MEASURING VALUE-ADDED CHARACTERISTICS IN FEEDER CATTLE

A Thesis

by

CRYSTAL DAWN MATHEWS

Submitted to the Office of Graduate Studies of
Texas A&M University
in partial fulfillment of the requirements for the degree of

MASTER OF SCIENCE

August 2007

Major Subject: Agricultural Economics

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Approved by:

Chair of Committee,	David Anderson
Committee Members,	Oral Capps
	Jason Sawyer
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ABSTRACT

Measuring Value-Added Characteristics in Feeder Cattle. (August 2007)

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Chair of Committee: Dr. David P. Anderson

According to the USDA, there were 52.7 million marketings of cattle through live and internet auction markets and other venues in 2005. With the national average herd size at 43 head, most producers have limited bargaining power when it comes to marketing and auctioning their cattle. This has led to the birth of numerous value added cattle programs in the U.S. Value added programs are named as such, because they add additional value to the cattle before they are sold, but this value is difficult to quantify. The objective of this research was to measure the value of characteristics of feeder cattle sold through auction markets and special source verified feeder cattle sales, specifically the value of participating in these value added programs. Data over seven years from regular and special feeder cattle sales at Joplin Regional Stockyards were used.

The effects of explanatory variables on sale price were analyzed using ordinary least squares regression hedonic model. Type of sale, seasonality, cyclical effects, lot size, weight, breed type, sex, commingling, fed cattle futures price, and corn price were all found to have an impact on the sale price of feeder cattle. Feeder calves sold through MFA Health Track Beef Alliance and other value added programs received a premium over those calves that sold through regular sales and the premiums for MFA and other value added programs were statistically different. Commingled lots of feeder cattle

received a discount in comparison with non-commingled lots, but a lot size of 17 head would offset the negative effect of commingling.

The predictive power of the hedonic model was tested using out of sample forecasting. The mean absolute percent error and root mean square error are indicators of the ability of the model to forecast sale price based on the measured impact of the explanatory variables. When the hedonic model was used for forecasting the out of sample data, the MAPE was 7.84 and the RMSE was 10.48.

ACKNOWLEDGEMENTS

I am thankful that God gave me a strong mind, a loving family, and an abundance of opportunity that ensues with being an American girl, and has provided me with a fine education and the chance to pursue my dreams.

David Anderson, thank you for giving me the opportunity to learn from and work with you. I appreciate your help, your time, your advice and your laughter. I appreciate Jason Sawyer and Oral Capps for serving as members of my committee and for all their shared expertise and guidance through this process. Thanks to Roland Fumasi for your SAS guidance and to Kurt Willson for seeing me through the computer crash and crisis.

This research would not have been possible without the data and support provided by the Health Track Beef Alliance Team at MFA, Inc., and Joplin Regional Stockyards. Thank you to Mike John, Kent Haden, David Cope, Mike Griffin, Daniel Schafer, Mark Harmon, Jackie Moore, and Steve Owens.

I am blessed to have an abundance of wonderful friendships, and I am especially grateful to have my girlfriends Crystelle Miller, Hayley John, and Tracy Smith in my life.

Niki, Victoria, Stephanie, and Chad Boy, thanks for making me tough and "book smart." Hannah, thanks for hanging with me on those summer office days when you really wanted to get to the pool! And thank you to my parents, Matt and Denice, for supporting me, encouraging me, and not letting me come home to farm…at least not yet.

TABLE OF CONTENTS

Page

ABSTRACT……..... iii

ACKNOWLEDGEMENTS……... v

TABLE OF CONTENTS……... vi

LIST OF TABLES……. vii

CHAPTER

I INTRODUCTION……. 1

II REVIEW OF LITERATURE…… 6

III METHODOLOGY……. 17

Data……...……. 17
MFA Health Track…… 18
Model……. 19
Out of Sample Forecasting……. 23

IV RESULTS……... 24

Summary of Data……...……. 24
Regression Results……. 27
Out of Sample Forecast…….. 31
Summary……. 33

V SUMMARY AND CONCLUSIONS……. 35

REFERENCES…… 39

VITA…… 41

LIST OF TABLES

TABLE		Page
2.1	Summary of Results Found in Studies of Feeder Cattle Values in Review of Literature……	16
4.1	Descriptive Statistics for Cattle Sold Through MFA, Value Added, and Regular Joplin Regional Stockyard Sales, 2000-2006……..	25
4.2	Descriptive Statistics for MFA, Value Added, and Joplin Regional Stockyard Sales, 2000-2006…….	27
4.3	Estimated Premiums and Discounts for MFA, Value Added, and Joplin Regional Stockyard Sales for Specific Feeder Cattle Characteristics, 2000-2006……...	34

CHAPTER I

INTRODUCTION

The U.S. beef industry is comprised of more than one million farms, ranches, and businesses from all 50 states (National Cattlemen's Beef Association, 2007). In 2006, there were an estimated 97.1 million head of cattle and 800,000 ranchers and cattlemen in the United States. U.S. cash receipts from cattle and calves totaled $49.6 billion in 2005 (National Cattlemen's Beef Association, 2007). Beef is an important component in diets of Americans, as nearly nine out of ten U.S. households will eat beef at home in the next two weeks (National Cattlemen's Beef Association, 2006).

The U.S. beef industry is not only vast, it is also very efficient. The United States has less than 10 percent of the world's cattle inventory, but produces approximately 25 percent of the world's beef supply (National Cattlemen's Beef Association, 2006). With the amount of beef produced within the United States, export markets play a vital role in the movement and consumption of U.S. beef and the profits returned to producers and processors.

In order to stay in business, one has to make a profit or avoid losing too much. This requires a knowledge and understanding of the needs and demands of consumers and how to efficiently and effectively meet those needs and demands. This is no different for cattle and beef producers, but it is increasingly difficult for producers to know what extra inputs are going to be worth their time and resources, especially in

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This thesis follows the format of the *American Journal of Agricultural Economics*.

today's ever-changing markets. Adapting to significant changes in the beef industry is crucial to most livestock producers.

