VALUE ADDED TO THE BEEF CATTLE CHAIN THROUGH GENETIC MANAGEMENT

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by
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The undersigned, appointed by the Dean of the Graduate School,
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VALUE ADDED TO THE BEEF CATTLE CHAIN
THROUGH GENETIC MANAGEMENT

Presented by Jessica Robertson

A candidate for the degree of Master of Science

And hereby certify that in their opinion it is worthy of acceptance.

Joe Parcell

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Ron Plain

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ABSTRACT

The beef cattle industry has a substantial impact on the United States economy. Over $188 billion is contributed annually to the economy as a whole through direct and indirect activity from the beef industry. The look and taste of beef products are crucial in the market place. These physical characteristics of beef are directly influenced by genetics because they tend to have moderate to high heritability. Genetic management is becoming a part of the total farm management plan. But few producers make management decisions for female animals (e.g. culling or retaining) based on genetic related information feedback. The objective of this study is to determine whether or not the process of managing genetics has a positive impact on the quality of beef carcasses. This study will focus on female genetics, which is different than the majority of research done in the past. It was found that managing female genetics does increase the likelihood of having a carcass with a quality grade of Prime, but may not affect the likelihoods of a Choice or Select. Genetic management does not seem to have any impact on what type of yield grade a carcass will receive. It will be up to individual producers to decide whether the probability of successfully managing genetics is significant enough to cost effectively obtain premiums for higher quality carcasses. This research has shown that a higher probability exists for producing Prime carcasses if dam genetics are managed. The next step for the producer is to look at the management costs involved and decide if the value outweighs the cost.

1. INTRODUCTION

The beef cattle industry has a substantial impact on the United States economy. Over $188 billion is contributed to the economy as whole through direct and indirect activity from the beef industry (Otto and Lawrence, 2001). This industry is constantly changing. Twenty years ago, calves were sold off the farm with little or no thought to what the characteristics of the end beef product would be. Now, the look and taste of beef products are crucial in the market place. Lusk et al. (1999) researched consumer opinions by talking with shoppers in several grocery stores. The study found that 69% of participants in a blind taste test preferred a tender steak to a tough steak. Also, in blind tests, consumers consistently showed a preference for high marbling in steaks. Lusk (2001) found that consumers ranked the color of a steak as its most important attribute, along with marbling. These physical characteristics of the final beef product help determine how much consumers will buy and what price they will pay. Genetics have been proven to directly influence carcass traits. These traits tend to have moderate to high heritability. Ribeye area, fat thickness, marbling, and tenderness all have a heritability between 40% and 70% (Dikeman et al. 2005). As a result, producers can directly alter the type of cattle they are sending to the feedlot by altering the type of sires and dams used. Genetic management is becoming a part of the total farm management plan. But few producers make management decisions for female animals (e.g. culling or retaining) based on genetic related information feedback. Instead production information is often used. So, what is the value of genetic information in making management decisions?

The objective of this study is to determine whether or not the process of managing genetics has a positive impact on the quality of beef carcasses. For example, consistent higher quality beef carcasses, from an individual cow, sold through a value based pricing system, such as grid pricing, might signal for a cow-calf producer to keep future heifer calves for retention back into the herd. Beef producers will more likely incorporate genetic performance capabilities into their herd management decisions if it is proven that this planning will provide a net increase in the value of the final product, *ceteris paribus*. This study will focus on female side genetics, which is different than the majority of research done in the past. Most research is done looking at male, or sire, genetics because more information is available. Figure 1.1 shows a sample pedigree for a calf and where the calf's genetics come from. Fifty percent of the calf's genetics come from the sire and 50% from the dam. As you progress through the pedigree, each animal in the calf's history contributes something to that calf's genetics. The grandsires and granddams contribute 25%, while the great-grandsires and great-granddams contribute 12.5%.

Assuming that ribeye area, fat thickness, marbling, and tenderness are approximately 50% heritable, then female side genetic management might contribute up to 25% of the calf genetic variability with the male side genetic management contributing the other 25%. Realizing that not 100% of fed calf quality variability can be controlled through genetic and production management, much of the quality and production can be influenced with some probability of success. It is the determination of the probability of success through female genetic management that is sought for the current study.

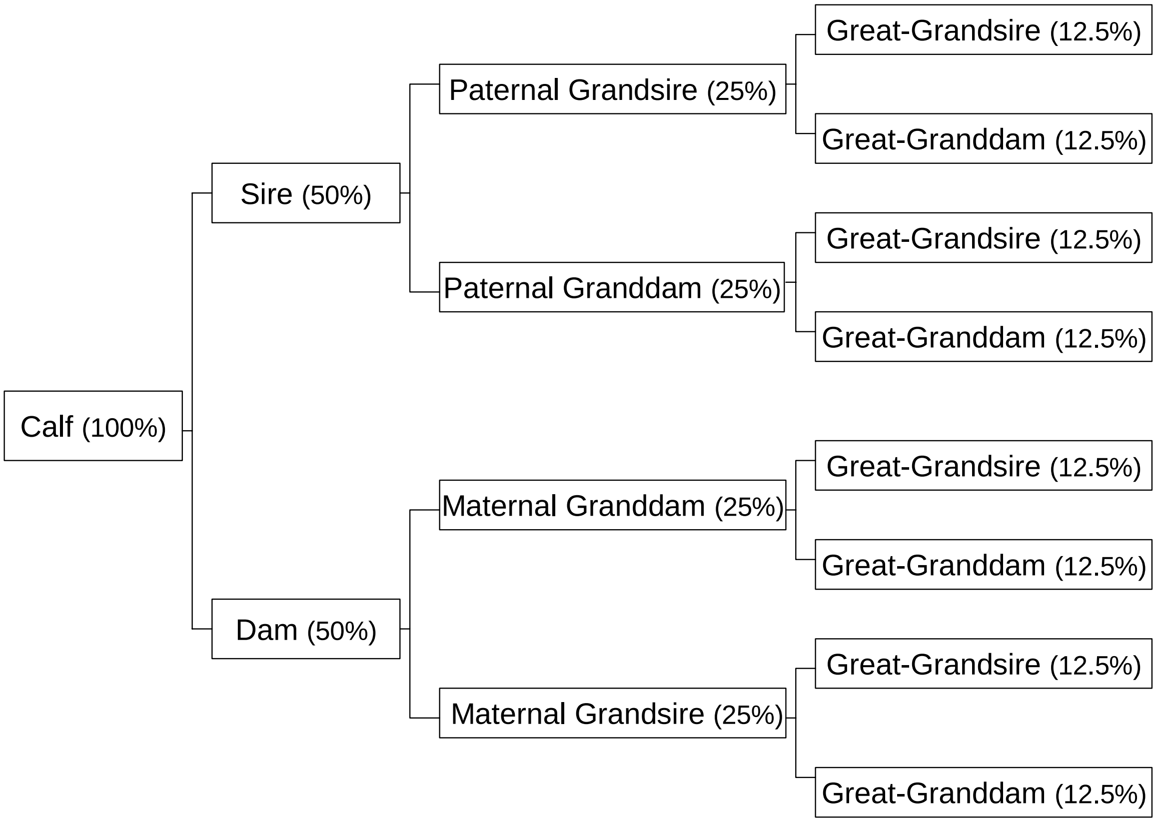

Figure 1.1. Sample pedigree of a calf

The information from this research will help beef producers better assess the value of managing for genetics versus managing the selection of genetics. That is, some producers may approach genetic management from the standpoint of retaining heifers from dams with a history of superior quality- and yield-grade calves. Other producers may manage the selection of genetics by paying closer attention to the sire and maternal grandsire EPDs. This research investigates the value of allowing market performance to determine heifer calf retention.

Figure 1.2 shows that for each calf born on the farm, a producer must make a decision whether to sell that calf at weaning or retain ownership of that calf for a period of time. For steers, this retaining ownership is often done as the steer passes through the supply chain from farm to feedyard to processor. This is shown in Figure 1.3. One major benefit for retaining ownership of feedlot animals is the feedback information that producers receive after animals are harvested. This information can help beef producers make selection decisions in their genetic management program. For heifers, retaining ownership means keeping that heifer back and adding her to the breeding program. Heifers would be more likely to be retained from cows that have proven progeny performance information from carcass data sheets.

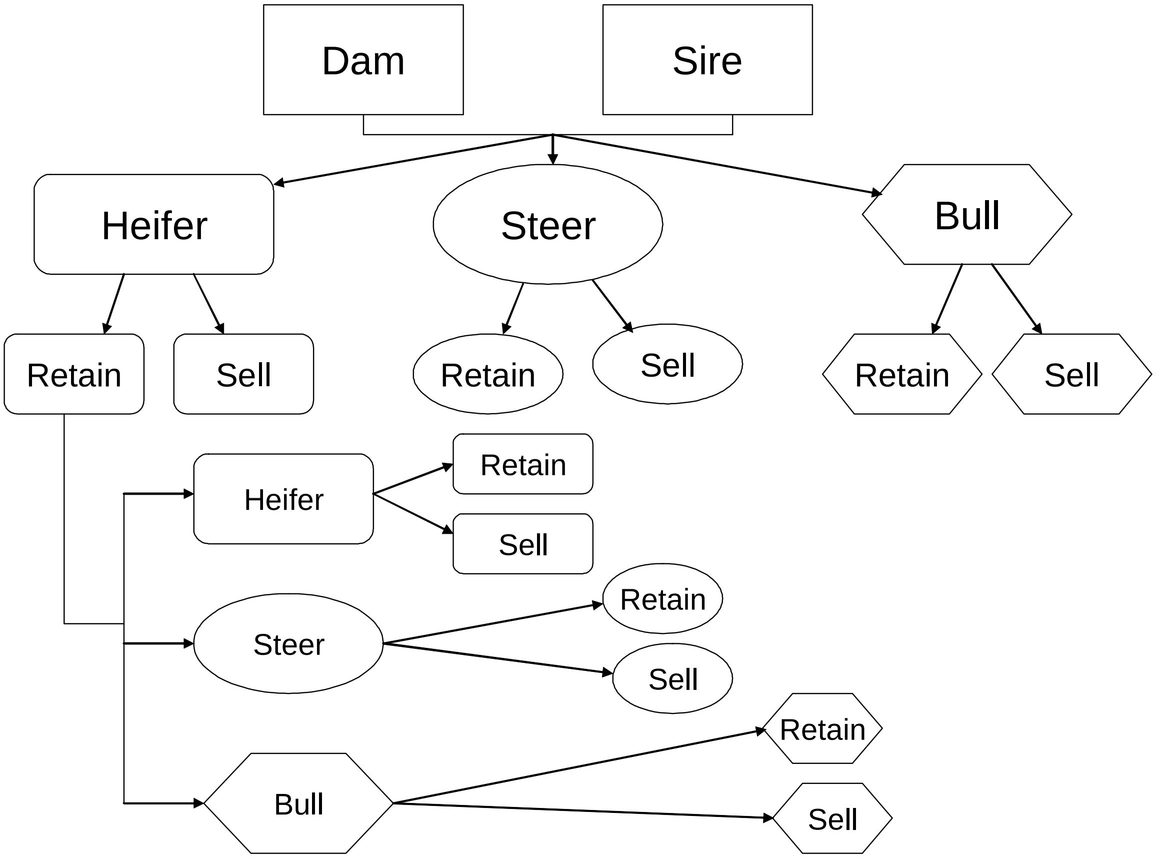

Figure 1.2. Decision to retain or sell each calf born on a farm, 2006.

