Valuing Beef Herd Dam Genetic Pedigree Management

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Abstract

An important component of the beef cow herd is the contribution of the dam to herd profitability. Yet, no research has contributed to valuing the dam's genetic contribution to herd quality performance or profitability. This paper examines how managing for dam genetic pedigree quality grade affected the outcome of calf crop quality, and simulates the economic impact for different levels of quality premium. The results show that managing for dam pedigree genetics beyond three generations in the herd has little economic value for producers.

Introduction

Beef producers have been faced with numerous challenges in recent history, which can be seen in the drop of cattle inventory numbers by roughly 1.6 million head (NASS, 2009). However, beef producers have continued to meet the challenges of their industry head on, and upcoming challenges will force beef producers to look deeper than ever before, into the very genetics of their products. Twenty years ago, calves were sold off the farm with little or no thought to the characteristics of the end beef product. Now, the look and taste of end beef products are crucial for success in the market place. These physical characteristics of beef primal products influence how much consumers will buy and what price they will pay. Genetics directly impact carcass traits, and these traits tend to have moderate to high heritability. Several money making selections such as the Ribeye area, back-fat thickness, marbling, and tenderness all show a high heritability of between 40 and 70 percent (Dikeman et al., 2005). To secure their market share, cow-calf producers use genetic management practices, particularly on the sire side, to strategically alter the type of cattle they produce. Due to this, genetic management is becoming a key part of the total farm management plan. However, few commercial beef producers make

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management decisions pertaining to female animals (e.g., culling or retaining) based on genetic related information feedback. Instead, more general production information (i.e., did she raise a calf) is often used in dam (female or cow) cull decisions. So, how much value can be added by using this genetic information when making management decisions?

This study's objective is to determine whether the process of managing dam genetics over time has a positive impact on calf quality over time. For example, a cow-calf producer should retain future heifer calves from a cow for herd-building, if that particular cow's progeny consistently yields quality carcasses and fetches premium prices through value-based (e.g., grid) pricing systems. This will add value to the producer's herd overall.

Literature Review

A beef producer must know which genetic traits are most critical to retain in order to add the most value to the herd. McDonald and Schroeder (2000) determined the relative impacts of several factors on profit per head of cattle marketed through a grid structure. Price, cattle quality, and feed performance factors were examined. They used two separate marketing grids. When only non-price variables were considered, the cumulative quality of cattle in a pen was the most important factor influencing profit. Genetics influence the quality of cattle and thus influence how much profit can be earned as well.

One of the grids McDonald and Schroeder used was a weighted plant average base price (Grid A). In this grid, the base price is derived from the price paid and carcass characteristics of all cattle bought live in the previous week. Another grid used a base carcass price linked to the western Kansas direct weekly fed cattle price reported by the USDA (Grid B). For Grid A, the same premium was paid for yield grades 1 and 2, while yield grades 4 and 5 had separate discounts. Premiums were paid for Prime carcasses and discounts given for Select carcasses. For Grid B, premiums were paid only on the percent of the pen that was above baseline quality traits; discounts were given for pens having undesirable traits above a certain level.

According to consumers, beef quality has been linked to beef primal appearance and taste, which were found to be crucial in the market place. Through experiments with Kansas grocery shoppers, Lusk (1999) established that consumers preferred *Guaranteed Tender* steaks over *Probably Tough* steaks, even when participants were not informed of steak quality beforehand. Using a mail survey, Lusk (2001) determined that consumers consider the deep red color of a steak, along with marbling, as its most important attributes. Umberger et al. (2000) discovered consumer preferences and willingness-to-pay for flavor in beef steaks using auction market experiments with consumers in Chicago and San Francisco. Panelists gave significantly higher ratings for flavor desirability, juiciness, tenderness, and overall acceptability to high marbled steaks versus the low marbled steaks. They were willing to pay a higher market price for upper Choice steaks compared to Select steaks in 34 of the 48 auctions. Chicago consumers were willing to pay $0.25 more per pound, while San Francisco consumers were willing to pay $0.03 more per pound.