In 2005, 32.8 million head of cattle were slaughtered, with 52.7 million marketings of cattle through live and internet auction markets and other venues (National Cattlemen's Beef Association, 2006). At a national average herd size of 43 head (National Cattlemen's Beef Association, 2007), most producers have limited bargaining power when it comes to marketing and auctioning their cattle. This has led to the formation of numerous value added cattle programs in the U.S. Value added programs are intended to enhance or add additional value to the cattle before they are sold. Traditionally, value has been added to calves by feeding to increase weight while providing adequate care to keep calves healthy. Today's value added programs use commingled lots, standardized weaning and nutrition, verified vaccination programs, age and source information, particular breeding programs, and other characteristics to increase the value of cattle sold. These programs, often created and organized by producers, are designed to give producers an advantage in the marketplace while providing incentives to buyers with cattle that are more consistent, guaranteed for health or performance, verified by age, source, and/or processing, and offer greater value for their price. One value added program is the MFA Health Track Beef Alliance.

MFA Incorporated is a marketing cooperative and regional farm supply based in the Midwest and headquartered in Columbia, Missouri. MFA serves more than 45,000 farmer/owners in Missouri and surrounding states with 106 MFA Agri Service Centers, 27 MFA affiliates, and 400 independent dealers. The MFA Health Track Beef Alliance

was created and has been operated by the Livestock Operations division of MFA, Inc. since 2000.

All producers participating in the Health Track Beef Alliance must meet program requirements for age and source verification, nutrition, weaning, processing, and reporting. In addition, producers must have Beef Quality Assurance and Livestock Owner's Ruminant Protein certification. Calves must be born, raised and weaned at the ranch of origin for at least 45 days prior to the sale date. MFA Cattle Charge is a feed ration that must be fed during the first 14 days of weaning with an approved MFA feeding program to be followed after the first 14 days.

All calves must have two rounds of vaccinations. Required vaccines include two doses of 7-way blackleg, haemophilus somnus, and IBR, BVD, PI3, BRSV; one dose of pasteurella hemolytic vaccine; and treatment for external and internal parasites. Use of growth promoting implants is optional, but such use must be recorded. All calves must be castrated and dehorned prior to sale. The producer must provide all processing information, including individual calf treatments. Calves are tagged with a visual and electronic ID. This processing regimen is also referred to as Wean Vac 45.

MFA Health Track calves meet United States Department of Agriculture (USDA) qualifications for the Beef Export Verification and Quality Systems Assessment Programs. All calves have a verified record of individual birth date or group age verification. MFA Health Track combines standardized nutrition, Wean Vac 45 processing, and Beef Quality Assurance certification.

Global beef markets are in a constant state of change, requiring producers to know the value of cattle characteristics that were never considered before. With the discovery of BSE in the United States on December 23, 2003, the conditions and demands of governments and consumers in importing nations has changed. For example, since Japan resumed imports of U.S. beef, the beef has to be verified from cattle that were 20 months of age or less. There is a demand for beef that is age verified, source verified, process verified, and other characteristics that in the past were not as valuable. Even the appeals for country of origin labeling and a national animal identification system have developed markets for a product that can be traced to the original ranch, and account for all stops made along the way to slaughter. Several companies are now selling certified beef, substantiating that there is a profit to be made with cattle that offer such credible characteristics. Some consumers value organic beef that requires process verification. Other markets, like Mexico, require beef from cattle less than 30 months old at the time of slaughter. The USDA has created export verification, process verification, and quality systems certifications to assist companies and alliances in marketing and exporting beef products.

In order for American beef producers to make effective production, management, and marketing decisions, they require knowledge of the values of these cattle characteristics to determine which efforts are profitable to adopt. Previous research has evaluated price differentials due to traits such as color, breed, sex, condition, fill, lot size, location, and seasonality. Today producers need to know the value of age, source, and process verification, and the benefit/loss of participating in a value added program.

This research will analyze prices for cattle and estimate price premiums, if any, for these informational characteristics.

The objective of this research is to determine the value of characteristics of feeder cattle that are sold through auction markets and special source verified feeder cattle sales. The cattle characteristics that may have value include age, source verification, electronic animal identification, process verification, sex, weight, condition, color, health, uniformity and lot size. This research will identify information and characteristics that carry premium value for producers. Producers may be able to use this information to make more profitable decisions.

CHAPTER II

REVIEW OF LITERATURE

Estimating feeder cattle and calf price differentials due to their characteristics is not new in the agricultural economics literature. Most of the literature focuses on physical characteristics such as weight and sex, or production process characteristics like pre-conditioning. None of the literature examines changing values due to combinations of factors like production processes seasonally or cyclically. The following reviews the past literature in this area.

In 1978, Pate and Crockett measured the value of preconditioning beef calves. Three trials were conducted each fall of 1973, 1974, and 1976, using two lots of approximately 50 calves. The first group was sent to the feedlot directly after weaning. The second group was preconditioned for three to four weeks after weaning using feed supplements and medication treatments before being sent on to the feedlot. The expense per calf of preconditioning was $27.94, in addition to a $10.40 per calf cost of shipping to the feedlot at a higher weight several weeks after weaning. The savings in feedlot finishing costs averaged $26.81 per calf, creating an $11.53 loss from time of weaning by preconditioning. These results showed that preconditioning was unprofitable, due to an insignificant health advantage and rate of gain increase, and a lack of price premiums garnered from buyers to offset increased costs. However, given the state of the cattle market due to price controls and the overall economic issues of the early-mid 1970's, this may have been an unfortunate time period for this study.

Buccola (1980) analyzed feeder cattle price differentials by studying the effects of animal characteristics, production costs, and expected slaughter cattle prices on buyer and seller break-even prices. Results showed that a $1.00/cwt increase in expected slaughter steer prices led to a Choice feeder steer price increase of $1.36/cwt. Every $1.00 increase in corn price per bushel led to a Choice feeder steer price decrease of $8.33 per cwt. Choice feeder steers brought higher average prices than choice feeder heifers, and the discounts on heavyweight and lightweight steers were greater than the discounts for heavyweight and lightweight heifers. While a $1.00/cwt increase in expected slaughter cattle price increase the average feeder cattle price by $1.36/cwt, the premium for lightweight over heavyweight cattle increased by $2.62/cwt. Likewise, a one percent increase in corn price decreased average feeder cattle price by 0.4 percent, but decreased lightweight over heavyweight premiums by 1.37 percent. As steer weights increase, prices decrease at a decreasing rate.

