j.h}$ is the value of the marginal product of the jth characteristic used to produce output h. It can be interpreted as the marginal implicit (or imputed) price paid for the jth product characteristic used in the product h. This lets $p_h dF_h/ dx_{j\cdot h} = T_{jh}$" (Ladd & Martin, 1976). Where Equation 7 is defined as,

(7) $r_i = \sum_j T_{jh}(dx_{j\cdot h}/ dv_{ih})$.

$T_{jh} dx_{jh}/dv_{ih}$ is the value of the marginal yield of the jth characteristic by using the ith input for the production of h (Ladd & Martin, 1976). It is assumed that $dx_{j\cdot h}/dv_{ih} = x_{jih} = constant$ and $T_{jh} = constant$. This allows for the creation of Equation 8. This means that the yield of each characteristic by an input is not affected by how the input is used (Ladd & Martin, 1976). In application to this study, this assumption means that an additional pound of feed will have the same yield across heifers. With T_{jh} being constant this means that the marginal implicit price is constant with a change in a characteristic across all heifers. Where Equation 8 is defined as,

(8) $r_i = \sum_j T_{jh} x_{jih}$

However, Ladd & Martin (1976) provide a quadratic adaption to the model, if T_{jh} is not assumed to be constant. This is seen in equation 9. The functional forms of the variables will be created by conceptual knowledge of the industry. Equation 9 is defined as,

(9) $r_i = \sum_j x_{jih} B_j + \sum_j x_{jih}^2 B_{jj} = \sum_j x_{jih}(B_j + x_{jih} B_{jj})$.

For example, the variable for the number of heifers in a pen is expressed in a quadratic form. The marginal implicit price for the number of heifers in a pen can be represented as, $(\beta_1 + \beta_2 * x_{number\ of\ head})$. The betas are the estimated parameters.

This hedonic framework is applied to the estimate the marginal implicit values of the characteristics of the quality bred heifers. This gives the ability to see how the Tier II heifers' values have developed over the period of its creation.

Data

The sale data used for this study comes from the Show-Me Select (SMS) Replacement Heifers, Inc. between 2003 and 2010. In order for a producer to enter a heifer into the sale, minimum criteria must be met in order to ensure quality bred animals. The animals must meet both quality and health requirements throughout the animal's development. One requirement of the program is that the producer must have owned the animal 60 days prior to breeding. Also, health examinations and vaccinations at weaning, prior breeding and pregnancy exams are required for the program. SMS requires the animal to be dehorned, scurs removed and treated for parasites 30 days prior to sale. The sire's breed and pedigree birth weight EPD information is required for the heifer. In addition, the heifer must weight a minimum of 800 pounds, have a body score of five and be free of blemishes to be entered in the program. A heifer that meets the previous criteria will be given a "Show-Me-Select" ear tag.

For the Tier II classification, the heifer's sire must meet the minimum accuracy in the traits of calving ease (direct; .65), calving ease (maternal; .3), weaning weight (.75), carcass weight (.20) and marbling (.20). These accuracies are important to the probability of a heifer having a female that could be used as a replacement heifer where a producer would have to spend little or no time in assisting the heifer give birth. The other accuracies point to the potential for the heifer to give birth to a superior calf that has the ability to gain more pounds at weaning and produce a superior carcass.

The data was collected seven sale locations throughout the state of Missouri during the 2003 through 2010 period. The data include information for 6,729 heifers sold in this time frame at the various sale locations. Both spring and fall bred heifers are included in the data. The Spring sales were held in May and the Fall sales were held in November and December. Summary statistics for selected variables used are reported in Table 1 along with the expected signs for the variables.