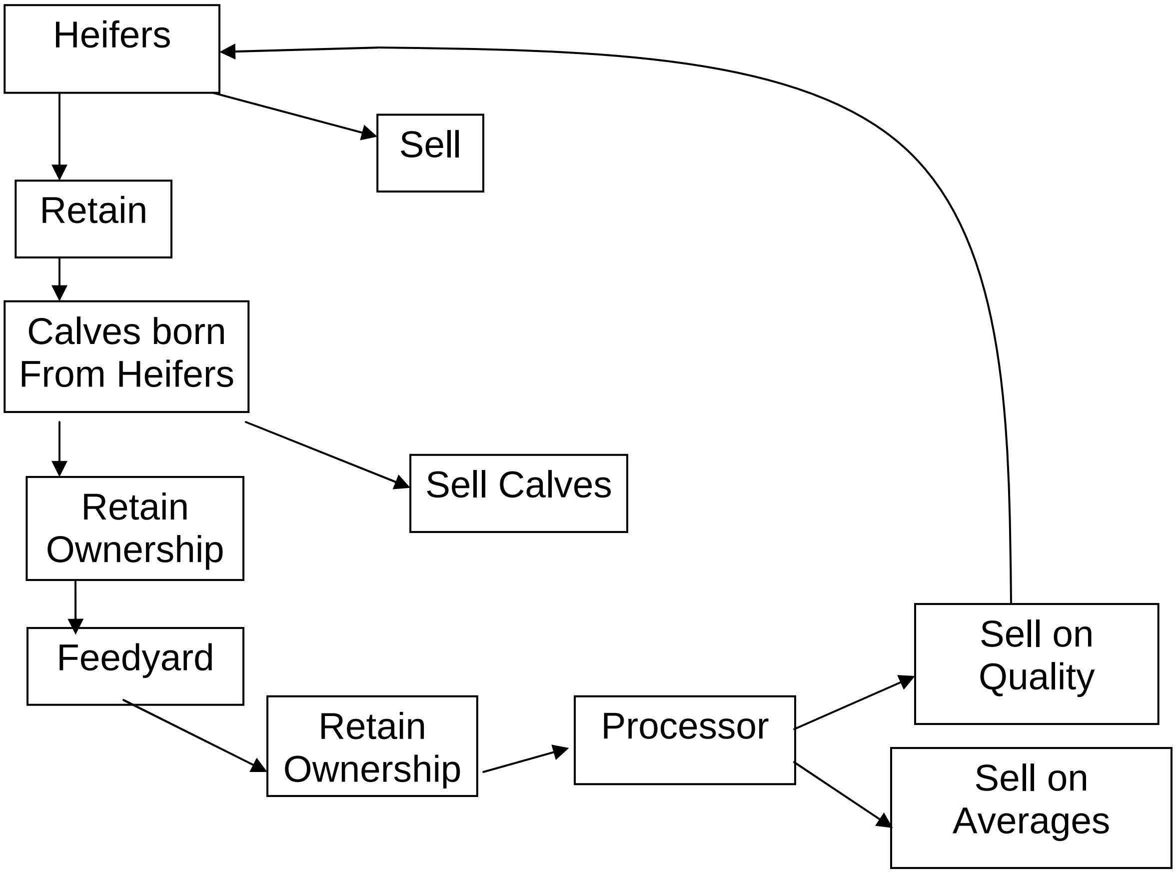

Figure 1.3. Retaining ownership of calves through the supply chain, 2006.

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 are performing. It 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% in the number of alliances that compensate cow-calf producers for meeting performance guidelines was seen from 2000 to 2001**.** Table 1.1 shows some examples of active alliances in the beef cattle industry. According to Sartwelle et al. (2000), beef cattle alliances fall into three categories. The carcass alliances include breed association-sponsored, commercial, and natural/implant-free.

Name of Alliance	Type of Alliance
Certified Angus Beef	Breed Association-Sponsored
Certified Hereford Beef	Breed Association-Sponsored
Red Angus Feeder Cattle Certification Program/Supreme Angus Beef	Breed Association-Sponsored
Supreme Beef Alliance	Commercial
U.S. Premium Beef	Commercial
Angus America	Commercial
Coleman's Natural Meats	Natural/Implant-Free
Laura's Lean Beef	Natural/Implant-Free
Maverick Ranches Beef	Natural/Implant-Free

Table 1.1 Beef Cattle Industry Alliances, Data from Sartwelle et al. (2000)

Alliances can be an important tool to use when marketing cattle. Instead of single beef producers marketing a few head of cattle each year, an alliance can allow several beef producers to pool their cattle and market them as one unit. This gives the group more bargaining power within the beef cattle chain.

Motivation

Value based marketing is an important marketing tool for cattle producers. Beef producers who are producing higher quality cattle want to be rewarded for it. Quality grade is a strong indication of the type of cattle produced. The three main quality grades are Prime, Choice, and Select, in order from highest to lowest quality. Figure 1.4 shows the pounds of meat produced and graded at each quality level for the last 30 years. It does not take into account non-graded beef, which makes up a portion of beef sold. Of the graded meats, pounds of Prime and Choice meats have stayed relatively constant. However, pounds of Select have increased. One reason for this increase in amount of Select meat graded during the 1990's is the United States' focus on nutrition. Select is a leaner meat and several branded products are now being produced solely from Select beef, such as Laura's Lean Beef. Also, with the advent of further processed meats, there is the ability by retailers to market low quality beef in an altered state so that consumers do not care as much about the quality. For example, ready-to-eat meals using meat products are pre-cooked so that tenderness is not an issue. The consumers that buy these types of meat products are more concerned with the convenience of the meal than the quality of meat used to prepare it.

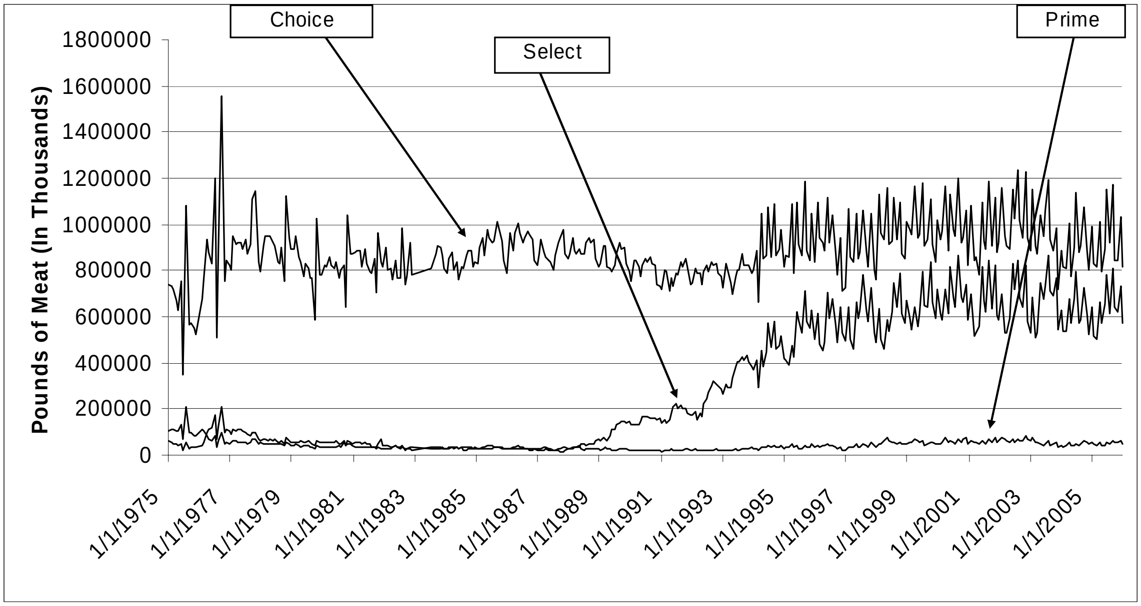

Figure 1.4. National Summary of Meats Graded from 1975 – 2005, Data from Livestock Marketing Information Center

Prime is known as the most flavorful type of meat due to the heavier marbling. Many high end restaurants and consumers prefer this type of meat. Generally, in value-based marketing systems, grids are used to figure premiums and discounts. Quality grade is combined with the yield grade score to figure the total premium or discount. Premiums are given for Prime, discounts for Select, and Choice is used as the base. The only exceptions to this typical premium/discount arrangement are niche markets looking for a specified type of meat. For example, Certified Angus Beef pays premiums for the top 1/3 of Choice as well as Prime and Laura's Lean Beef pays premiums for Select. For the average beef producer, the goal is to raise the quality of grade of their cattle to receive premiums on the typical grids. But is the probability of successfully managing genetics for the individual producer significant enough to cost effectively obtain this premium?

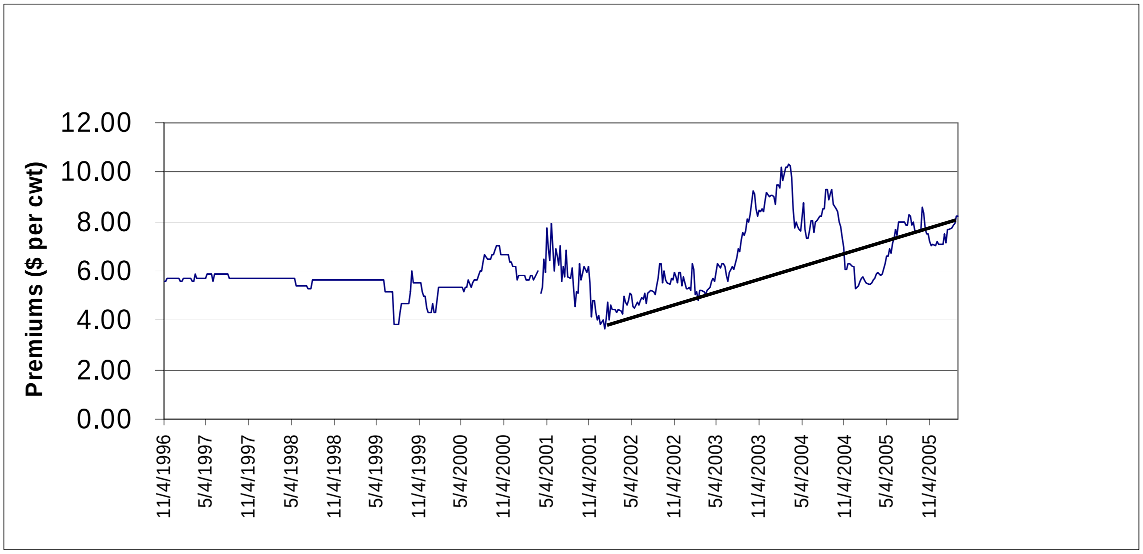

Figure 1.5 National Carcass Premiums for Quality Grade Prime (For Slaughter Steers and Heifers), November 1996 – March 2006, Data from Livestock Marketing Information Center

Figure 1.5 shows the trend in premiums paid for quality grade Prime. The average premium has varied from about $4 to about $10 for the last ten years. A general up-trend is seen from 2002 through 2005, with the exception of a couple of dips in premiums during 2004 and the beginning of 2005. This up-trend in premiums paid for Prime carcasses could be result of higher demand for this type of meat, particularly by restaurants. Figure 1.6 shows the trend in discounts for quality grade Select over the last ten years. This discount has ranged from about $2 to about $25. There has been a great deal of variation in the discounts throughout the time period, but quality grade Select has always received a discount of some kind.