Marsh (1985) studied the price differences between steer calves and yearlings. Distributed lags were used to determine the monthly price premiums and discounts between steer calves and steer yearlings. Data were collected from the U.S. Department of Agriculture's livestock and meat reports for the Kansas City market from January 1972 to December 1982 for steer calves weighing 300 to 500 pounds and yearlings at 600 to 700 pounds. Results showed that premiums and discounts were not seasonal but, were impacted by the feedlot cost of gain, i.e. corn, and expected outlook for slaughter prices. A $1 per bushel increase in the price of corn over six months reduced calf prices by $5 per cwt and yearling prices by $3.65 per cwt. A $1 per cwt increase in slaughter

prices over a six-month period increased calf prices by $1.39 per cwt and yearling prices by $1.19 per cwt. Steer calf prices tend to be more sensitive than yearling prices due to the added time risk of keeping calves on feed longer than yearlings to reach finishing weight. Differences were also found in the length of time the premium or discount for steer calves or yearlings lasted after a change in the corn or slaughter price due to differing lengths of finishing periods. On average, the effect on the premium of a change in corn or slaughter price dampened after twelve to eighteen months. This research was limited by the lack of an ideal variable for supply since monthly inventories of calves and yearlings outside of feedlots are not available. It is difficult to predict price premiums and discounts due to weight because it incorporates more risk as it requires forecasts of corn and slaughter prices.

Faminow and Gum (1986) did an empirical study of feeder cattle price differentials in Arizona auction markets. Data was collected from two Arizona county cattle association sales during May 1984 and May 1985. Data was collected for more than 400 lots, and 368 sale lot observations were deemed usable for analysis. Results showed that the steer price/weight relationship was quadratic and convex for both years. The 1984 heifer price/weight relationship was nearly linear, while the 1985 relationship was highly concave. This 1984 heifer price/weight relationship suggests atypical market behavior and may be due to dramatic U.S. cattle and calf liquidation in 1984. The 1985 heifer price/weight relationship showed that heavier heifers were discounted at an increasing rate, which could suggest that the fat cattle market outlook was unfavorable in the short-term, but expectations were more favorable in the long-term. This explanation

was consistent with market commentary in the May 1985 issue of *Drovers Journal*. The marginal value/weight analysis showed that 1985 heifers had a loss of total value after surpassing 615 pounds. The price/lot size relationship was significant and quadratic, and showed that cattle lots of sixty head reached peak prices. Lots of cattle with less than ten head were found to have potential price discounts up to $3.00 per cwt when compared to lots of sixty head. Price was found to be maximized at lot weights of 32,000 pounds, which was somewhat unexpected due to average truck capacity being 40,000 pounds. Explanations for this include end-of-market buyer behavior, including trades and off-market transactions, and ranges in the sales data collected, with few observations at the upper end of the lot size scale. This paper concludes that the model used in this study could be maintained and updated to provide useful market information to cattle producers.

Schroeder, Mintert, Brazle, and Grunewald (1988) studied the impact of a wide variety of physical characteristics on feeder cattle prices. Using data collected from seven weekly Kansas feeder cattle auction markets for seven weeks in the fall of 1986 and five weeks in the spring of 1987, the data set included 138,027 head sold in 17,121 lots. Fourteen characteristics for the cattle in each lot were recorded. Results showed weight to have a nonlinear relationship to price. Lot size was significant, with a maximum premium for lots of 45 to 50 head of lightweight cattle and for lots of 55 to 65 head of heavier cattle. Health had the strongest influence on price, with 5 to 8 percent discounts for cattle appearing stale, highly stressed and on the verge of sickness, and 20 percent discounts for sick cattle. Discounts were also present for cattle with horns,

fleshy and fat cattle, and full and tanked cattle that have more fill than a gaunt or average calf. Discounts for heavier cattle were greater in the spring than in the fall, while discounts for thin and very thin cattle were greater in the fall than in the spring. This result contradicted the early work by Marsh that showed no seasonal component to discounts. The discounts for medium and light muscled cattle were more prominent in steers than in heifers, and the discounts for small and the lower half of medium framed cattle were more important for heifers than for steers. Breed was significant with discounts for Angus, English crosses, Brahman, dairy, and Longhorns, as compared to Herefords. The time of sale was also significant, with cattle sold in the second and third quarters of the sale receiving $1 to $2 per cwt more than cattle sold in the first quarter. This may be due to the presence of more buyers later in the sale. The data was more homogenous than previous studies because it was broken up by sex and weight class. The research indicated that some of the price impacts from these characteristics varied by season and included several physical characteristics found to be important determinants of feeder cattle prices that had not been included in several previous studies. In contrast to previous studies, Schroeder, et al. (1988) made adjustments during the period of data collection according to changing market expectations and their impact on the cash market.

Bailey, Peterson, and Brorsen (1991) compared cattle prices between three large regional auction markets (Oklahoma City, OK; Dodge City, KS; Greeley, CO) and the nation's largest satellite video cattle auction (Superior Livestock Auction) that sold more than 270,000 cattle in 1987. Average adjustments were made to prices for shrink,

trucking, commissions, quality, and delivery dates. Results showed that sellers received an average of $6.65 to $23.52 per head more for a 700 pound steer sold through the video auction rather than the traditional regional auction market. On average, buyers of a 700 pound steer are willing to pay between $4.62 and $16.87 per head more through a video auction. The major explanation for the higher prices received by sellers through the video auction is lower transaction costs. Combined buyer and seller transaction costs for the video auction averaged 1.9 percent of the average unadjusted bid price less than the regional auction markets.