Table 1- Summary Statistics and Expected Signs of Variables used in the Hedonic Heifer Price Regression

Item	Avg	SD	Expected Impact
Avg price of heifer in pen ($/head)	1262.71	203.94	NA
Avg Weight of heifer in pen	1082.69	113.43	+
Percentage of pens AI sired	37.63	48.45	+
Calving Period *(% of pens calving in specified period)*			
January and February	33.35	47.15	+
March, April and May	36.14	48.05	Default
August and September	16.27	36.92	+
October and November	14.24	34.95	+
Calving span between first and last expected birth for pen (d)	12.86	12.82	-
Calf production EPDs *(only for angus pens with 1 sire)*			
Birth Weight	0.10	0.57	-
Weaning Weight	7.23	17.13	+
Yearling Weight	13.43	31.69	+
Maternal Milk	3.79	9.07	+
Carcass EPDs *(only for angus pens with 1 sire)*			
Carcass Weight	1.34	4.28	+
Marbling	0.06	0.69	+
Ribeye Area	0.18	2.27	+
Sale Location *(% of pens sold at location)*			
Northeast	15.65	36.33	?
North central	3.55	18.51	?
West central	16.07	36.72	Default
Southeast	23.78	42.58	?

Southwest	28.41	45.10	?
Central	3.59	18.58	?
South central	8.96	28.57	?
Sale Year *(% of pens sold in year)*			
2003	19.11	39.32	Default
2004	16.27	36.92	+
2005	13.98	34.69	+
2006	2.94	16.90	+
2007	15.56	36.25	+
2008	12.31	32.85	+
2009	10.55	30.72	+
2010	9.27	29.01	+
No. of head per pen	3.98	1.85	+
Percentage of pens sold in Fall	69.97	46.23	?
Percentage of pens with ALL Tier II heifers			
Tier II in 2008 *(n=51)*	6.16	8.67	+
Tier II in 2009 *(n=42)*	5.92	7.88	+
Tier II in 2010 *(n=51)*	8.17	8.67	+
Percentage of pen with more than one sire used	51.63	49.98	-
Percentage of heifers in pens with Angus sire used	45.85	48.83	+

N=6459

Empirical Model

A hedonic model was used to acquire the value of the heifer, expected calf and carcass, and market characteristics. The hedonic framework refers to assigning an economic value to each characteristic of a bundled product. Each bred heifer was purchased due to its collective characteristics (e.g. breed, calving span). The hedonic model was used in order to estimate the marginal contribution of each characteristic to the overall bred heifer price.

The explanatory variables used in the hedonic price model will represent the areas of physical and genetic characteristic, calves expected performance characteristic and market factors following from Parcell et al. 2006. Thus, the average price of a heifer in pen is a function of a set of physical and genetic characteristics, calves expected performance characteristics and market factors.

A model will be estimated where the average price of the bred heifer in pen *i* for sale *k* is a function of:

(9) $\text{Price}_{ik} = f(\text{Physical and Genetic Characteristics}_{ik}, \text{Calves Expected Performance Characteristics}_{ik}, \text{Market Factors}_{ik})$

Heifer characteristics to be analyzed include weight, Angus breed, heifers bred using AI, expected calving month, expected calving span and pens with more than one sire used. Calf expected progeny difference (EPD) values (birth weight, weaning weight, yearling weight and maternal milk), carcass EPDs (carcass weight, marbling and ribeye area), and market factors (year, location, season, lot order and pen size) will be used to examine the impact on heifer prices. In addition, the impact of pens with all Tier II heifers (heifers' calves sires met minimum accuracies).

Prices used in the model represent the average heifer price per head for a pen of heifers. Thus, some characteristics are aggregate pen averages. Previous research has specified weight as a non-linear relationship; however, in this study the heifers have a minimum weight requirement in order to enter the sale. Heifer weight is expressed linearly in order to capture the greater price for a higher quantity of beef along with the ability to calve easier. A binary variable was created to represent whether the pen of animals were Angus or Angus-cross. The variable was set to one when all heifers in the pen where Angus. A premium was expected for Angus pens. A binary variable was created for pens where all heifers were artificially inseminated; in this case the variable was set to one. It was expected that AI pens would receive a premium.