Data and Evaluation

Data for this paper was obtained from a Southeast Missouri beef cattle producer. The producer kept extensive records of his breeding herd for several years. Two types of data were used: carcass kill sheets and the cattle pedigrees. Carcass kill sheets were available for 13 lots of cattle harvested between 1999 and 2005. Lots ranged in size from 50 head to over 100 head. Most of these cattle originated from the producer's herd, but some were alliance calves from the beef cow multiplier alliance he owned and managed. Carcass kill sheets did not all originate from the same feedlot. All kill sheets included data on yield grade, quality grade, estimated live weight, and carcass weight, and some also include additional carcass information pertaining to marbling, back fat, and ribeye area. Therefore, the information was consolidated into consistent categories. Additionally, there may have been some differences in feed rations across feedlots, affecting carcass grades, which could not be accounted for. The second set of data contains the cattle pedigrees, which provided the dam genetic information. The producer kept these records through the Angus Information Management System (AIMS) software program, available through the American Angus Association. Producers with access to this program or similar systems for low cost record keeping may find the results presented here particularly interesting. Pedigree profiles were utilized to determine the extent to which genetic management had been used, as measured by stacked generations on the dam side. The number of dam generation refers to the sequential number of pedigrees known. For example, an animal for which just the dam information was known would have zero stacked generations. An animal for which the dam information was known and the dam's dam information also known, would have one stacked generation. For this set of animals, there was a range of zero to five dam stacked generations.

A binomial logit analysis was performed on the data to determine the marginal effects of the independent factors on the dependent variables. The dependent variables were selected to determine how well the independent variables affect final carcass QG. Another model was also specified for yield grade (YG). However, only lot number (e.g., environment and management) but not dam stacked generations had an effect on YG, and hence, the rest of the paper focuses on the more interesting QG models. If a positive coefficient is estimated, then the independent variable has a positive impact on QG. For example, if the dependent variable is whether the carcass graded Prime, then an estimated coefficient for an explanatory variable of 0.30 indicates that for the presence of the explanatory variable there is a 30 percent higher probability of the animal carcass having the QG Prime. If the result is negative, then the variable has a negative impact on the final grade.

Separate models were estimated for Prime and Certified Angus Beef:

$$\left.\begin{array}{c}\text{Prime}\\ \text{or}\\ \text{CAB}\end{array}\right\} = f\left(\text{Dam Stacked Generations}_i\ \text{Series of Sire dummy varia}\ \ldots\ \text{year dummy variables}\right),$$

where *i* represents the number of dam stacked generations evaluated for a particular equation. Dam stacked generation and sire are used to show the effect of genetics, while lot number captures the effects of environmental and management factors in the feedlot. Dam stacked generation represents the number of generations on the dam side in which genetics is known. Dam stacked generation is a binary variable such that each equation, for both prime and CAB, is estimated five times to represent from a one stacked generation to a five stacked generation dam. It is important to point out that estimating the model as one equation would introduce significant multi-collineartiy because the data set includes any animal that has more than one stacked generation of genetics also is a stacked generation in the levels below that stack. For example, an animal with five stacked generations of genetics also has four stacked generations, three stacked generations, and so on. To take this into account, a separate model is run for each level of stacked genetics, e.g., five stacked generations is the maximum so there are five sets of equations to be estimated for each Prime and Certified Angus Beef. The producer providing the data was a proofer for a registered Angus breeder, and a series of binary independent variables was used to account for the 65 different sires of calves in the dataset. While a high number of sires is undesirable for most analyses, the high number of sires aids in assurance of factoring out sire impacts for a given dam in this analysis. Lot number is used to show of which contemporary group each animal is a member. Thirteen lots exist in the dataset, and series of binary variables distinguish one lot from another. Summary statistics for the beef herd are reported in Table 1.

Results

Results from our analysis show whether a relationship exists between quality grade (QG) and the dam genetic management. The dam stacked generations' marginal effects for the QGs are presented in Table 2. Results from individual sire effects and lot effects are not reported here to conserve space. These results are available from the authors upon request. The middle column of Table 2 shows the effects of the dam stacked generation variables on whether a carcass QG is Prime. The last four variables, representing two through five levels of dam stacked generations, are statistically significant. The marginal effects have the most interesting outcome. Stacking two generations of dam stacked genetics increases the likelihood of an animal grading Prime by 17 percent. The marginal effect peaks at three generations of stacked dam genetics, with a 29 percent higher likelihood of grading Prime than with no stacking, and increases slightly to 33 percent with four stacked generations.