In 1992, Jeffrey Johnson completed a master's thesis that measured price differentials at a feeder cattle auction market in Southeast Texas. The study used 1987-1989 data from Port City Stockyards in Brenham, Texas, that included 755 observations from fifteen auctions. Results showed that breed, frame size, muscle score, weight, seasonality, number of lots available, and futures prices significantly affected feeder cattle prices. Lot size was not found to be significant, which is inconsistent with previous research and may be due to possible limitations because of the size of the data set. This research was also limited by a lack of observations of cattle sold weighing more than 600 pounds.

Schulte (2001) studied the economic incentives for backgrounding cattle and selling them at commingled sales. Data collection began with production costs on the ranch and ended at Premium Stocker Sales at the Jordan Cattle Auction in San Saba, Texas. A hedonic pricing model was used to regress the selling price on ten different characteristics to determine the premiums or discounts. The data were also used to

calculate the commingled sale premium and the preconditioning marginal return as compared to a weighted average from other auctions across Texas. The research showed that cattle at a certified sale in San Saba received an average overall premium of $7.59/cwt over the Texas Combined Average. This premium was found to be influenced by weight, sex, and quality. The size of the premiums decreased over the 16 month period that data was collected, but it is suggested that this was due to a rising market price during this time frame. Characteristics that were identified as having a significant impact on overall price received included breed, color, muscling, sex, lot size, weight, and seasonality. Whether or not lots were available for sale over the Internet was not found to be significant. The study recommends producers conduct *pro forma* budgeting for each preconditioning program to find the estimated net returns. The data set was limited by being unable to differentiate between commingled lots and certified preconditioning as the source of the premium received at the San Saba sales. There may have been a lack of observations of some characteristics that affect cattle prices in this data set to create a representative sample.

Lawrence and Yeboah (2002) valued source verification in feeder cattle. They used a hedonic characteristic feeder cattle pricing model to measure cattle and lot characteristics, as well as market characteristics, in order to evaluate the Iowa-Missouri Beef Improvement Organization's source verified program. The results were mixed as to whether or not there was a premium for the source verified cattle in the program, with the exception of the statistically significant premium observed in lightweight cattle.

Ward, Ratcliff, and Lalman (2004) measured price premiums from the Oklahoma Quality Beef Network (OQBN) from 2001 to 2003. OQBN began in 2001 as a process verification program for preconditioned calves. Data was collected for eleven characteristics of each calf sold during the seven or eight sales held at different locations primarily from October to December each year. If premiums existed, they were estimated by a traditional method of using sale lot size and a series of cattle characteristics to explain variation in sale prices for calves. Premiums were also estimated using an alternative method that compared sale lots that met specific criteria to lots that did not. The criteria was 10 or more head calves sold in uniform lots that were OQBN certified with no bulls, no horns, and all healthy. The weighted average premium for all sales in 2001 was $1.04/cwt, and the average premiums were $4.85/cwt and $4.38/cwt in 2002 and 2003, respectively. The total number of head sold through the OQBN program decreased from 13,824 in 2001 to 11,258 in 2003. The authors note that in nearly all cases where there was a significant difference in price, OQBN calves received a premium. There were many instances where buyers did not differentiate between OQBN calves and calves managed outside of the program. Premiums had large variations both within and between sales from a discount of -$7.57/cwt to a high of $13.73/cwt. For some sales, cattle were sorted into more uniform lots that were OQBN certified, at least 10 head, and healthy with no horns. The average premiums ($/cwt) received for these lots of cattle in 2001, 2002, and 2003 were 5.70, 5.38, and 6.46, respectively. Although this research reports the price premiums received for cattle that were preconditioned and certified through the Oklahoma Quality Beef Network, it does

not incorporate the additional costs, such as labor, feed, and animal health supplies, to the producer for implementing such a program.

In 2005, King, Salman, Wittum, Odde, Seeger, Groteleuschen, Rogers, and Quakenbush measured the premiums paid for value-added health programs at Superior Livestock Auction. They found that over a ten year period, the number of process verified calves in the Pfizer VAC 34 and VAC 45 increased while also continuing to garner a premium price. During the 10-year period, the average premium paid for VAC 45 calves was $4.37/cwt and the premium paid for VAC 34 calves averaged $1.91/cwt. The percentage of lots of calves sold through Superior Livestock with no viral vaccination decreased from 45 percent in 1995 to 5.4 percent in 2004. The percentage of VAC 45 lots of calves sold of increased from 3 percent in 1995 to 25 percent in 2004. Lots of VAC 34 calves increased from 12 percent to 49 percent over the same time frame. The 10-year trend showed a strong correlation between the participation level in value-added health programs and the price received for calves sold, regardless of market conditions.

Vaaler, Schroeder, and Boland (2005) conducted research on the costs and benefits of using a process verified program to market beef. They analyzed the costs of developing and implementing a process verified (PV) program for Kansas producers associated with a natural beef alliance. Data was collected for 2002 and 2003 through surveys conducted with 40 producers in the alliance. Results showed that average costs decreased per head as the number of animals marketed through the alliance increased. The larger producers in the alliance had a PV cost of $0.66 per head, while the smallest

producers had a cost of $47.00 per head. A hedonic model was used to estimate the determinants of the carcass premium or discount for cattle sold through this alliance. The variables found to be statistically significant included age, days on feed, days on feed squared, USDA Choice boxed beef price, gender, breed (Angus), USDA Prime grade, and seasonality. Process verified animals were discovered to have a discount to the carcass price of $0.1814 per pound, which was both statistically significant and unexpected. Researchers conclude that this discount may be due to an abnormal year in the market with record high prices in 2003, or the model may already identify PV characteristics through age, gender, and breed, or PV may be capturing a time trend instead of the characteristics of the animal. This research was limited by the short length of the study period, the lack of yield grade information and the analysis of only one alliance.

Table 2.1 contains a summary of the previous research that has been conducted in this field. While there have been several studies done to value different feeder cattle characteristics, most only measure the traditional physical characteristics such as weight, lot size, health, horns, and breed. It was not until recently that buyers were concerned with and potentially willing to pay more for characteristics like age, source, and process verification. And while several groups have studied the premiums of various process verification programs, a majority are looking at a single process verified program with a small number of head in a relatively small time frame, usually comparing only a few sales over the course of one to three years. Most of these sale prices are compared to the state or regional average price during the same time frame. There is a lack of larger

scale, more comprehensive research in this area. This research will fill this hole in the literature.