Four binary time variables (January/February, March/April/May, August/September, and October/November) were created for the expected calving month for a pen of heifers. The January/February was expected to be positive since it is the closest calving date relative to a sale date.   This means that producers will have less investment prior to calving and will have a calf marketable sooner as compared to a later calving period. In addition, it is expected that the period of August/September and October/November will carry a premium as well. This is due because calves born in these time periods, will be weaned February through May which is a non-peak period of calves coming onto the market; thus, these calves will receive a premium due to the seasonality of cattle production in the area. A binary variable was created for the calving span of the pens. It was set to one when the difference between the first heifer and last heifer expected to give birth is greater than thirty days. A discount is expected due to additional management needed for same different aged calves, as well non-uniform calves having less value. A binary variable was created that indicates whether all heifers in a pen were bred by the same sire. It was set to one when the pen had more than one sire used to breed; thus, resulting in a discount.

One data specification change was made with respect to EPD values. The EPDs of birth weight, maternal milk and marbling needed to be expressed in a natural logarithmic format. These values ranged from negative to positive values. All EPD values had a constant (25) added to them in order to avoid the issue and preserve the variance. However, the constant was subtracted out when stimulating impacts of the variables. These values where then interacted with a dummy variable that was created by interacting whether a pen was of Angus breed (1=yes) and whether the pen only had one sire used to breed the heifers (1=yes). The dummy variable that was created, designated that the pen was of angus breed and had only one sire used. This procedure was done since EPD levels vary across breeds and only pens with one sire could be used since sires differ on their EPDs. So the EPDs used in this analysis are only from pens with angus animals and pens where one sire was used to breed the heifers. Expected birth weights were expressed in natural logarithmic form so that greater weights would be discounted relative to lower weights. Expected birth weight was not found to be significant which was not unexpected due to the SMS program requiring that a minimum birth weight EPD must be met. Both expected weaning and yearling weight was expected to result in premiums for heavier weights. Expected maternal milk is expressed in logarithmic form so that lower milk EPDs are discounted. It was expected that higher milk levels would result in a premium due to the potential for female progeny to have higher milk production that would contribute to the growth of calves.

Besides calf EPDs, carcasses EPDs are also used in the analysis. Expected carcass weight and ribeye area were expressed linearly, while marbling was expressed in a natural logarithmic form. Marbling was expressed in this form so that lower scores would be discounted due to the loss in grid value. Expected carcass weight was expected to show a premium for higher weights, which represents that amount of meat a calf would produce. In addition, it was expected that premiums would be shown for carcasses with a higher ribeye area, a highly valuable cut of meat.

Market factors were also used in the analysis. Sale year was specified in a series of binary variables for the years from 2003 through 2010, with 2003 serving as the default. Premiums are expected for the years after 2003 due to cattle prices being the lowest in 2003 compared to the years after that year. In addition, binary variables were created for seven regions of Missouri. They included northeast, north central, southeast, southwest, central, south central and west central with west central serving as the default. It is expected that some differences may exist regionally due to differences in localized markets. A binary variable was created for the season of the sale which was set to one when the sale was held in Fall. A premium is expected for Fall heifers, since they will be expected to give birth in the Spring when grass is more abundant to supplement the calves' growth until weaning. Lot order was expressed in a quadratic form with the expectation that pens that sale later are discounted relatively as buyers start to leave the sale. Pen size was specified in a quadratic form with the expectation that larger pens relative to smaller pens would receive a premium.

Three binary variables were created to indicate pens with all Tier II females for the years of 2008, 2009 and 2010. The Tier II females have additional requirements for the sire that includes minimum accuracies must be met in addition to the other requirements of Show-Me-Select. The program started the Tier II classification in 2008. This classification has created a new value added product for the program. Product life theory predicts that profits will increase as sales increase (Gedikoglu & Parcell, 2009). This theory suggest that that a new product will go through four stages that include an introduction, growth, maturity and a decline stage (Gedikoglu & Parcell, 2009). It suggests that profits start out as negative and grow positive in the introduction stage (Gedikoglu & Parcell, 2009). It is expected that we may see negative premiums growing into positive premiums for the Tier II pens. The product life theory suggests that as a products gets to the end of its lifecycle, profits will become negative due to the competitive environment (Gedikoglu & Parcell, 2009). This suggests that products must continue to adjust with new characteristics in order to preserve profit margins. However, as we see the Show-Me-Select Tier II program continue, we expect to continue to see premiums increase for these heifers with the Tier II “product” continuing in its introduction stage on into its growth stage and on into its maturity stage.