The right-hand side of Table 2 shows the interaction between the dam stacked generation variables and the likelihood of a carcass receiving a QG Certified Angus Beef. Two through four dam stacked generations had a statistically significant marginal effect on CAB grade. The second level dam stacked generation has a 6.42 percent higher probability of grading CAB, and a third and fourth generation have a 16.4 and 14.2 percent marginal effect on calves grading CAB, respectively. The large marginal effect for dam stack generation five is not statistically significant because of the number of low observations.

Simulation Results

Prime grade marginal probabilities are reported in Table 3, column 2. For Table 3, a value of 0.173 indicates a 17.3 percent higher probability of obtaining a quality grade of Prime relative to a cow without any known dam pedigree. Furthermore, we focus on the economic simulation results from our estimated model.

To see how the results from this study apply in the beef cattle industry, an economic sensitivity was created. Stacking generations of dam genetics was shown to increase the likelihood of a carcass grading Prime. Prime carcasses are of top quality and receive premiums when marketing through grid pricing systems. These premiums may vary over time. For the sensitivity, Prime grade premiums of \$6/cwt, \$10/cwt, \$14/cwt, \$16/cwt, and \$20/cwt were used. Table 3 is used to show how each level of stacked generations affected the overall premium received by the producer. The reported value added represents the premium multiplied by the probability of its occurrence. That product is then multiplied by eight to account for the average carcass hundred weights of the cattle. If a producer can receive a $10/cwt premium for Prime carcasses and has an average of two stacked generations of dam genetics, then the projected premium received per animal is $13.86/cwt. The marginal contribution of each additional generation is also shown in the table. For the same example of a $10/cwt Prime premium, going from two to three stacked generations marginally contributes an additional $9.34/cwt. A positive marginal contribution is seen for each premium level. For beef producers, the conclusion to be drawn from this simulation is added revenues from stacking generations of dam genetics may peak at three generations. To determine if the premiums received are profitable, an individual producer must look at the premium received minus the cost of stacking generations of dam genetics.

Additional value can be expected from these management decisions. The heifer calves from these quality cows will have a higher probability that throughout their lifetime higher quality-grade calves will be produced. Hughes (2007) provides a detailed analysis of arriving at the economic value of bred heifers over their lifetime. Following Hughes' methodology and assuming a $16/cwt Prime quality grade premium, 17.8 percent probability of achieving the prime quality grade, and a cow lifespan of 7 calves, we computed a lifetime net present value increase of nearly $100/head for a replacement heifer selected based on quality grade pedigree from the previous two dam generations. This value is computed relative to a replacement heifer without knowledge of dam pedigree.

Conclusions

This research represents the first step in determining the value added to the beef cattle chain through genetic management on the dam side. The objective of the study is to determine whether the process of managing dam genetics has a positive impact on beef carcass quality. Managing dam genetics is found to increase the likelihood of having a carcass with a quality grade of Prime or Certified Angus Beef. For Prime grade, managing up to three generations is sufficient. For managing a target of Certified Angus Beef grade, managing up to four or five dam generations may be needed. It will be up to individual producers to decide whether the probability of successfully managing genetics to obtain premiums for higher quality carcasses is substantial enough to be cost effective. While the cattle industry's current focus is toward quality, production efficiencies or inefficiencies have a large impact on herd profitability (Kovanda, Schroeder, and Wheeler, 2004). Hence, producers must consider the implications of their choices for both calf quality and production efficiency.

The evidence that managing dam genetics in addition to sire genetics improves calf performance implies that appraisal value of female seed-stock should be based on recent sales of animals of similar quality genetics, and that, particularly for producers with access to low-cost computerized recordkeeping systems, managing genetics on the dam side may improve their bottom line. Langemeier and Jones (2000) attribute technological change in beef feed conversions partly to genetics and suggest that relatively slow technological change in beef cattle finishing may have contributed to the deterioration of beef's competitive position among pork and poultry alternatives. Hence, genetic management decisions impact not just individual producers but the industry as a whole.

Retained ownership and a desire for value-based pricing are incentives for producer alliances. Retained ownership is often a part of producer alliances. The main reason for retained ownership is the feedback of carcass information. This feedback is critical for producers because this is the indicator of how their cattle perform and makes evident the areas that need to be improved upon. Producers desire value-based pricing so that they can be rewarded for higher quality animals. This is the incentive to put time and effort into managing genetics and carcass traits. Alliances are becoming more popular among cow-calf producers. In BEEF Magazine's "2002 Beef Alliance Yellow Pages," an increase of more than 30 percent in the number of alliances that compensate cow-calf producers for meeting performance guidelines was seen from 2000 to 2001 (Ishmael, 2000).