Table 2.1. Summary of Results Found in Studies of Feeder Cattle Values in Review of Literature

1978 Pate and Crockett	($11.53/calf)	Loss from time of weaning by preconditioning calves
1980 Buccola	$1.36/cwt	Increase in choice feeder steer price due to $1/cwt increase in expected slaughter steer prices
	($8.33/cwt)	Decrease in choice feeder steer price due to $1/bu increase in corn price
1985 Marsh	$1.19/cwt	Increase in yearling prices due to $1/cwt increase in slaughter prices over six months
	($3.65/cwt)	Decrease in yearling prices due to $1/bu increase in corn price over six months
1986 Faminow and Gum	($3.00/cwt)	Potential price discount for lots of 10 head of cattle as compared to lots of 60 head
1988 Schroeder, Mintert, Brazle, and Grunewald	45-50	Maximum premium for lots of lightweight cattle
	55-65	Maximum premium for lots of heavyweight cattle
	20%	Discount for sick cattle
	$1 - $2/cwt	Premium for cattle sold in 2nd and 3rd quarters of the sale as compared to those sold in the 1st quarter
1991 Bailey, Peterson, and Brorsen	$6.65 - $23.52/cwt	Average premium received for a 700 pound steer sold through video auction as compared to regional auction market
2001 Schulte	$7.59/cwt	San Saba certified sale average premium over Texas Combined Average
2002 Lawrence and Yeboah	$1.30/cwt	Source verification premium for lighter cattle (<650 pounds)
2004 Ward, Ratcliff, and Lalman	$1.04/cwt $4.85/cwt $4.38/cwt	Average premium for certified cattle sold in the Oklahoma Beef Quality Network in 2001, 2002, and 2003, respectively
2005 King and Seeger	$4.37/cwt $1.91/cwt	Average premium paid from 1995-2004 through Superior Livestock Auction for VAC 45 and VAC 34 calves, respectively
2005 Vaaler, Schroeder, and Boland	($.1814/lb)	Carcass price discount for process verified animals

CHAPTER III

METHODOLOGY

The primary objective of this research is to analyze the value of characteristics of feeder cattle that are sold through auction markets and special source verified feeder cattle sales. The secondary objective is to determine if there is a price premium or discount for value added cattle as compared to feeder cattle marketed without defined age, source, or process verifications. Based on a review of literature, a hedonic model will be used to estimate the value of feeder cattle characteristics and compare cattle marketed in regular and value added sales. Out of sample forecasting will be done to determine the accuracy and predictability of the model.

Data

The data for this research came from sales held at Joplin Regional Stockyards (JRS) in Carthage, Missouri. Available data were collected from 138 regular Monday sales and 36 value added sales between December 5, 2000 and June 26, 2006. The data set includes price records for 1,015,973 head of feeder cattle sold in 154,587 separate lots. There were 4,704 lots of MFA cattle, 9,303 lots of other value-added cattle, and 140,580 lots sold through regular feeder cattle auctions. While all sales took place at JRS in Carthage, Missouri, the data were obtained from records held at MFA, Inc., in Columbia, Missouri. Data were collected on price, lot size, sale date, weight, and sex for each sale, and when available, color, value-added program, commingling, and defects.

MFA Health Track

MFA Incorporated is a marketing cooperative and regional farm supply based in the Midwest and headquartered in Columbia, Missouri. MFA serves more than 45,000 farmer/owners in Missouri and surrounding states with 106 MFA Agri Service Centers, 27 MFA affiliates, and 400 independent dealers. The MFA Health Track Beef Alliance was created and has been operated by the Livestock Operations division of MFA, Inc. since 2000.

All producers participating in the Health Track Beef Alliance must meet program requirements for cattle age and source verification, nutrition, weaning, processing, and reporting. In addition, producers must have Beef Quality Assurance and Livestock Owner's Ruminant Protein certification. Calves must be born, raised and weaned at the ranch of origin for at least 45 days prior to the sale date. Feeding requirements include MFA Cattle Charge to be fed during the first 14 days of weaning with an approved MFA feeding program to be followed after the first 14 days.

All calves must have two rounds of vaccinations. Required vaccines include two doses of 7-way blackleg, haemophilus somnus, and IBR, BVD, PI3, BRSV, one dose of pasteurella hemolytica, and treatment for external and internal parasites. Implants are optional, but must be recorded, and all calves must be castrated and dehorned. The producer must provide all processing information, including individual calf treatments. Calves are tagged with a visual and electronic ID.

MFA Health Track calves meet USDA qualifications for the Beef Export Verification and Quality Systems Assessment Programs. All calves have a verified

record of individual birth date or group age verification. MFA Health Track is unique in comparison to other value-added programs in that it combines standardized nutrition, Wean Vac 45 processing, and Beef Quality Assurance certification.

Model

A hedonic model is used to determine price premiums and discounts based on the various characteristics of each lot of feeder cattle and the seasonality for the time of sale. Rosen (1974) defines a set of implicit or hedonic prices as the "observed product prices and the specific amounts of characteristics associated with each good." In a hedonic model, a class of differentiated products, such as prices, is described by a vector of objectively measured characteristics. The objectively measured characteristics used in this research include month of sale, year of sale, type of sale, lot size, sex, average weight, color, and the presence of commingling.

The hedonic model for this research is designed as an ordinary least squares (OLS) regression, which is a multiple regression method that estimates the relationship between dependent variables and explanatory variables. If the explanatory variables are found to be statistically significant, they will improve the accuracy of the model. SAS 9.1 and SAS Enterprise Guide 3.0 will be used to estimate the hedonic model.

The intercept parameter is the expected value of Y when X is equal to zero. The Beta coefficients are slope parameters that explain the relationship between X and Y when the error term is held constant. The error term is also known as the residual, and

accounts for other factors besides X that effect Y. This residual is measured as the difference between the actual value of Y and the predicted value of Y.