Results

Regression results from the estimation of equation 8 are reported in Table 2. The ordinary least squares hedonic model explained 46% of the variation in heifer prices across pens. Positive parameters indicate a premium relative to the base heifer price, while negative parameters indicated a discount to the base price. The majority of the coefficients were significant at the 0.05 level.

Table 2- Quality Bred Heifer Characteristic Demand Model Price estimates (dependent variable average price per pen and coefficients refer to dollars per head)

Item	Coefficient	SE	P Value
Avg Weight of heifer in pen***	0.68	0.02	<0.01
Pens AI sired***	48.60	5.37	<0.01
Calving Period (default= March, April and May)			
January and February**	11.51	5.49	0.04
August and September***	63.79	12.13	<0.01
October and November***	57.62	12.12	<0.01
Calving Span = 1 if greater than 30 d***	-19.99	6.81	<0.01
Calf production EPDs (only for angus pens with 1 sire)			
Birth Weight (logarithmic)	-113.83	79.84	0.15
Weaning Weight*	1.83	0.97	0.06
Yearling Weight**	-1.47	0.57	0.01
Maternal Milk (logarithmic)	-61.39	38.14	0.11
Carcass EPDs (only for angus pens with 1 sire)			
Carcass Weight	0.43	0.70	0.54
Marbling (logarithmic)**	191.07	83.98	0.02
Carcass Ribeye Area	-0.26	0.97	0.79
Sale Location (default = West central)			
Northeast	4.69	7.12	0.51
North central	-12.99	11.18	0.25
Southeast	7.64	6.74	0.25
Southwest**	-12.65	6.07	0.04
Central**	24.88	11.29	0.03
South central***	-56.14	8.17	<0.01
Sale Year (default = 2003)			
2004***	266.17	6.42	<0.01
2005***	224.79	7.19	<0.01
2006***	155.09	12.59	<0.01
2007***	172.73	6.68	<0.01
2008***	98.59	7.26	<0.01
2009***	113.84	7.60	<0.01

2010***	311.01	9.80	<0.01
Lot order***	-1.18	0.45	<0.01
Lot order squared	-0.00	0.01	0.86
Head per pen***	18.19	2.45	<0.01
Head per pen squared**	-0.65	0.27	0.02
Season = 1 if Fall***	37.83	11.58	<0.01
Pens with all Tier II heifers			
Tier II in 2008 *(n=51)*	-24.38	22.33	0.27
Tier II in 2009 *(n=42)****	137.93	24.75	<0.01
Tier II in 2010 *(n=51)***	46.25	22.55	0.04
Pen with more than one sire used = 1***	-32.25	5.70	<0.01
Pens with all Angus Sires = 1	-0.95	5.47	0.86

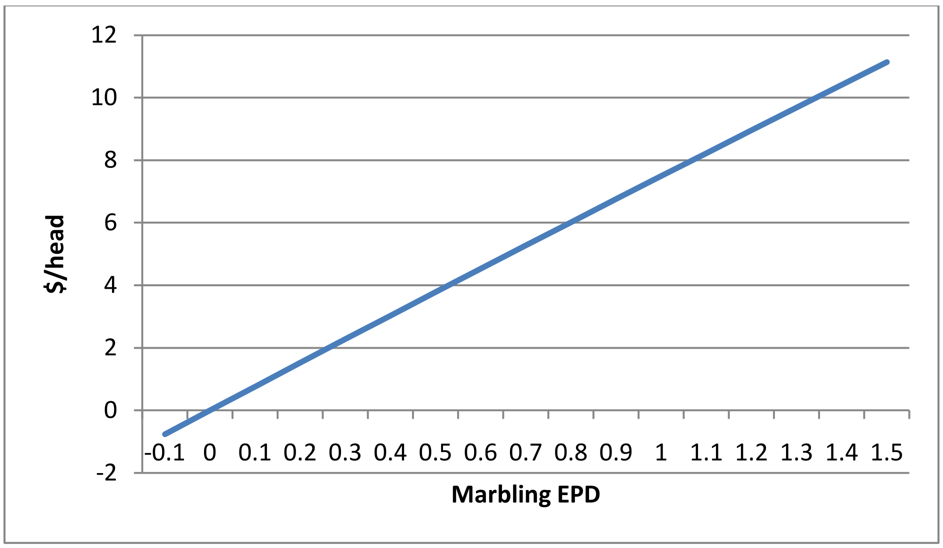
****-Significant at <1% level, **-Significant at <5% level, *-Significant at <10% level*