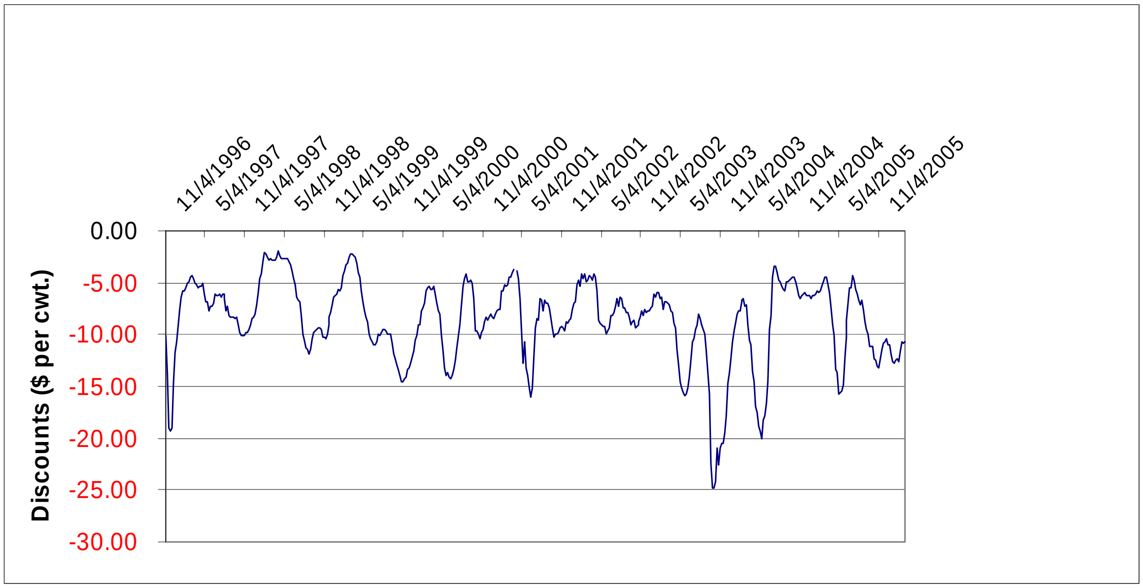

Figure 1.6 National Carcass Discounts for Quality Grade Select, November 1996 – March 2006, Data from Livestock Marketing Information Center

Monthly averages for premiums given to carcasses receiving a quality grade of Prime and for discounts given to carcasses receiving a quality grade of Select are shown in Figures 1.7 and 1.8. The averages were taken for each month over a period from 1997 to 2005. Figure 1.7 shows premiums for Prime carcasses on a steady up-trend for the majority of the year, peaking in October and falling off during November and December. Figure 1.8 shows discounts for Select carcasses going through two distinct cycles through the year. An upward trend is seen from January through March, then discounts increase during the downward trend through April, May, and June. This cycle repeats during the second half of the year with discounts increasing from June through October and decreasing during the last two months of the year.

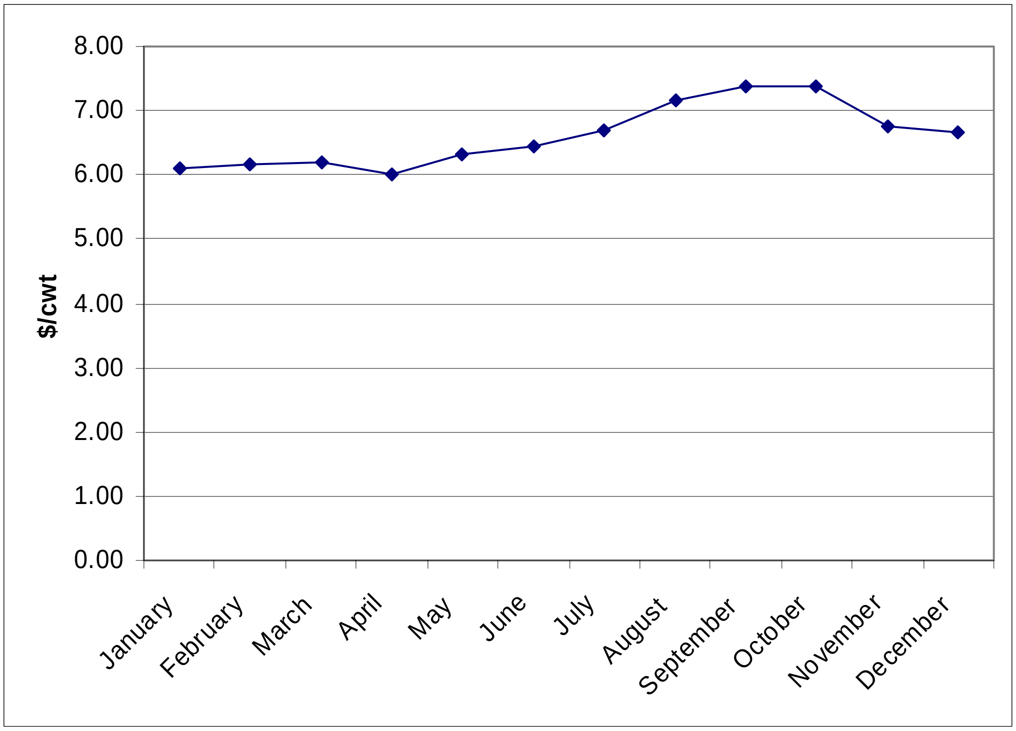

Figure 1.7 Monthly averages of premiums given to carcasses receiving a quality grade of Prime, 2006.

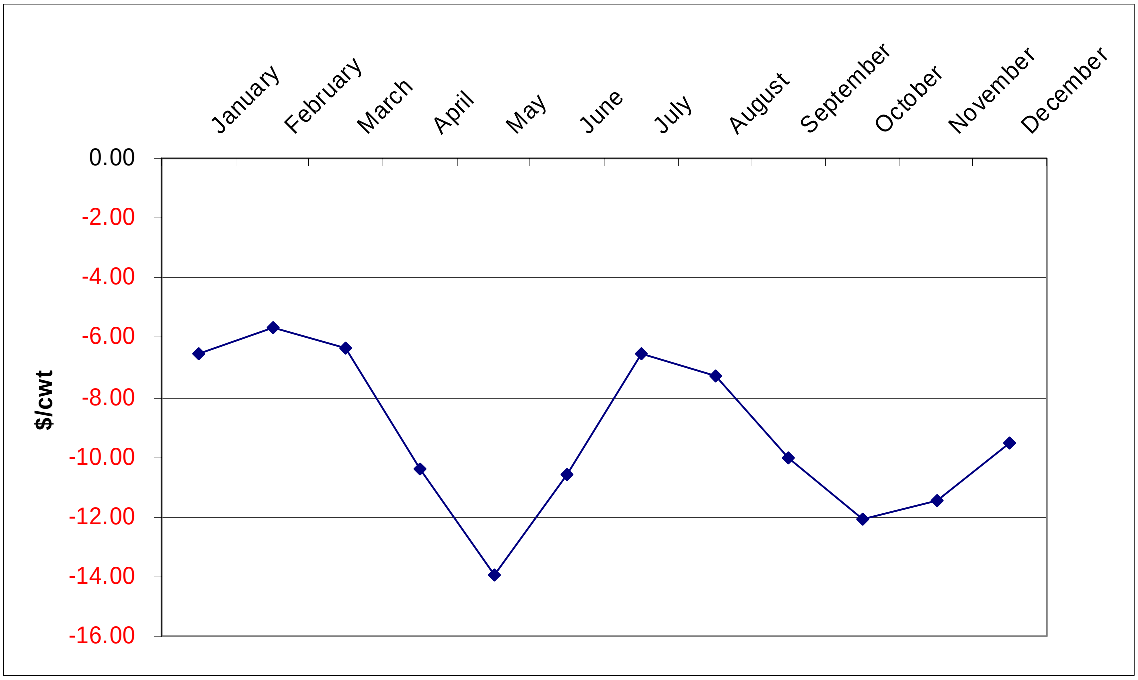

Figure 1.8 Monthly averages of discounts given to carcasses receiving a quality grade of Select, 2006

This research is important in determining the benefits of managing female side genetics in an overall genetic management program. Beef producers are beginning to incorporate genetic management into a total production management program. The genetic management component influences the type of calves the producer will market and ultimately the type of beef that consumers will buy. Most producers focus solely on the sire genetics and manage what type of bulls will be used to breed the herd. This study looks to prove that producers should also focus on managing the females in the herd. If certain females have produced high quality calves, then heifers from those females should be retained into the cow herd. If other females have produced poor calves, then these animals should be culled and no progeny retained into the cow herd.

The remainder of this thesis will provide a detailed summary of the research performed. Chapter 2 provides an overview of previous research conducted in this area through a literature review. Four areas of research are represented including consumer preferences, genetics, grid pricing, and alliances. Chapter 3 will discuss the theoretical and conceptual framework for the research, as well as information on the statistical model used. Chapter 4 will focus on the data used in the study, discussing both the herd information kept by the producer and the carcass information received from feedlots. Chapter 5 will provide a detailed look at the results of this research and chapter 6 will summarize the findings.

2. LITERATURE REVIEW

The majority of previous research completed on genetics in beef cattle has been conducted from a scientific or biological perspective. However, several studies have been conducted from an economic perspective on how genetics could be used to increase net profit for a group of cattle. Research has been conducted on areas that will influence how producers look at genetic management including consumer preferences, grid pricing, and alliances.