The proposed model will test the effects of several independent variables (X) that are hypothesized to explain the dependent variable (Y), based on the review of literature. The proposed hedonic model is as follows:

$$SP = \beta_0 + \beta_1 Sale + \beta_2 Month + \beta_3 Year + \beta_4 Lot + \beta_5 Sex + \beta_6 WT + \beta_7 Breed + \beta_8 C + \beta_9 FP + \beta_{10} CP + \beta_{11} Lot^2 + \beta_{12} WT^2 + u$$

where *SP* is the sale price of the cattle, β_0 is the intercept parameter, *Sale* is the type of sale (MFA, VA, or JRS), *Month* is the month of the sale, *Year* is the year which the cattle were sold, *Lot* is the number of head in the lot sold, *Sex* is steer or heifer, *WT* is the average weight of the cattle in the lot, *breed* is the breed type as indicated by color, *C* is whether or not it is a commingled lot, *FP* is the fed cattle futures price, *CP* is the corn price, Lot^2 is the lot size squared, WT^2 is the average weight squared, and *u* is the error term.

The purpose of this research is to explain the effects of different characteristics on the sale price of feeder cattle. Therefore, sale price must be used as the dependent variable (Y) for this OLS regression.

The sale type is represented by dummy variables for regular Monday JRS sales, MFA calves sold through special value added sales, and other value added cattle sold through special sales. Many value added programs claim that their cattle garner premium prices as a result of selling in special sales that are preferred by buyers. This will test whether the type of sale actually affects price.

Dummy variables were used to define the month and year of sale to test the effects of seasonality and the cattle cycle on price. It is hypothesized that some months of the year, such as late summer, bring higher feeder cattle prices while other months bring lower prices due to typically higher volumes of cattle for sale. Previous research shows cattle prices fluctuate by cycle, and it is also expected that the year of sale will affect price. This data also spans a unique seven-year period that encompasses the first case of Bovine Spongiform Encephalopathy (BSE) in the United States and the global export market closures to U.S. beef that followed, as well as periods of record high feeder cattle prices in the U.S.

Lot size is used as an explanatory variable. The majority of previous literature has indicated that lot size was found to have a statistically significant influence on price. Lot size may be correlated to sale type, since many value added sales offer commingling services to create larger, more uniform lots. There is great variation in the lot sizes of this data set, from 1 to 498 head per lot.

Dummy variables were used to define whether feeder cattle were heifers or steers. Price records for bulls were eliminated from the original data set. Previous research shows sex to have statistically significant effect on price, and it is hypothesized that heifers will be discounted as compared to sale prices of similar steers.

Average weight is included as an explanatory variable, and is recorded as the total weight of the lot divided by the number of head in the lot. Past research indicates weight to effect prices with a negative coefficient, so it is hypothesized that price will decrease as average weights increase.

Color or breed type was defined by dummy variables that classified the cattle into eight groups: black, red, mix (and crossbred), black with white face, red with white face, continental breeds (Charolais and Simmental), Holstein (and other dairy breeds), and unknown. Color and breed have been found to have an influence on price in previous research, though every color is measured separately so not all may affect price.

Dummy variables were also used to define the presence of commingling among lots of cattle. Schulte (2001) used a hedonic model to measure the characteristics affecting prices at commingled sales, but did not use commingling as a separate explanatory variable.

The fed cattle futures price for the contract nearest six months away from the date of the sale was also added. The six month contract was chosen based on the total average weight of all lots at 534 pounds, and estimated days on feed for a calf to reach harvesting weight. Previous research has shown expected slaughter steer prices and changes in slaughter steer prices to affect feeder cattle sale price (Buccola, 1980 and Marsh, 1985).

Weekly average corn price from Omaha for the week prior to the sale was also used as a variable. Buccola (1980) and Marsh (1985) found feeder cattle prices to be impacted by a change in corn price.

Lot size squared and average weight squared were used as explanatory variables. Taking the square of these continuous variables accounts for non-linear relationships and have been found to be statistically significant variables in previous research (Schulte, 2001).

The comparative base characteristics arbitrarily chosen for this hedonic model were non-commingled crossbred steers, sold in a regular JRS Monday sale in May 2000. In order to adjust for outliers and observations that could skew the end results, recorded price observations that were above or below four standard deviations of the mean were removed from the data set.

The hedonic pricing model defined above was used to calculate the statistical significance of the price differences among the different characteristics of feeder cattle observed and measured in this data set.

Out of Sample Forecasting

While the entire data set contains 154,587 complete observations, a random sample of sixty percent of these observations (92,752) will be drawn to create the hedonic model and run the OLS regression. The remaining forty percent of the observations (61,835) will be used to predict price with the given characteristics and the coefficients delivered by the regression. The actual sale price subtracted from the predicted price will provide the absolute error, and this information will be used to determine the forecasting capabilities of this model. Microsoft Excel will be used to conduct this out of sample forecast and calculate the root mean square error and mean absolute percent error.

CHAPTER IV

RESULTS

The objective of this study is to analyze the value of characteristics of feeder cattle that are sold through auction markets and special source verified feeder cattle sales. The secondary objective is to determine if there is a price premium or discount for value added cattle as compared to feeder cattle marketed without defined age, source, or process verifications. To achieve this objective, data is first summarized and analyzed to detect characteristics and trends in the original data. A hedonic model is used to examine the effect of explanatory variables on sale price. Finally, out-of-sample forecasting is conducted to determine the effectiveness of the model for prediction.

Summary of Data

The data set includes observations of 154,587 lots of feeder cattle sold in regular auctions and special sales at Joplin Regional Stockyards (JRS). The summary of descriptive statistics for all measured characteristics of all observed lots is contained in Table 4.1. Approximately 91 percent of the data set comes from regular Monday sales at JRS, while 9 percent of the data is from value added sales held on Thursdays, and 3 percent are specifically MFA calves (Table 4.1). The mean price, measured in dollars per hundredweight, for all cattle sold in these sales was $102.37. The standard deviation for price was $20.58 per hundredweight. The mean lot size was 6.57 head and lot size ranged from 1 head to 498 head. The average weight of all lots sold was 535.38 pounds

Table 4.1. Descriptive Statistics for Cattle Sold Through MFA, Value Added, and Regular Joplin Regional Stockyard Sales, 2000-2006.