The heifer characteristics that were significant at least the 5% level include: heifer weight, AI heifer pens, expected calving span and pens with multiple sires used. These finding are consistent with previous studies. A one pound increase in heifer weight led to a $0.68 per head increase in bred heifer price. This value represents the cull value of the heifer in the future. Artificially inseminated heifer pens will garner $48.60 per head increase in heifer price. This indicates that buyers believe that AI provides premiums for the future value of the heifer's calf. Heifers that were scheduled to calve in January/February receive $11.51 per head premium compared to March/April/May period. This is likely because of the calving dates being earlier in the spring with respect to the default, giving producers a longer length of time to put pounds on calves before selling at weaning in the Fall. This gives calves more time to utilize the forage before the dry summer months. This is valuable to producers because they do not have to invest more time in a heifer prior to calving. For the calving period of August/September, heifers received a $63.79 a head premium, while heifers that were expected to calve in October/November receive a $57.62 a head premium. The premiums received for these animals most likely reflect the idea that the calves will be weaned in the Spring, meaning that this would be during the historical seasonal high of feeder cattle prices. Thus, the seasonality of the feeder cattle market creates premiums for animals sold in the off-season, so that animals are supplied in the area year around.

Heifers that had an expected calving span greater than thirty days were discounted by $19.99 per head. There are additional costs of management associated with non-uniform calves. There was a $32.25 discount per head for heifer pens that had more than one sire used to breed them. This result relates to the ability to have more uniform calves when one sire is used to breed the heifers. However, it was interesting to find that the Angus breed was not significant in determining bred heifer price. This contrasts with other findings and the fact that Angus cattle have a potential to receive an Angus beef premium in the marketing system.

The calf and carcass EPDs that were significant at least the 10% level included, weaning weight, yearling weight and marbling. These finding are in line with previous research results. However, it was found that the calf and carcass EPDs of birth weight, maternal milk, and ribeye area were not significant which contrasts previous finding that found these variables significant in explaining price. A one pound increase in expected weaning weight increased the heifer price by $1.83 per head. The impact ranged from a $27.34 per head discount to a premium of $68.15 a head. Since most producers sell calves at weaning, this indicates that buyers are willing to pay more for heifers that are likely to produce calves that are likely to be heavier at weaning. This high premium for weaning weight may be related to the superior nature of the calves sold at weaning with the potential to have a premium carcass. A one pound increase in yearling weight was found to have $1.47 discount per head which is unexplained due to the relationship being expected to be in the opposite direction. An increase in the natural logarithmic of marbling was found to increase a heifer's price. This relationship can be seen in Graph 1. For example, an EPD value of one for marbling will result in a $7.49 premium per head. This indicates that sellers are being compensated for using higher quality genetics that can produce a higher quality meat. This makes sense since a primary indicator of USDA carcass quality is marbling. Ribeye area was not found to be significant in determining bred heifer price. This is surprising since the ribeye area is one of the highly priced cuts of beef. It appears that buyers are willing to pay for most heifer characteristics and some calf and carcass expected characteristics.