2.1 Consumer Preferences

Carcass quality has a direct link to how beef will look and taste. These characteristics of beef products are crucial in the market place. Lusk et al. (1999) researched consumer opinions by talking with shoppers in several grocery stores in Kansas. Two treatments were used during the study. With the first treatment, shoppers at the meat counter were asked to participate in an experiment. They were asked to sample two different types of steak, which were labeled “Red” and “Blue.” The Red was actually a guaranteed tender steak and the Blue was a tough steak according to a slice shear force test. Consumers were not told that the samples differed in tenderness. After tasting the steaks, the consumers were asked questions regarding taste, tenderness, texture, juiciness, and overall palatability. The second treatment was identical to the first except that the steaks were labeled “Guaranteed Tender” and “Probably Tough” instead of Red and Blue. A statement was also provided that explained that the USDA divided steaks into tenderness categories based on a shear force test. Both treatments in the study resulted in the majority of the consumers choosing the more tender steak. In the first treatment, 69% of participants preferred the Red (guaranteed tender) steak and in the second treatment, 84% preferred the Guaranteed Tender (red) steak. So, when the differences in steak tenderness were revealed to the consumers, more preferred the tender steak. Lusk (2001) sent a mail survey to a random sample of consumers in the U.S. The consumers were asked to rank six quality characteristics that were important in making the decision whether or not to purchase a steak. The six characteristics were price, external fat, USDA quality grade, brand (label), color, and marbling. The survey found that consumers ranked the color of a steak as its most important attribute, along with marbling.

Umberger et al. (2000) sought to discover consumer preference and willingness-to-pay for flavor in beef steaks. The objectives of the research were to analyze consumer preferences for beef steaks by comparing highly marbled USDA upper 2/3 Choice versus low marbled USDA Select steaks and to establish what the price premiums would be for this flavor preference. To isolate flavor as the determining factor, tenderness was held constant by using steaks with similar shear force values. An experimental auction market procedure was used to elicit consumer willingness-to-pay for the steaks. Consumers were asked to bid on steaks by writing a price down on a piece of paper. The fourth highest bid determined the market price with the top three bidders required to purchase steaks at that market price. Participants were from two markets, Chicago and San Francisco. Taste panels of six to twelve consumers were used with a total of 124 participants in Chicago and 124 in San Francisco. Consumer panelists practiced with three sample auctions. Then, they tasted six samples from three paired sets of steaks.

Two of the pairs were high marbled versus low marbled steaks. After tasting each steak, consumers wrote down their bid price for each steak. The results from this research showed that panelists gave significantly higher ratings for flavor desirability, juiciness, tenderness, and overall acceptability to the high marbled steaks versus the low marbled steaks. Consumers were willing to pay a higher market price in 34 of the 48 auctions for the upper Choice steak compared to the Select steak. Chicago consumers were willing to pay $0.25 more per pound, while San Francisco consumers were willing to pay $0.03 more per pound.

2.2 Genetics

The influence of genetics on the market value of livestock is important. Carcass traits tend to have moderate to high heritability. Dikeman et al. (2005) found that marbling, juiciness, and overall tenderness have a heritability of 0.40-0.70. Because of this heritability, producers can better determine the type of cattle they send to market by managing the genetics used in their operation. Improving tenderness and juiciness is a reasonable goal due to the heritability so producers marketing on a value-based system could receive higher premiums for cattle that more closely resemble what consumers are looking for.

Richards and Jeffrey (1996) sought a method of measuring and reporting the genetic value of dairy bulls. The researchers wanted to use an alternative approach to the normal measure of genetic valuation used in Canada, which is the Lifetime Profit Index (LPI). Statistical analysis of market price data for semen was done and hedonic pricing was the method used to determine the value of genetic traits in Holstein bulls in Alberta.

Hedonic pricing models say that demand for a product, in this case genetic value, is a function of its characteristics. Researchers stated that the market price of a bull's semen is a function of the values of the genetic characteristics. Data was obtained from the July 1994 volume of the Who's Who sire guide for 692 purebred Holstein bulls on production characteristics such as milk, fat, and protein. Prices of semen, in dollars per straw, were obtained from SEMEX Canada. The empirical model consisted of a Cobb-Douglas function, where the semen price index is a function of the proof characteristics. A Tobit model was also used to estimate marginal characteristic values. The study found that the hedonic pricing method provides a better explanation for market prices of semen than does the LPI. Researchers concluded that the hedonic pricing model accomplishes all of the objectives of the LPI, but at a lower cost and in a way that is easier to comprehend.

Dhuyvetter et al. (1996) estimated market values for bulls based on specific bull attributes, expected progeny differences (EPDs), and bull sale marketing efforts. The researchers decided that important bull price determinants are bull color, polled, conformation, muscling, disposition, age, birth weight, weaning weight, milk EPD, birth and weaning weight EPDs, sale location, order bull was sold, whether the bull had a picture in the sale catalog, and whether a percentage of semen rights were retained by the seller. Data was collected from 26 purebred beef bull sales in Kansas during spring 1993. A total of 1,650 observations were used, representing seven beef breeds. A hedonic pricing model was used. Bull characteristics were categorized as either physical and genetic characteristics or expected performance characteristics. The physical and genetic characteristics refer to the bull itself, while the expected performance characteristics refer to future progeny of the bull. Bull price was specified as a function of physical and genetic characteristics, expected performance characteristics, and marketing factors. Two different models were used to determine the importance of EPDs. One model contained weights without EPDs and the other included weights and EPDs. The study found that EPDs were statistically significant in explaining the price of three breeds, but less significant in the other breeds. Several characteristics of the bulls resulted in the buyers paying premiums, including polled, high subjective ratings for conformation, muscling, and disposition. Marketing factors were also relevant. Prices paid for bulls decreased as sales progressed. A premium was paid for a bull with a picture in the sale catalog and one where a portion of semen rights were retained. The study found that quantifying values of specific bull characteristics is necessary to determine the economic importance of these factors. This study estimated the marginal contribution of various bull traits to the bull's overall value. Researchers concluded that expected performance variables were important in explaining price variability among bulls from the same breed. Prices were positively correlated with weaning weight EPDs in all breeds. Prices were also positively correlated with milk EPDs in three of the breeds. For most breeds, the birth weight EPDs were not seen as providing new information to buyers compared with the actual birth weights and were only significant in three of the breeds.

Radke et al. (2000) studied the value of genetic information in selection of replacement Holstein heifers. The study compared competing information systems (IS), which were defined as a "set of messages and associated decision rule." The objective of the study was to determine what the economic value of using genetic information would be and whether this value was adequate for producers to select replacement heifers on this basis. The data consisted of Michigan Holstein heifers born within a six month period that had also calved within a six month period. The two IS used were a complex genetic message and a simple genetic message. The complex genetic message was based on parents' PTAs of milk, fat, protein, and associated reliabilities and the simple genetic message was based only on parents' PTAs of milk. It was found that the two messages were essentially equivalent so it was suggested that the simpler method be used. The researchers concluded that it was profitable to use genetic information as selection criteria as opposed to random selection. For the average Michigan producer, improved heifer selection increased farm profitability approximately 3% – 5%.

2.3 Grid Pricing

Purcell (2002) found that cash market pricing systems fail to send the correct signals to producers about what quality characteristics consumers desire from the beef they purchase. As a result, the quality of beef available in stores may not be consistent with the quality of beef that consumers demand. The outcome of this situation is that consumer demand for beef will not be stable because consumers will only buy the beef that meets the quality characteristics they desire. Producers have explored new opportunities to better serve consumers. However, producers are not willing to invest in these new opportunities without incentives. Producers seek ways to market their product that will provide rewards for higher quality. Some of these alternative marketing methods include pricing grids, contracts, and vertical alliances. Non-price coordination such as the methods listed previously is the main process in which producers can be paid for value. For this process to be successful, feedback on individual animals is essential.

Ward, Schroeder and Feuz (2001) explain that grid pricing is becoming more common in the fed cattle market. With grid pricing, producers are rewarded for high quality cattle and penalized for low quality cattle. This is achieved through a system of premiums and discounts. With grid pricing, an incentive is present for producers to use genetic selection to enhance carcass traits. Packers typically set a standard set of quality specifications and assign a base price for an average carcass. Carcasses that are above average will receive the base price plus a specified premium. Carcasses that are below average will receive the base price minus a specified discount. Most base prices are tied to an external market price through some type of formula, unless the base price is determined through negotiation. The formulas may be very different depending on the external price used. For example, a base price that is tied to the futures market could be different than a base price tied to the cash market or the wholesale market.

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 feeding performance factors were examined. Two distinctly different grid structures were analyzed to determine whether factors affecting profit vary based on the type of grid used. Grid A used a weighted plant average base price. The base price is derived from the price paid for and carcass characteristics of all cattle bought live in the previous week. Grid B used a base price based on the western Kansas direct weekly fed cattle price reported by USDA converted. This was converted to a carcass price using the average hot yield for the plant from the previous week. 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. For Grid B, premiums were paid only on the percent of the pen that were above pre-set requirements for quality traits and discounts were given for pens having undesirable traits above a certain level. Ordinary Least Squares regression was used to explain the differences in profit per head for cattle sold on grids. Two data sets were used, one for a group of cattle (3,483 pens of cattle) sold using Grid A and one for a group of cattle (1,011 pens of cattle) sold using Grid B. When considering all variables, feeder cattle price and grid base price were found to have the greatest impact on cattle profit per head in both grid structures over time. Researchers found that when considering only non-price variables, the cumulative quality of cattle in a pen is the most important factor influencing profit. Genetics influence the quality of cattle and thus influence profit as well.

2.4 Alliances

The failure of market signals from consumers back down to beef producers resulted in producers looking for ways to go around traditional signaling mechanisms and provide the type of product that consumers desire. Because packers and feedlots were not distinguishing between high quality animals and low quality animals, little incentive existed for producers to invest in producing high quality animals and genetic management was not a part of the total herd management plan. Alliances can give small beef producers an advantage when marketing their cattle. By pooling their animals, the group will have more bargaining power. If the producers work together on management issues and breeding strategies, then more uniformity should exist within their group of cattle than an average pooled group of cattle. This will also give them an edge when marketing the animals.

Schroeder and Kovanda (2003) studied strategic alliances as a method to improve vertical cooperation and profitability. Even though this study discussed vertical alliances specifically, many of the concepts and conclusions could be used to describe horizontal alliances, which many beef producers are turning to as a marketing tool. An alliance was defined as “an association among groups that is established to accomplish a particular goal more effectively than the parties could accomplish independently.” The beef industry was going though a period of restructuring and downsizing due to declining demand in the 1980’s and 1990’s. Schroeder and Kovanda contend that the increases in beef demand since 1998 can be partially attributed to improved vertical coordination. Horizontal alliances could also attribute to increasing demand. Producers who join together with a goal of using value based marketing have an advantage. They can share information to increase the quality of cattle. By aligning their management strategies, especially genetic, reproductive, and nutrition strategies, the groups of calves marketed through the alliance should have more uniformity than a typical group of pooled cattle. This uniformity could result in premiums paid to the producers.

3. THEORETICAL, STATISTICAL AND CONCEPTUAL MODEL

Data should be evaluated to discover what factors are most important in determining the final merit of the carcass. Two main components of carcass merit are yield grade and quality grade. These components are influenced by several factors including dam genetics, sire genetics, lot number, quality grade, yield grade, marbling, backfat, ribeye area, internal fat, and hot carcass weight. The model will determine which of these factors influence carcass merit and to what extent they influence it.