Variable	Mean	Minimum	Maximum	Std Dev	CV
Price	102.37	41.00	187.50	20.58	20.10
Lot Size	6.57	1.00	498.00	11.53	175.45
Weight	535.38	200.00	1490.00	147.61	27.57
JRS	0.91	0.00	1.00	0.29	31.57
MFA	0.03	0.00	1.00	0.17	564.47
Value Added	0.06	0.00	1.00	0.24	395.18
Steers	0.57	0.00	1.00	0.49	86.18
Heifers	0.43	0.00	1.00	0.49	116.03
Commingled	0.02	0.00	1.00	0.15	642.07
Fed Futures	79.80	66.45	91.85	7.08	8.87
Corn Price	2.12	1.47	3.10	0.39	18.32
January	0.11	0.00	1.00	0.31	282.05
February	0.06	0.00	1.00	0.25	381.72
March	0.09	0.00	1.00	0.29	313.37
April	0.08	0.00	1.00	0.27	339.88
May	0.06	0.00	1.00	0.25	379.74
June	0.12	0.00	1.00	0.32	277.20
July	0.02	0.00	1.00	0.14	683.90
August	0.04	0.00	1.00	0.20	476.55
September	0.09	0.00	1.00	0.29	318.24
October	0.11	0.00	1.00	0.31	282.43
November	0.09	0.00	1.00	0.28	325.66
December	0.12	0.00	1.00	0.33	268.92
2000	0.00	0.00	1.00	0.05	1838.50
2001	0.05	0.00	1.00	0.22	436.76
2002	0.11	0.00	1.00	0.31	287.04
2003	0.22	0.00	1.00	0.41	190.12
2004	0.30	0.00	1.00	0.46	152.21
2005	0.28	0.00	1.00	0.45	160.13
2006	0.04	0.00	1.00	0.20	488.40
Black	0.28	0.00	1.00	0.45	159.39
Black White Face	0.03	0.00	1.00	0.16	616.42
Continental	0.12	0.00	1.00	0.32	275.89
Holstein	0.02	0.00	1.00	0.15	646.24
Mix	0.38	0.00	1.00	0.49	127.09
Red	0.14	0.00	1.00	0.34	250.58
Unknown	0.00	0.00	1.00	0.05	2178.66
White Face	0.03	0.00	1.00	0.17	563.36

per head. Steers represented 57 percent of the cattle and the remaining were heifers. Two percent of the cattle were sold in commingled lots.

Cattle color is a proxy for breed type. The largest percentage of the cattle (38 percent) is identified as mixed breed. Black cattle make up 28 percent of the sales. Red and Continental cattle, combined, make up another 26 percent of the cattle.

Summary statistics for price, lot size, and average weight are disaggregated by type of sale and are contained in Table 4.2. The value added sales garnered the highest average price at $104.57 dollars per hundredweight. The standard deviation in price was greatest for the regular auctions at JRS. The average lot size was substantially larger for value added and MFA sales at 12 and 14 head, respectively, compared to a mean of nearly 6 head in regular sales. This is due to more lots being commingled for value added sales.

Mean average weights were higher for value added sales, which could be due to the nutrition and weaning requirements of such programs that lead to greater feeder weights at the time of sale. Observations of sale price for lots of calves with average weights less than 200 pounds were sparse, but eliminated from the data set because buyers of baby calves and feeder calves are generally different and value differing characteristics. There were some lots with larger average weights, up to 1490 pounds for the JRS sales and 1230 pounds for the MFA sales. Producers may retain these calves and sell them at higher weights for a variety of reasons. Some will sell a few larger calves at the same time they sell many smaller calves to save money on transportation by only hauling one load to the stockyards. Sometimes producers will wait to sell their

calves until the bills are due. Some may have storages of feed to use before selling their calf crop. Regardless of the reason, there are some lots with larger weights, but average weights greater than 850 pounds comprise less than three percent of the data.

Table 4.2. Descriptive Statistics for MFA, Value Added, and Joplin Regional Stockyard Sales, 2000-2006.

	Variable	Mean	Min	Max	Std Dev	CV
All Sales	**Price**	102.37	41.00	187.50	20.58	20.10
	Lot Size	6.57	1.00	498.00	11.53	175.45
	Weight	535.38	200.00	1490.00	147.61	27.57
JRS	**Price**	102.26	41.00	187.50	20.86	20.40
	Lot Size	5.94	1.00	498.00	10.57	177.91
	Avg Wt	529.10	200.00	1490.00	148.01	27.97
MFA	**Price**	101.53	43.00	173.00	17.89	17.62
	Lot Size	14.11	1.00	205.00	18.87	133.70
	Avg Wt	607.26	215.00	1230.00	128.00	21.08
VA	**Price**	104.57	41.00	170.00	17.16	16.41
	Lot Size	12.34	1.00	252.00	16.57	134.30
	Avg Wt	593.82	200.00	1260.00	126.88	21.37

Regression Results

The hedonic model was estimated using 60 percent of the total observations (92,752 lots), drawn at random from the entire data set. The remaining 40 percent of observations were set aside to be used later for out of sample forecasting. Table 4.3 contains the regression results for the hedonic model. The R^2 is the coefficient of determination which represents the percentage of the observed variation in sale price that is explained by the explanatory variables. The R^2 value for the model was 0.738, which indicates that the independent variables used in the model explain nearly 74 percent of

the variation in sale price. Parameter estimates are presented along with the standard errors, t-values, and p values. The parameter estimates (coefficients) are the impact of each variable on price. The base for the choice, or dummy variables, was defined as mixed breed steers, sold at the regular Joplin Regional Stockyard sale, using May and 2000 for the base month and year.