Graph 1- Effect of Marbling on Average Price per Bred Heifer in the Pen



Year was shown to be significant at the less than one percent level, indicating the importance of beef price trends in the bred heifer price. In addition, regional price differences were found for southwest, central and south central in comparison to west central. These results for year and region are similar to previous findings. Table 3 shows the differences in average yearly prices with the base year being 2003 for feeder cattle prices, live cattle prices and Show-Me-Select heifer prices for per hundred weight. Yearly prices have been higher since 2003; however, it is noted that Show-Me-Select prices are higher than feeder and live cattle prices in 2004, 2009 and 2010. The trend for Show-Me-Select heifer prices has followed a similar trend to feeder cattle and live cattle prices, with it most closely following feeder cattle prices. Live cattle refers to the calf stage until the calf weights around 600 to 800 pounds. After this stage, this is when the animals can be referred to as feeder cattle.

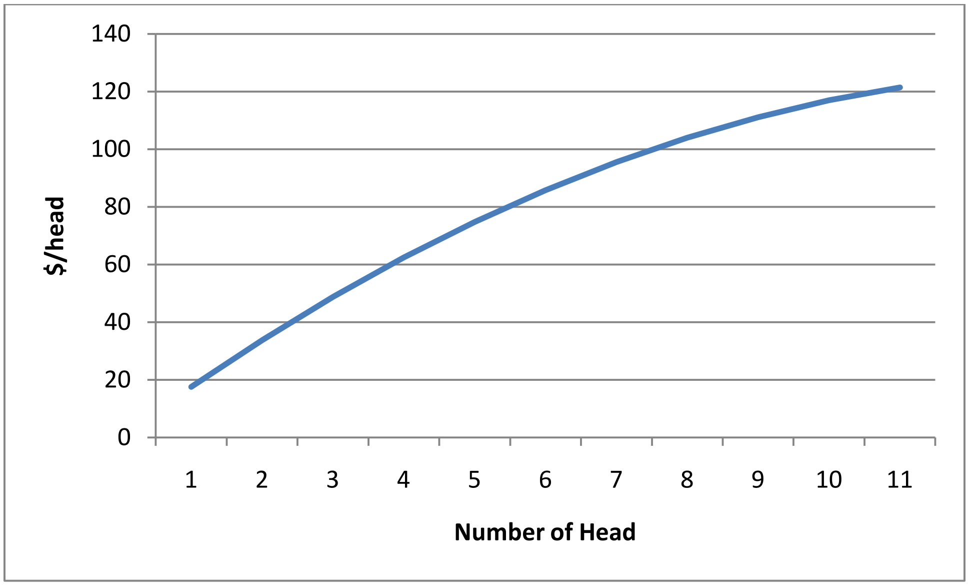
Table 3- Average Yearly Price Changes (base=2003)

	Feeder Cattle Prices (cwt, base=2003)	Live Cattle Prices (cwt, base=2003)	Show-Me-Select Prices (cwt, base=2003)
2010	17.42	15.00	28.74
2009	3.18	3.00	10.52
2008	9.46	8.00	9.11
2007	15.32	17.00	15.96
2006	19.12	31.00	14.33
2005	23.03	33.00	20.78
2004	17.15	17.00	24.60

Source- (AMS, USDA, 2011)