There are obvious limitations to this research. We only used one producer's production data. However, it is rare for commercial cattle producers to collect pedigree information over such a long time horizon. We were also unable to obtain feedlot performance data to analyze the costs associated with these animals achieving the level of quality grade. Replicating this same type of analysis in other parts of the country, controlling for lot size, and running all cattle through the same feedlot with identical feed rations may be useful avenues for future research. Still, the findings of this study are suggestive and are of particular interest to producers already keeping dam pedigree records and others who may or may not keep such records but have access to the Angus Information Management System (AIMS) or similar software programs that reduce the costs of recordkeeping.

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Table 1. Summary statistics for variables used in statistical analysis

Variables		% of Data
Quality Grade		
Prime		10.92%
Certified Angus Beef (CAB)		27.00%
Choice		72.80%
Select		15.37%
Standard		0.30%
% of cow herd with no information for cow's dam		2.82%
% of cow herd with information to cow's dam (1st generation, 1DSG)		51.46%
% of cow herd with information to cow's grand dam (2nd generation, 2DSG)		29.63%
% of cow herd with information to cow's great grand dam (3rd generation, 3DSG)		13.15%
% of cow herd with information to cow's great, great grand dam (4th generation, 4DSG)		2.43%
Lot 1	1999	8.59%
Lot 2	1999	7.79%
Lot 3	2000	8.19%
Lot 4	2000	7.28%
Lot 5	2001	6.88%
Lot 6	2001	7.48%
Lot 7	2002	6.37%
Lot 8	2002	12.84%
Lot 9	2003	7.79%
Lot 10	2003	6.37%
Lot 11	2004	8.49%
Lot 12	2004	4.25%
Lot 13	2005	7.68%
Sire	Various sires were used and a set of dummy	

Table 2. Marginal effects of factors influencing carcass quality grade

Variable	Prime Marginal Effect	Certified Angus Beef Marginal Effect
DSG 1	0.0488	-0.0118
DSG 2	0.1723*	0.0642*
DSG 3	0.2903*	0.1635*
DSG 4	0.3305*	0.1420*
DSG 5	0.3470*	0.2280

* Indicates statistical significance at the 10 percent level

Table 3. Marginal contribution of dam stacked generations to "Prime" quality grade premium for a steer calf

	Probability of Achieving Prime Grade	Expected Added Value per Calf ($6/cwt) [a]	Marginal Contribution of Additional Generation	Expected Added Value per Calf ($10/cwt)	Marginal Contribution of Additional Generation	Expected Added Value per Calf ($14/cwt)	Marginal Contribution of Additional Generation
1 DSG[b]	0.048	$2.30	~	$3.84	~	$5.38	~
2 DSG	0.173	$8.31	$6.01	$13.86	$10.02	$19.40	$14.02
3 DSG	0.290	$13.92	$5.61	$23.20	$9.34	$32.48	$13.08
4 DSG	0.330	$15.84	$1.92	$26.40	$3.20	$36.96	$4.48
5 DSG	0.348	$16.69	$0.85	$27.82	$1.42	$38.94	$1.98

	Probability of Achieving Prime Grade	Expected Added Value per Calf ($16/cwt)	Marginal Contribution of Additional Generation	Expected Added Value per Calf ($20/cwt)	Marginal Contribution of Additional Generation
1 DSG	0.048	$6.14	~	$7.68	~
2 DSG	0.173	$22.17	$16.03	$27.71	$20.03
3 DSG	0.290	$37.12	$14.95	$46.40	$18.69
4 DSG	0.330	$42.24	$5.12	$52.80	$6.40
5 DSG	0.348	$44.51	$2.27	$55.63	$2.83

[a] Assumes carcass weight of 800 lbs, and value in parentheses is the market premium for Prime quality grade.

[b] The probability of an added generation of DSG (dam stacked generation) to Prime grade premium for a steer calf is given in dollars per head. For example, using a 3 DSG and $16/cwt Prime grade premium there is a $14.95/head premium relative to 2 DSG ($37.12 – $22.17) and a $37.12/head premium relative to 0 DSG.