Quality grade is influenced by marbling and age of the animal. Age will not be a factor in this research because all animals are within the “A” maturity, meaning they are between 9 and 30 months of age. So, marbling is the biggest influence on quality grade of an animal. Marbling is flecks of fat distributed through the muscle that influence the flavor of the meat. In general, the higher the marbling of a cut of meat is the greater the flavor of that cut of meat. Because marbling is highly correlated with quality grade, it was not included in the model. The quality grade of an animal should encompass the age and marbling factors. Quality grade is also influenced by the genetics of the animal. The animal’s genetics are directly influenced by dam genetics and sire genetics. Both of these genetic components are included in the model.

Yield grade represents the amount of closely trimmed, boneless retail products that can be obtained from a carcass. Yield grade is determined through four factors, which include backfat, ribeye area, internal fat, and hot carcass weight. According to ZoBell et al (2005), a base yield grade of 3 equals measurements of 0.40 backfat, 600 lb. hot carcass weight, 11.0 square inch ribeye area, and 3.5% internal fat. Because backfat, ribeye area, internal fat, and hot carcass weight are highly correlated with yield grade, these factors were not included in the model. The yield grade of an animal should encompass all four of these factors. Yield grade is also influenced by environmental factors such as management and weather. The lot number variable approximates these environmental factors because the groups of calves in each lot were exposed to the same type of conditions.

A limitation of this study is that the entire data set comes from one beef producer. This could mean that the conclusions drawn from this research may not be applicable to all other beef producers. The reason only one set of data was used is that it was the most complete data set available. The producer had managed the female side of the herd and kept records for many years. The producer also retained ownership on calves so carcass data was available for the animals harvested from the herd.

This data set has few observations for animals with five or more stacked generations of dam genetics. This makes it difficult to draw conclusions for higher levels of stacked genetics. But the trend seen through the first four generations of stacked genetics seems applicable to the higher levels. The likelihood of an animal with stacked generations of dam genetics receiving a quality grade of Prime increases from first to second levels and from second to third levels, then decreases slightly from third to fourth levels. From this trend, it is likely that the likelihood of grading Prime would continue to decrease through the fifth, sixth, and seventh levels of stacked genetics.

3.1 Theoretical Model

The theoretical model is for a beef producer that must make management decisions of allocating inputs to create beef. Let F_b represent a beef producers production function, x_{ij} be the quantity of input i used to produce beef (b),

(3.1) $$q_b = F_b(x_{1\cdot b}, x_{2\cdot b}, \ldots, x_{m\cdot b}).$$

Equation 3.1 states that quality of beef processed is a function of the amount of inputs used in production. Let v_{ib} represent the ith calf produced in beef production, so the total quality of each characteristic used in beef production can be expressed as:

(3.2) $$x_{j\cdot b} = X_{jb}\,(v_{1b}, v_{2b}, \ldots, v_{nb},\; x_{j1b}, x_{j2b}, \ldots, x_{jnb}).$$

So, equation 3.2 relates the amount of each quality characteristic (x) used for each calf produced (v). Thus, the production function for beef production can be defined as:

(3.3) $$q_b = G_b\,(v_{1b}, v_{2b}, \ldots, v_{nb},\; x_{11b}, x_{12b}, \ldots, x_{mnb}).$$

The profit function derived from 3.3 for a beef producer is given as:

(3.4) $$\pi = p_b F_b(x_{1\cdot b}, x_{2\cdot b}, \ldots, x_{m\cdot b}) - \sum_{i=1} k_i v_{ib}$$

where P_b denotes the price of the ith carcass of beef. Beef producers are assumed to maximize profits and are perfectly competitive. Equation (3.4) states that a cattle producers profit is a pre-determined price of fed cattle (p_b) multiplied by the number of calves produced $(F(\cdot))$ with multiple characteristics $(x_{m \cdot b})$ less the cost of producing characteristics (x_m) using process $v_{i,b}$ at the price k_i. For example, the profit of producing and selling Angus calves is the price of Angus cattle (with premium) multiplied by the number of Angus cattle sold less the cost of producing Angus calves. Production costs are components of the entire animal so that there is a separate incremental cost of producing calves that are Angus breed. A producer could have chosen to use the Hereford breed, but by choosing the Angus breed, there is an extra cost associated with sourcing dam and sire Angus breed genetics.

For the current study, the interest lies in the incremental cost and value associated with managing for characteristics. The incremental change in achieving a higher characteristic level $(x_{i \cdot b})$ in the production of beef $(F(\cdot))$ is sought for a change in the management for characteristic v_{ib}. In particular, this research analyzes how managing the input of dam genetics impacts the quantity, $(F(\cdot))$, of quality cattle marketed.

3.2 Statistical Model

This analysis entails evaluating how changes in the level of an input into calf production influence the probability outcome of a quality characteristic in processed beef production. Since the dependent variable is a discrete choice variable, either the desired outcome occurred or it did not occur, a discrete dependent variable statistical model is used. For this analysis, the Logit model is estimated for a series of discrete choice dependent variables. The statistical specification of the Logit model follows.

The general Logit model takes the form:

$$(3.5) \qquad F(X_t^{'}\beta) = \frac{1}{1 + \exp(-X_t^{'}\beta)}$$

Where one of the X_{ij} equals 1 for the constant term, for example, let $X_{kj}=1$, and the β_i^0 's are the true parameter values. This model can be estimated by maximum likelihood in the same way as before. According to Greene (1993) and Bierens (2004), the log-likelihood function is

$$(3.6) \qquad L(\beta) = \sum_{t=1}^{N} \left\{ Y_t \ln\left[1 - F(X_t^{'}\beta \right] \right\}$$

Marginal effects are shown through running a Logit model. The marginal effect of X_j for a dummy variable is:

$$(3.7) \qquad \text{Prob}(Y = 1 | X_k = 1, X_*) - \text{Prob}(Y = 1 | X_k = 0, X_*)$$

The marginal coefficients explain what the likelihood of that animal receiving a particular quality or yield grade is. This helps pinpoint which quality and/or yield grades are most affected by dam stacked genetics and at what level they are most affected.

3.3 Conceptual Model

A binomial logit analysis is performed on the data to determine the marginal effects of the independent factors on the dependent variables. The independent variables include dam stacked generation (DSG), sire, and lot number (LN). Dam stacked generation and sire are used to show the effect of genetics, while lot number will show the effects of environmental and management factors in the feedlot. Marbling, backfat, ribeye area, internal fat, and hot weight were not included in the final model due to their endogeneity. Marbling is a direct component of quality grade, while the other four characteristics are direct components of yield grade.

The dependent variables are selected to determine how well the independent variables affect final carcass quality through yield grade and quality grade. If a positive coefficient is estimated, then that means that the independent variable has a positive impact on the final grade. If the result is negative, then the variable has a negative impact on the final grade. A separate analysis was performed for each yield grade and quality grade.

YG1 = f(DSG, Sire, LN)

YG2 = f(DSG, Sire, LN)

YG3 = f(DSG, Sire, LN)

YG4 = f(DSG, Sire, LN)

YG5 = f(DSG, Sire, LN)

QPrime = f(DSG, Sire, LN)

QChoice = f(DSG, Sire, LN)

QSelect = f(DSG, Sire, LN)

Definitions of the variables used in the logit analysis are provided in Table 3.1. Dam stacked generation (DSG) represents the number of generations on the dam side in which genetics is known. DSG is a binary variable such that each equation is estimated seven times to represent from a one stacked generation to a seven stacked generation dam. It is important to point out that 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, i.e. seven stacked generations is the maximum so there are seven sets of equations. Sire is used to distinguish the sires from one another in the analysis. A series of binary independent variables is used. A total of 67 different sires are represented in this group of data. Lot number is used to show what contemporary group each animal is a member of. Thirteen different lots exist in the group of data and series of binary variables distinguish one lot from another.

Table 3.1. Definitions for variables used in Logit Analysis, Genetic Management and Beef Carcasses, 2006.

Variables	Definition
Quality Grade	
Prime	Binary variable; = 1 if prime, = 0 ow
Choice	Binary variable; = 1 if choice, = 0 ow
Select	Binary variable; = 1 if select, = 0 ow
Standard	Binary variable; = 1 if standard, = 0 ow
UB	Binary variable; = 1 if UB, = 0 ow
Yield Grade	
YG1	Binary variable; = 1 if yield grade 1, = 0 ow
YG2	Binary variable; = 1 if yield grade 2, = 0 ow
YG3	Binary variable; = 1 if yield grade 3, = 0 ow
YG4	Binary variable; = 1 if yield grade 4, = 0 ow
YG5	Binary variable; =1 if yield grade 5, = 0 ow
Sire	0 or 1 binary variables to distinguish sire (67 sires)
No DSGB (default)	n/a
DSG1	Binary variable; = 1 if one, = 0 ow
DSG2	Binary variable; = 1 if two, = 0 ow
DSG3	Binary variable; = 1 if three, = 0 ow
DSG4	Binary variable; = 1 if four, = 0 ow
DSG5	Binary variable; = 1 if five, = 0 ow
DSG6	Binary variable; = 1 if six, = 0 ow
DSG7	Binary variable; = 1 if seven, = 0 ow
LN1 (default)	Binary variable; = 1 if animal is in 1st lot, = 0 ow
LN2	Binary variable; = 1 if animal is in 2nd lot, = 0 ow
LN3	Binary variable; = 1 if animal is in 3rd lot, = 0 ow
LN4	Binary variable; = 1 if animal is in 4th lot, = 0 ow
LN5	Binary variable; = 1 if animal is in 5th lot, = 0 ow
LN6	Binary variable; = 1 if animal is in 6th lot, = 0 ow
LN7	Binary variable; = 1 if animal is in 7th lot, = 0 ow
LN8	Binary variable; = 1 if animal is in 8th lot, = 0 ow
LN9	Binary variable; = 1 if animal is in 9th lot, = 0 ow
LN10	Binary variable; = 1 if animal is in 10th lot, = 0 ow
LN11	Binary variable; = 1 if animal is in 11th lot, = 0 ow
LN12	Binary variable; = 1 if animal is in 12th lot, = 0 ow
LN13	Binary variable; = 1 if animal is in 13th lot, = 0 ow

The quality and yield grade variables shown in Table 3.1 are dependent, while all other variables are independent. A positive relationship is expected between Prime quality grade and dam stacked generation as well as between Choice quality grade and dam stacked generation. Sire should also have a positive relationship with Prime and Choice quality grades if managed correctly. A negative relationship should be seen between Select, Standard, and UB quality grades and dam stacked generation and between Select, Standard, and UB quality grades and sire. Lot number will have little or no effect on the quality grades. The environmental influences should be minimal on what quality grade will be.