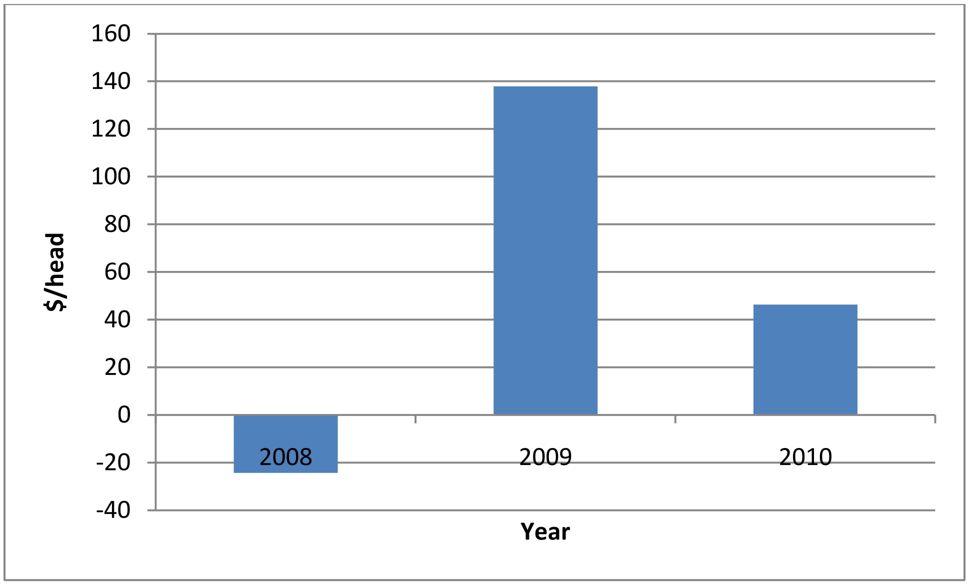
Lot order was shown to have a linear relationship to price, since the squared term was not significant. It was shown that heifers sold in the Fall received a $37.83 a head premium. This is likely because the heifers bought will most likely calve in the Spring, giving producers the ability to utilize their forage resources to put pounds on the calves. The impact of seasonality on sales hasn't been explored in previous heifer price research. The number of animals in the pen was shown to have a quadratic relationship to bred heifer prices; this being the same result found Parcell et al., 2006. This quadratic relationship with number of heifers to price can be seen in Graph 2. For example, a pen of four heifers will obtain $249.44 a pen premium over a pen with one heifer.

Graph 2- Effect of Number of Heifers on Average Price per Bred Heifer in the Pen



The Tier II variable was found to be significant for the years of 2009 and 2010. 2008 was the first year that the Tier II program began so there might have been some buyer confusion on what buying a Tier II animal meant. In 2009, it was shown that animals that were in an all Tier II pen, received $137.93 premium per head. In 2010, the Tier II premium was $46.25 per head. Graph 3 shows the Tier II premiums or discounts for the years of 2008 through 2010. From 2009 to 2010, there was a decline in the premium for Tier II heifers. This is somewhat strange, since cattle prices increased in 2010 compared to 2009. This leaves questions unanswered about what buyers believe Tier II animals are worth in additional value. Producer will choose to raise more Tier II heifers, if the premiums are large enough to off-set the cost of using of accuracy sires.

Graph 3- Premiums/Discounts for Tier II Heifer 2008-2010



The Tier II program could benefit from potential marketing efforts to increase the awareness of what the characteristics and value are for Tier II heifers. Since this program is still in the introductory stage of the product life cycle, it could benefit in marketing dollars being spent in order to move the product into the next stage of growth. Marketing dollars that are spent in the introductory stage can have large impacts in the long run by decreasing the length of time a product spends in the introductory stage; thus, increasing the next stage known as the growth stage. The growth stage is characterized by increase sales and profits continuing to increase. The investment in marketing could increase participation of producers raising Tier II heifers along with buyers' better understanding the value of these heifers, increasing their willingness to pay for these high quality animals. The higher premiums in 2009 as compared to 2010 could be related to initial investment dollars going into promote the program which resulted in a high premium in 2009. However, since the start of the Tier II program it may be possible that marketing dollars for the program have decreased over time, resulting in a lower premium for Tier II heifers in 2010.

It appears since the Tier II program is in an infancy stage that premium values are still being determined. In accordance with the product life cycle theory, it is expected as sales of Tier II animals continue to increase; we will see premiums continue to grow for these animals. During this time, the Show-Me-Select program should begin to create an idea for a new product of even higher quality in order for producers to continue to receive premiums for quality animals, since over time the competitive nature will drive profits to zero. However, over time once we see the premiums and sales of Tier II animal start to trend downward, we will expect that we are in the maturity stage of the life cycle. In the stage prior to the maturity stage, which is known as the growth stage (profits reach maximum), this would be an ideal time to introduce a new value added product in order to preserve quality premiums.

Implications

This study uses transaction level data to estimate marginal implicit values for bred heifer characteristics including the value of minimum sire accuracies. This study finds that heifers that are bred to sires with quality genetics receive premiums. In addition, the higher quality heifers, known as Tier II heifers, have received a premium for their value added characteristic of using minimum sire accuracies that produce higher quality calves that can be used as replacement heifers or even produce carcasses that grade high on the rail.

The implicit marginal prices determined for Tier II heifers shows the buyers' willingness to pay for the animal with respect to the expected value the heifer creates over her lifespan, as well as through the genetics carried on through possible calves that are developed into breeding bulls or replacement heifers.

In order for the producer to develop Tier II heifers, they must incur additional costs to produce these higher quality heifers. In addition, to meeting the standard requirements for the Show-Me-Select Program, they also must use high accuracy sires to breed the heifers that they are developing for the program. The producer will incur additional costs for more time spent of managing the heifers as well as spending more money on quality genetics in order to produce a quality heifer that meets the requirements of the program.

The additional cost for someone that is already participating in the Show-Me-Select program that is using artificial insemination to breed heifers would only have a small marginal cost in order to strive to produce Tier II heifers. This is because these heifers must be bred with a sire that has high accuracies for calving ease, weaning weight, carcass weights and marbling. The only additional cost for these type of producers would be to pay more for quality semen that meets the required sire accuracies for the Tier II program. However, a producer who is already participating in the Show-Me-Select program who is using a bull for natural service (where the EPDs don't meet the required accuracies) for their herd would see greater costs incurred in order to strive to produce Tier II heifers. This producer would have to either purchase a new bull that had the required minimum sire accuracies or they would have to start using artificial insemination. If the producer wanted to strive to produce Tier II heifers through using artificial insemination, they would need to purchase sire semen that meets the minimum required EPD accuracies. In addition, this producer would have to invest additional time, labor, and equipment in order to use artificial insemination in the herd.

Parcell & Franken (2009b) have determined net present value estimates for Show-Me-Select heifers. They investigated the impact that these heifers had on improved calving quality and consistency. These heifers were created to be high quality "reproductive machines." These heifers are expected to see lower calf losses and produce higher productive calves in comparison to an average animal. The heifer's offspring are expected to be more consistent throughout the heifer's life. It was found that these heifers' improved dam productivity and calf consistency added an additional $187 per head to the value of the bred heifer in 2008. The present value of an average heifer was estimated at $918, while the Show-Me-Select heifer value was $1,105.

The hedonic study shows that that the Tier II heifers have an even higher present value. The higher value of these animals is due to the fact that these heifers will produce an even higher valued first offspring due to minimum sire accuracies used to breed the heifer. It is expected that this first offspring will grade better on the rail or could become a better replacement heifer than the offspring of a Show-Me-Select heifer that is not bred to a sire with minimum accuracies.

The hedonic approach gives a better measure of buyer's willingness to pay for certain heifer characteristics. One reason for this is that net present value estimates normally only incorporate the value of an animal's offspring and assume that their offspring is sold and not kept to improve the overall genetic make-up of the herd. This suggests that present value estimates of quality heifers are most likely underestimated due to this reason.

More research needs to be done in order to identify what value added characteristics receive premiums; thus, helping individuals to better understand and improve the value marketing chain. In addition, more research needs to be done to investigate how new value characteristics premiums change over the life of the product. This will allow market participants to better understand the life cycle of a new value characteristic as well as be better able to adapt their product line to capture premiums.

ENDNOTE

1. One requirement of the program is that the producer must have owned the animal 60 days prior to breeding. Health examinations and vaccinations at weaning, prior breeding and pregnancy exams are required for the program. SMS requires the animal to be dehorned, scurs removed and treated for parasites 30 days prior to sale. The sire's breed and pedigree birth weight EPD information is required for the heifer. In addition, the heifer must weight a minimum of 800 pounds, have a body score of five and be free of blemishes to be entered in the program.

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