It is hard to say what the relationships between yield grade and dam stacked generation and between yield grade and sire will be. Yield grade is typically affected more by environmental factors than genetics, but some influence should appear. The genetics could influence carcass weight, ribeye area, and internal fat, which are all components of yield grade. The genetics could have a positive or negative relationship on each level of yield grade. The producer should be managing to achieve the higher yield grades of 1 – 3 so a positive relationship could be seen between these three yield grades and dam stacked generation and sire. This would lead to a negative relationship between yield grades 4 and 5 and dam stacked generation and sire. Lot number should have a strong influence on the yield grade. Again these effects could vary based on each lot because each lot endured different environmental conditions. Each group of cattle was managed at a different point in time so the type of feedlot management could change. Several feedlots were represented among these 13 lots of cattle so each one would be managed differently. Also, the weather would have varied over the time that each group of cattle was in the feedlots. If the lot of cattle was managed well and had decent weather, a positive relationship should be seen between yield grades 1, 2, and 3 and lot number and a negative relationship should exist between yield grades 4 and 5 and lot number. All Logit models estimated using Shazam (Whistler et al. 2001).

4. DATA

Data for this paper was obtained from a Southeast Missouri beef cattle producer. The producer kept an extensive record of his herd for several years. Two types of data were used. The first type used was carcass kill sheets. Carcass sheets were available for 13 lots of cattle harvested between 1999 and 2005. Most of the cattle in this data set originated from the producer's herd, but some were alliance calves that the producer gained ownership of through the alliance. The carcass sheets were not all from the same feedlot and so the information was provided in different types of tables. For the most part, all of the information in the tables was the same. Three of the lots did not have information directly from the feedlot. Instead, the carcass data was presented through the Angus Herd Improvement Record Carcass Summary (American Angus Association). Some differences existed between the information presented in these summaries and the summaries from the other ten lots. The differences were in how marbling score, quality grade, and yield grade were reported. For ten of the lots, marbling was listed as one of the ten degrees of marbling ranging from very abundant to practically devoid. Within the data set, marbling scores ranged from abundant to trace. On the three remaining lots, marbling was shown as a number. To convert the number to a degree of marbling, a graph was used from a "Study Guide for the Ultrasonic Evaluation of Beef Cattle for Carcass Merit." This graph showed the relationship between the numeric value from ultrasound and the degree of marbling. So, each numeric value was converted to the degree of marbling for each animal in the three lots based on this graph. Quality grade was reported as the actual quality grade (i.e. Prime, Choice, Select, Standard) for ten of the lots. The remaining three lots with the carcass summaries from the American Angus Association show quality grade as a numeric value. Bill Bowman, Vice President of Information and Data Programs with the American Angus Association, explained the difference. The numeric values were on a scale of 17, where three numbers represented each quality grade. For example, 17 equaled Prime plus, 16 equaled Prime, and 15 equaled Prime minus. Using this scale, each numeric value was converted to the actual quality grade. The final area where differences existed between the carcass summaries from the American Angus Association and those from the feedlots was yield grades. Yield grades from the majority ten lots were listed on the typical scale of one to five. The three remaining lots showed yield grades with decimals used and not as whole numbers. Also, a few of the yield grades were actually larger than six. Bill Bowman also explained the yield grade differences. The American Angus Association figures the yield grade from information provided from the carcass data. They want to provide more detailed information to the producers so yield grade is figured with the decimals and not just a whole number. It was decided that the few animals with yield grades larger than six should be considered a yield grade five. When the yield grades were figured by the American Angus Association, these animals mathematically were larger than five, but since this is the highest yield grade on the USDA scale, it will be used.

The second set of data used in this analysis was genetic information or the pedigree of the animal. The producer kept these records through the AIMS, or Angus Information Management System, software program. The AIMS program is available through the American Angus Association. The software keeps track of each animal in the herd and all important information pertaining to that animal from birth. The pedigree profile for each animal was used to determine whether genetic management had been used. A stacked generation of dam side information was looked for on each animal used in the study. A stacked generation was categorized as knowing genetic information for more than one previous generation. For example, an animal in which just the dam information was known would have zero stacked generations. An animal in which the dam information was known and the dam's dam information was known would have one stacked generation. For this set of animals, there was a range of zero to seven stacked generations.

Each animal with carcass data in the summary sheets was looked up in the AIMS program to determine genetic information on that animal. Then all the information for the animals was entered into a large spreadsheet to be used for analysis. A total of 860 observations were available for the final analysis.

Summary statistics are reported in Table 4.1. About half of the animals had at least one stacked generation of dam genetics. Thirty percent had one stacked generation and 13% had two stacked generations. Few animals had over four stacked generations. Regarding quality grades, the majority of animals graded Choice (73%). Eleven percent graded Prime and 15% graded Select. Just over half of the animals received a yield grade 3. Twenty nine percent were yield grade 2 and 10% were yield grade 4.

Table 4.1. Summary Statistics for variables used in Logit Analysis, Genetic Management and Beef Carcasses, 2006. (989 total observations)

Variables	% of Data	
Quality Grade:	Quality of Retail Product	
Prime	10.92%	
Choice	72.80%	
Select	15.37%	
Standard	0.30%	
UB	0.61%	
Yield Grade:	Percent Retail Product	
YG1	1.82%	
YG2	29.12%	
YG3	56.72%	
YG4	10.11%	
YG5	2.22%	
Sire	n/a	
DSG:	Level of dam stacked generations	
DSG0 (default)	51.46%	
DSG1	29.63%	
DSG2	13.15%	
DSG3	2.43%	
DSG4	2.02%	
DSG5	0.51%	
DSG6	0.40%	
DSG7	0.40%	
Lot Number:	Contemporary Group in Feedlot	Time Harvested
LN1	8.59%	Apr-1999
LN2	7.79%	Jul-99
LN3	8.19%	Jan-00
LN4	7.28%	May-00
LN5	6.88%	Jun-00
LN6	7.48%	Dec-00
LN7	6.37%	Jul-01
LN8	12.84%	Dec-01
LN9	7.79%	Dec-02
LN10	6.37%	Jun-03 and Jul-03
LN11	8.49%	Jan-04
LN12	4.25%	May-04
LN13	7.68%	May-05

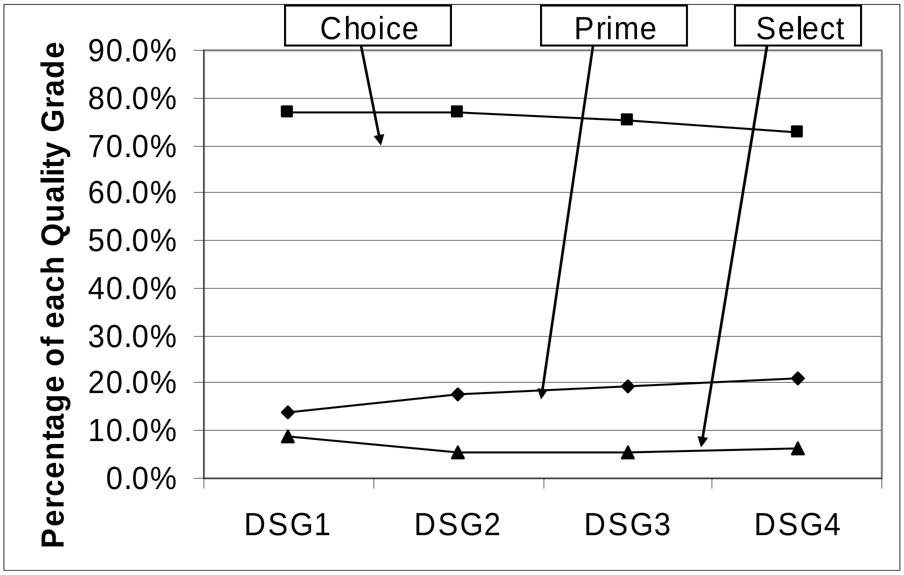

Figure 4.1. Distribution of Quality Grades within each level of Dam Stacked Generation

Figure 4.1 shows how the three quality grades are distributed within each dam stacked generation level. The number of Prime carcasses increases with each level of dam stacked generation; 14%, 17.6%, 19.3%, and 21.2% respectively. The number of Select carcasses decreased between one level of stacked genetics (9%) and two levels of stacked genetics (5.3%). It stayed at 5.3% with three levels of stacked genetics and then increased slightly to 6.1%. The number of Choice carcasses decreased slightly through the levels of stacked genetics from 77% with one stacked generation to 72.7% with four stacked generations.[1]

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[1] Data is only shown for the first four levels of stacked generations due to the amount of data available.

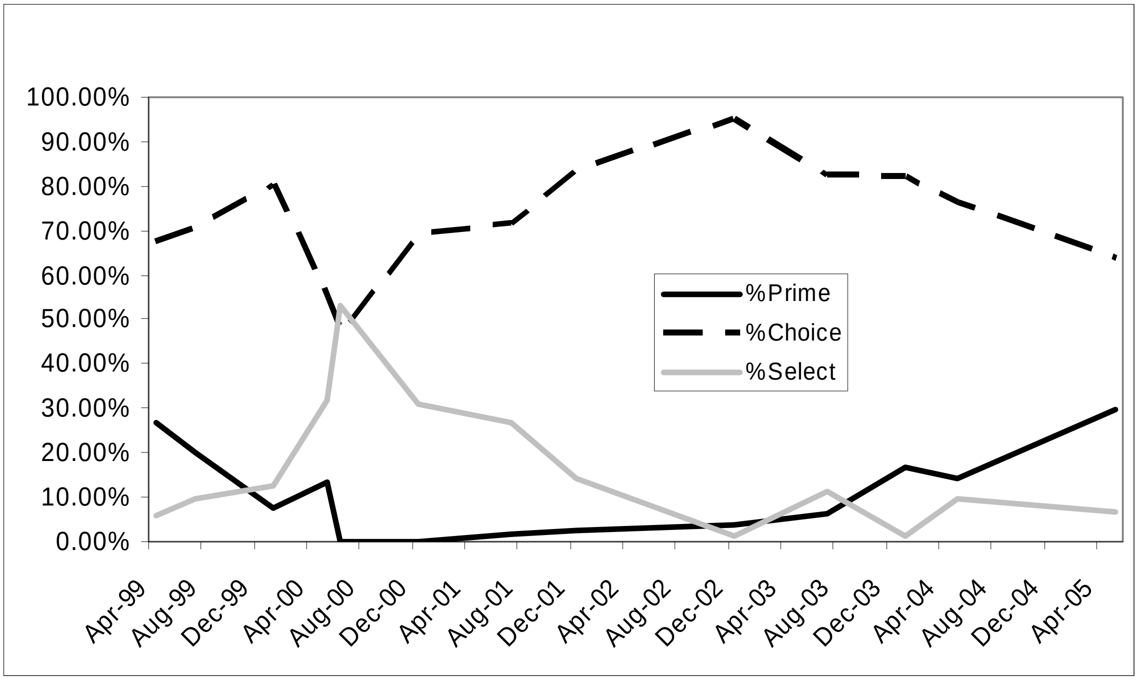

Figure 4.2. Distribution of Quality Grades within Data Set

The distribution of quality grades within the data set is shown in Figure 4.2. Over the time period, from 1999 to 2005, there were consistently more Choice cattle than Prime or Select. For a short period in 2000, there were a large number of Select cattle, but then they fell back off again. The number of cattle receiving a quality grade of Prime has increased steadily since 2000 to make up about 1/3 of cattle marketed in 2005.

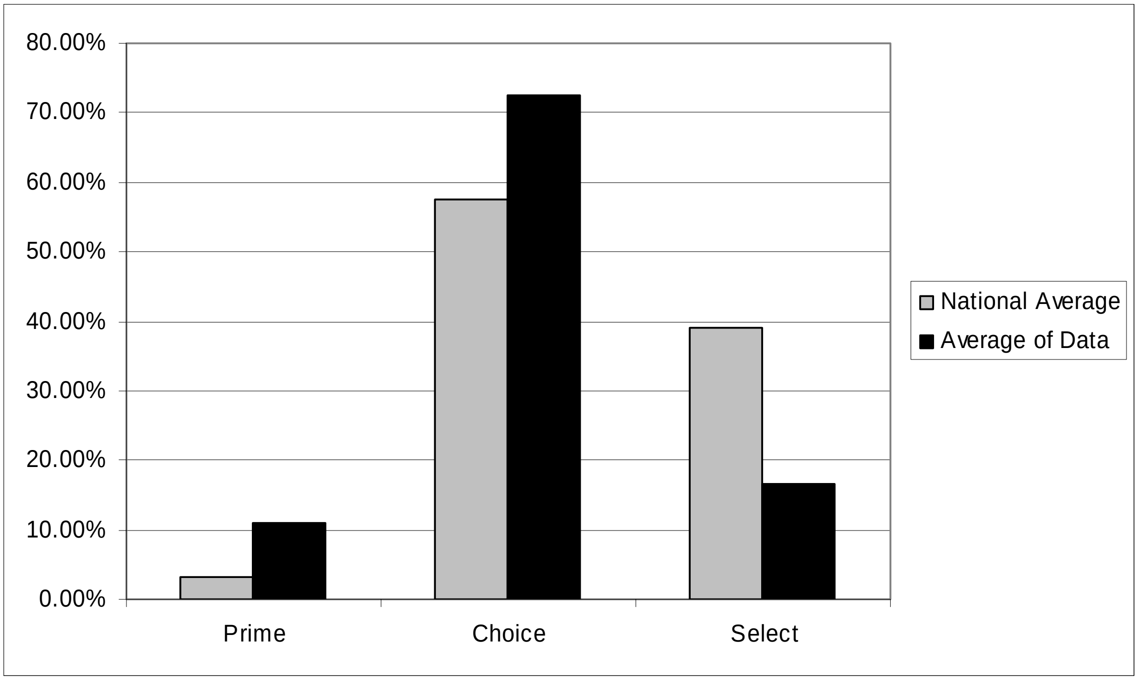

Figure 4.3. Comparison of the average distribution of quality grades with the data set vs. the average distribution nationally, 1999 – 2005.

The cattle in this study were from an above average producer. The producer had focused on marketing quality cattle for several years and implemented new techniques along the way. The producer is interested in always improving management to improve the final quality of cattle produced. Figure 4.3 shows a comparison between the distribution of the average quality grades for the producer and the average quality grades nationally from 1999 to 2005. The figure helps to illustrate the high quality of cattle in this data set. An above average number of the cattle grade Prime and Choice and below average number grade Select when compared to the national averages from the Livestock Marketing Information Center. This atypical distribution could mean that the results from this study may not be directly applicable to the average producer. However, the relationship between the quality grades and dam stacked generation variable should be transferable to other herds, even if exact numbers are not.

Table 4.2. Distribution of Quality Grades by Lot Number

LOT #	%YG1	%YG2	%YG3	%YG4	%YG5
1	0.00%	15.12%	84.88%	0.00%	0.00%
2	0.00%	23.38%	71.43%	5.19%	0.00%
3	0.00%	67.90%	30.86%	1.23%	0.00%
4	1.32%	63.16%	26.32%	9.21%	0.00%
5	5.88%	64.71%	26.47%	2.94%	0.00%
6	0.00%	10.81%	82.43%	6.76%	0.00%
7	0.00%	11.11%	25.40%	36.51%	26.98%
8	7.03%	31.25%	50.00%	9.38%	2.34%
9	0.00%	15.58%	66.23%	16.88%	1.30%
10	0.00%	31.75%	66.67%	1.59%	0.00%
11	3.57%	8.33%	69.05%	19.05%	0.00%
12	2.38%	19.05%	71.43%	7.14%	0.00%
13	0.00%	16.88%	63.64%	18.18%	1.30%

It is assumed that lot number has an effect on yield grade distribution for the cattle. Lot number is a proxy for environmental factors that all the cattle within that lot faced. Because the group of cattle was in the feedlot at the same time, they should have been exposed to the same type of management, the same weather, etc. Table 4.2 shows how yield grades were distributed within each lot. Lot number 7 has a large number of lower yield grade cattle, including the lowest of yield grade 5. This could mean that the group was kept on feed longer while at the feedlot, which would have put more backfat on the cattle and resulted in a lower yield grade. Typically, the lots have a majority of yield grades 2 and 3.

5. RESULTS

Results from the analysis will show whether a relationship exists between the independent variables of quality grade and yield grade and the dam stacked generation variable. The analysis should show which grades are most affected by dam stacked generation and whether they are positively or negatively influenced.

Table 5.1 through Table 5.6 show the coefficients, standard errors, and marginal effects for the quality grades and yield grades that were run. Logit analysis was not run for the quality grades and yield grades that had too few observations, which includes quality grades Standard and UB as well as yield grades 1 and 5.

Table 5.1. Coefficients, Standard Errors, and Marginal Effects of Factors Influencing Whether Carcass **Quality Grade** is **Prime**, Logit Analysis, 2006

Variable	Coefficient	Standard Error	Marginal Effect
Dam Stacked Generation 1	0.55392	0.27496	0.10511*
Dam Stacked Generation 2	0.84687	0.28860	0.18755*
Dam Stacked Generation 3	1.0076	0.43033	0.23029*
Dam Stacked Generation 4	0.97120	0.53629	0.22294*
Dam Stacked Generation 5	0.57628	0.86321	
Dam Stacked Generation 6	-25.844	0.38435E+06	
Dam Stacked Generation 7	1.0021	1.3966	

*Indicates statistical significance at the 10% level

Table 5.1 shows the effects of the dam stacked generation variables on whether a carcass quality grade is Prime. The first four variables, representing one through four levels of dam stacked generations are significant in this equation. The marginal effects are the most interesting outcome. Stacking one generation of dam genetic management increases the likelihood of an animal grading Prime by 11%. Two generations of dam stacked genetics increases the likelihood of an animal grading Prime by 19%. The marginal effect peaks at three generations of stacked dam genetics, with a 23% higher likelihood of grading Prime than with no stacking and falls off slightly to 22% with four stacked generations.

Table 5.2. Coefficients, Standard Errors, and Marginal Effects of Factors Influencing Whether Carcass **Quality Grade** is **Choice**, Logit Analysis, 2006

Variable	Coefficient	Standard Error	Marginal Effect
Dam Stacked Generation 1	-0.24625	0.18802	
Dam Stacked Generation 2	-0.19370	0.21776	
Dam Stacked Generation 3	-0.33610	0.34739	
Dam Stacked Generation 4	-0.65004	0.44163	
Dam Stacked Generation 5	-0.38546	0.70599	
Dam Stacked Generation 6	-0.34229	1.1990	
Dam Stacked Generation 7	-0.50394	1.2511	

Table 5.2. shows the interaction between the dam stacked generation variables and the likelihood of a carcass receiving a quality grade of Choice. There were no significant marginal effects seen with this interaction. So, it is possible that dam stacked genetics may not influence whether or not a carcass grades Choice. However, the producer stated his goal as being to increase the number of Primes. The reason for not seeing any significance may be that the producer was already producing mostly Choice animals and wanting to increase the number of Primes.

Table 5.3. Coefficients, Standard Errors, and Marginal Effects of Factors Influencing Whether Carcass **Quality Grade** is **Select**, Logit Analysis, 2006

Variable	Coefficient	Standard Error	Marginal Effect
Dam Stacked Generation 1	-0.19781	0.26349	
Dam Stacked Generation 2	-0.73558	0.38682	-0.95664E-02*
Dam Stacked Generation 3	-0.45610	0.63435	
Dam Stacked Generation 4	-0.25701E-01	0.77232	
Dam Stacked Generation 5	0.12856	1.0950	
Dam Stacked Generation 6	1.3026	1.2155	
Dam Stacked Generation 7	-29.941	0.35842E+06	

*Indicates statistical significance at the 10% level

Table 5.3. shows the interaction between the dam stacked generation variables and the likelihood of a carcass grading Select. The significant marginal effect seen for two dam stacked generations is slight and believed to be an anomaly as no other levels of stacked generation had significant effects on whether or not a carcass graded Select.

The next three tables show the effects of the dam stacked generation variable on what yield grade the carcass will receive. Only one interaction was significant between dam stacked generation and yield grade. Because there was only one instance, this is thought to be a random error and not a significant interaction.

Table 5.4. Coefficients, Standard Errors, and Marginal Effects of Factors Influencing Whether Carcass **Yield Grade** is **2**, Logit Analysis, 2006

Variable	Coefficient	Standard Error	Marginal Effect
Dam Stacked Generation 1	0.13853	0.19646	
Dam Stacked Generation 2	-0.43072E-01	0.22876	-0.43028E-02*
Dam Stacked Generation 3	0.11447	0.35497	
Dam Stacked Generation 4	0.34322	0.44557	
Dam Stacked Generation 5	-0.40650	0.80135	
Dam Stacked Generation 6	-26.67200	0.29222E+06	
Dam Stacked Generation 7	-26.29500	0.28974E+06	

*Indicates statistical significance at the 10% level

The effect of stacking generations of dam genetics on whether or not a carcass will receive a yield grade of 2 is seen in Table 5.4. A significant marginal effect is shown for two stacked generations; however, this is believed to be an anomaly. No other levels of stacking seem to have an effect on this yield grade.

Table 5.5. Coefficients, Standard Errors, and Marginal Effects of Factors Influencing Whether Carcass **Yield Grade** is **3**, Logit Analysis, 2006

Variable	Coefficient	Standard Error	Marginal Effect
Dam Stacked Generation 1	-0.11922	0.17160	
Dam Stacked Generation 2	-0.53009E-01	0.19138	
Dam Stacked Generation 3	-0.22292	0.30193	
Dam Stacked Generation 4	-0.46539	0.38785	
Dam Stacked Generation 5	-0.47262	0.60201	
Dam Stacked Generation 6	-0.64795	1.0407	
Dam Stacked Generation 7	0.82939	1.1844	

Table 5.5. shows that the dam stacked generation variable has no effect on whether a carcass will receive a yield grade of 3. This is most likely due to the fact that

yield grade may respond more to environmental factors, such as feedlot management and weather, than to genetic factors. .

Table 5.6. Coefficients, Standard Errors, and Marginal Effects of Factors Influencing Whether Carcass **Yield Grade** is **4**, Logit Analysis, 2006

Variable	Coefficient	Standard Error	Marginal Effect
Dam Stacked Generation 1	0.18581	0.27358	
Dam Stacked Generation 2	0.10017	0.28535	
Dam Stacked Generation 3	0.42699	0.42198	
Dam Stacked Generation 4	0.39568	0.54985	
Dam Stacked Generation 5	1.1609	0.72615	
Dam Stacked Generation 6	1.8045	1.2794	
Dam Stacked Generation 7	0.99668	1.2223	

No significant effects were seen from the dam stacked generation variables on whether a carcass received a yield grade of 4. This is seen in Table 5.6. Once again, yield grade is more affected by environmental factors.

As seen in Tables 5.4, 5.5, and 5.6, yield grade is not responsive to the dam stacked generation variable at any level. This could be because of environmental factors and feedlot management having a greater impact on yield grade than genetics. Lot number was a significant explanatory variable in several instances. This variable takes into account how the animal was managed at the feedlot, i.e. days on feed, amount fed, disease prevention.

Prime was the only quality grade in which dam stacked generation seemed to have a significant effect. The marginal effects of stacking generations of dams on whether or not an animal will grade Prime are shown in Table 2. Quality grades Choice and Select were not affected. A possible reason for the lack of relationship between DSG and Choice and Select may be found in the selection of breeding animals by the cow-calf producer. The producer was striving to increase the number of Prime carcasses marketed by his operation. If the producer was purposefully selecting animals that he thought would produce Prime, this could account for some of the relationship between DSG and Prime and account for the lack of relationship between DSG and Choice and Select. Looking back at Figure 1.4 in the introduction section, there is considerably less variability in the amount of beef grading Prime than the amounts of beef grading Choice and Select. Because this smaller variability exists, it does not take as drastic of a change to produce a significant effect in the number of Prime animals as it would to produce a significant effect in the number of Choice or Select animals. Also, the cow-calf producer has a high quality of cattle to begin with in the herd. A majority of the cattle in the data set were grading Choice. This may mean that the level of cattle a producer begins with has an impact on how long it will take to increase the number of Primes. For example, if a producer had lower quality cattle that typically grade Select, then results may show that DSG has an impact on increasing the number of cattle that grade Choice in his herd and may not impact Prime as much.

Figure 5.1. shows the effect of stacking generations of dam genetics on carcasses receiving a quality grade of Prime. The effect is highest with three stacked generations, where a producer will have 23% higher likelihood of a carcass grading Prime and then falls off slightly at four stacked generations, with a 22% higher likelihood. No significance was seen after four generations of stacking, which is important to know. Producers should not focus on stacking dam side genetics after four generations if it makes no impact on the final carcass quality.

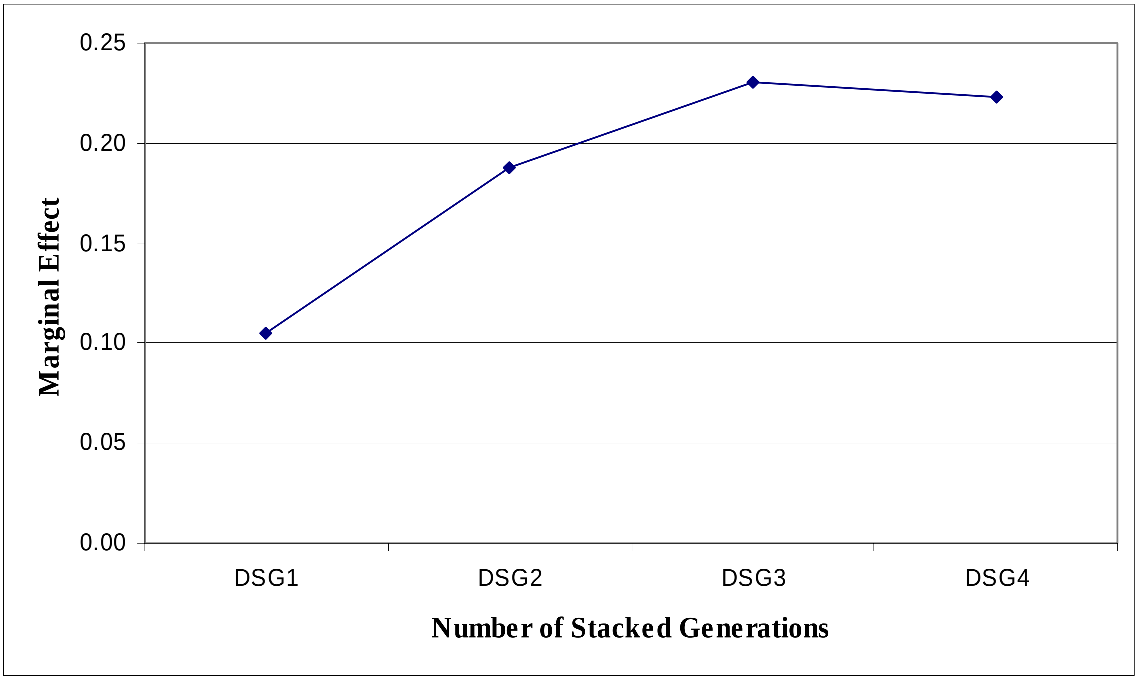

Figure 5.1.: Marginal Effects of Dam Stacked Generation on the Number of Cattle Grading Prime, 2006.

The results of this study can help the producer assess if managing genetics of the herd is helping the producer reach his goals for the carcass merit of cattle marketed. It may make heifer retention decisions easier. If stacking dam genetics increases the likelihood of carcasses grading Primes, then the producer may want to hold on to heifers from known lines of genetics. The results show that the effects of stacking genetics on the dam side may not be significant after four generations. With this in mind, the producer may not wish to retain heifers from the fourth generation on. Instead, rotating lines of stacked genetics may be most beneficial to increase the number of Primes.

It should be noted that the results of this study may not be applicable to all producers. The average beef cattle producer in Missouri may not be interested in managing dam genetics. Small herd sizes are typical and producers may not want to invest in a new type of management with few head to spread costs over. However, this research would be useful to a small group of producers with larger herds who are interested in improving the quality of beef that they are producing. These producers would be better able to implement management techniques and spread the cost over a large number of head.

Simulation

To see how the results from this study are applicable in the beef cattle industry, a simulation needs to be set up. Stacking generations of dam genetics has been shown to increase the likelihood of a carcass receiving a quality grade Prime. Prime carcasses are of top quality and receive premiums when marketing through grid pricing systems. These premiums may vary over time. For the simulation, Prime grade premiums were of \$2/cwt, \$4/cwt, \$6/cwt, \$8/cwt, and \$10/cwt were used. Table 5.7 shows each level of stacked generations affects the overall premium received by the producer. The marginal values used are pulled from this study and multiplied by each premium and then multiplied by 8 for the average carcass cwt. of the cattle. If a producer can receive a \$4/cwt. premium for Prime carcasses and has an average of two stacked generations of dam genetics, then the actual premium received per animal would be \$6.00/cwt. The marginal contribution of each additional generation is also shown in the table. A positive marginal contribution is seen for each premium level up to the fourth stacked generation of dam genetics. The fourth stacked generation is negative for each premium level. The marginal contributions for two stacked generations and three stacked generations of dam genetics increase as the premium level increases. For beef producers, the conclusion to be drawn from this simulation is that profitability from stacking generations of dam genetics may peak at three generations.

To figure out if the premiums received are profitable, an individual producer must look at the premium received minus the cost of stacking generations of dam genetics. If this number is positive, then it is profitable to stack dam genetics for that individual producer. This study has not addressed the cost, which is mainly a management cost. This is due to the fact that the cost will vary on an individual basis. The cost would be based on the amount of time spent deciding whether to retain or cull females from the herd. Some record keeping would also be involved.

Table 5.7. Marginal Contribution of Dam Stacked Generation to Prime Premium

	Marginal Value	Prime Premium per Animal ($2/cwt)	Marginal Contribution of Additonal Generation	Prime Premium per Animal ($4/cwt)	Marginal Contribution of Additonal Generation	Prime Premium per Animal ($6/cwt)	Marginal Contribution of Additonal Generation
1 DSG	0.11	$1.68	~	$3.36	~	$5.05	~
2 DSG	0.19	$3.00	$1.32	$6.00	$2.64	$9.00	$3.96
3 DSG	0.23	$3.68	$0.68	$7.37	$1.37	$11.05	$2.05
4 DSG	0.22	$3.57	-$0.12	$7.13	-$0.24	$10.70	-$0.35

	Marginal Value	Prime Premium per Animal ($8/cwt)	Marginal Contribution of Additonal Generation	Prime Premium per Animal ($10/cwt)	Marginal Contribution of Additonal Generation
1 DSG	0.11	$6.73	~	$8.41	~
2 DSG	0.19	$12.00	$5.28	$15.00	$6.60
3 DSG	0.23	$14.74	$2.74	$18.42	$3.42
4 DSG	0.22	$14.27	-$0.47	$17.84	-$0.59

*Assumed carcass weight of 800 lbs.

6. SUMMARY

This research represents a first step in determining the value added to the beef cattle chain through genetic management. The objective of the study is to determine whether or not the process of managing genetics has a positive impact on the quality of beef carcasses. It was found that managing genetics does increase the likelihood of having a carcass with a quality grade of Prime, but may not affect the likelihoods of a Choice or Select. Genetic management does not seem to have any impact on what type of yield grade a carcass will receive. So, if the goal of a cow-calf producer is to produce carcasses that meet the criteria for Prime quality grade, then genetic management should be used. It will be up to individual producers to decide whether or not the probability of successfully managing genetics is significant to cost effectively obtain premiums for higher quality carcasses. This research has shown that a higher probability exists for producing Prime carcasses if dam genetics are managed. The next step for the producers is to look at the costs involved in dam genetic management such as labor and possibly a software program and decide if the value outweighs the cost. Producers with larger sized herds will be more interested in genetic management because they have more cattle to spread the cost over. Also, with premiums realized at a per head level, the producers with larger herds may have more incentive to receive a few dollars per head premium because it will be received for a larger number of head.

This data was obtained from one beef producer. This could be a shortcoming of the study in that the addition of data from other producers may change some results. Few observations were available for the fifth, sixth, and seventh levels of stacked generations so conclusions drawn about these levels may not be completely accurate. Further research may be needed with larger numbers of cattle representing these levels of stacked genetics. No feed-out data was available so there is no information on how cattle were managed at the feedlot. It is known that feedlot management and other environmental factors influence carcass quality and yield grades. In this study, it was assumed that the changes in carcass quality and yield grades were due only to the management of genetics and not due to other factors such as management of the feedlot.

The process of managing genetics through retaining heifers from superior quality dams (thus stacking generations of genetics) and its effect on carcass merit was analyzed and not the selection of genetics through EPDs. The next step in this research should be to analyze the selection of genetics used based on EPDs to determine the final affect this type of selection has on carcass merit. Then a comparison will be available between the two types of management to determine which is more effective in improving the final value of carcasses. This information will be useful to beef producers in determining how to manage the genetics of their herd to maximize carcass value.

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