MFA calves garnered a $5.71/cwt premium over calves marketed through regular JRS sales. The MFA coefficient was significant at a one percent level. Calves in other value added programs brought $4.53/cwt over the base. The positive sign of MFA and other value added sales was expected, *a priori*, based on previous research. No past research was able to compare between programs. This research indicated that both programs had a positive price impact over the base, but the MFA premium was larger. An F test was conducted to determine if the coefficients for MFA and value added were different. With an f-value of 20.89, the parameter estimates for MFA and value added were statistically different at alpha 0.01.

Monthly dummy variables measured impacts of seasonality. With May as the base month, only April had a premium in comparison, at $1.14/cwt. October sales received the greatest discount of $10.37/cwt; September, November, and January sales also had large discounts. This was expected due to seasonal price patterns in feeder calves shown by previous research. All months were statistically significant in explaining seasonality at a five percent level or higher.

Dummy variables were used for each year from 2001 to 2006 with the year 2000 as the base to account for cyclical changes in sale price. Two years, 2001 and 2003,

were not found to be statistically significant while the other years were. The years 2003-2006 all had a positive sign (price premium) while 2001 and 2002 had a negative sign (discount). These variables account for the price level relative to the cattle cycle. The cattle price cycle was declining early in the study period and then increased later in the period.

Lot size and lot size squared are continuous variables based on the number of head sold in each lot. Lot size was hypothesized to be positively related to price. The coefficient on lot size was positive and significant, as expected. The negative coefficient for lot size squared indicates that, at some point, the lot size begins decreasing as additional head are added to the lot. Using the estimated parameters, the lot size premium peaks at approximately 133 head. Additional head added in excess of 133 head will receive a lower net price relative to the base.

Weight and weight squared are also continuous variables based on the average weight of each lot and are both statistically significant. Prices decrease at $0.12/lb as weights increase, which was anticipated. As buyers purchase heavier cattle, they generally pay less per pound purchased.

Heifers received a discount of $7.45/cwt in comparison with the base steers. This discount was statistically significant and expected. Heifer calves do receive lower prices than steer calves at the same weights. This coefficient is in line with what is received in markets.

The price of the fed cattle futures contract six months from the date of the sale also impacted sale price. Fed cattle futures price, six months out from sale date was

used as a proxy for expected slaughter weight sale price. Six months ahead is approximately the slaughter date for the average weight calf in the sale. For each $1/cwt increase in fed cattle futures prices, there is a $1.15/cwt increase in feeder cattle prices. Omaha corn prices for the week prior to the sale were a statistically significant variable which indicated that for each $1/bushel increase in the price of corn, feeder cattle prices decreased by $1.71/cwt. These results were expected, *a priori*.

Breed type had a statistically significant impact on sale price with the exception of lots of unknown breed type, which comprised less than one percent of the entire data set. Black calves garnered a premium of $1.84/cwt as compared to the base of mixed or crossbred calves. Red calves received a discount of $0.52/cwt, white face or Herefords received a discount of $4.92/cwt, and Holsteins and dairy breeds received the largest discount of $19.06/cwt. Continental breeds, such as Charlois and Simmental, garnered a premium of $0.95/cwt and black with white face calves, indicating an Angus-Hereford cross, received a $0.59/cwt premium. These results were not surprising. Black color may imply Angus cattle which can garner a premium and at slaughter could be eligible for the Certified Angus Beef program.

The parameter estimate for commingling was an unexpected -$4.94/cwt and statistically significant. Commingling lots of cattle has been thought to bring a premium due to the larger and, perhaps, more uniform lots offered to buyers. Earlier work by Schulte (2001) using commingled sale data indicated significant premiums for commingling due to lot size. The negative sign on commingled lots is unique in the literature. No other study found in this literature review had discovered this result.

However, this result makes intuitive sense that lends it credibility. A majority of commingled lots were sold in the value added sales, which could mean that the value of commingling is captured by the MFA and value added parameter estimates, or in the lot size and lot size squared parameters. Commingled lots might cause concern for buyers who worry about the potential increase in the spread of disease created by commingling. Commingled lots may also become too large for one truck load or become an odd lot size, which could potentially be an undesirable characteristic for buyers.

Utilizing the parameter estimates for lot size and commingled for calculations, the negative impact of commingling is offset by the premium for a larger lot size at 17 head. At 17 head the discount for commingling is still $4.94/cwt, but the premium is 17*($.31/cwt) which is $4.98/cwt. This counter effect to commingling may offer incentives for producers to commingle their cattle when the resulting lot size will be larger than 17 head, whereas the single source lot would have been smaller than 17 head.

Out of Sample Forecast

No earlier studies in the literature have done any out of sample testing of the estimated model. The size and quality of this data set allows for this testing.

The predictive power of this hedonic model was tested using an out of sample forecast. The forty percent of randomly drawn observations that were not included in the regression were used to test the predictive ability of the hedonic model. This included 61,835 observations of sale price and explanatory characteristics. The following formula was used to calculate predicted price:

$\hat{S}$ = 63.29 + 5.71* MFA + 4.53 *VA -5.54 *Jan -2.9 *Feb -.47 *Mar + 1.14 *Apr -2.95 *Jun -1.90 *Jul -2.35 *Aug -7.14 *Sep -10.37 *Oct -7.89 *Nov -3.08 *Dec -.15 *2001 -6.35 *2002 + 1.01*2003 + 7.94*2004 + 13.34*2005 + 12.34*2006 + .31*Lot Size -.001*Lot Size^2 -7.45*Heifer -.12*Weight + .000042*Weight^2 + 1.84*Black -.52*Red + .95*Continental + .58*BWF -19.06*Holstein -4.92*WF + 1.24*Unknown -4.94*Commingled + 1.15*Fed Futures -1.71*Corn Price.

The actual price was subtracted from the predicted price to calculate the residual, or error, of each forecast. The simple average of the residuals for all forecasts was $0.106/cwt, which shows that the average forecasting error of the model was nearly eleven cents per cwt. That is very small given that the average sale price was $102.37 per cwt. That small residual average may be indicative of some large negative residuals offset by large positive residuals. To further test the model's ability the MAPE and RMSE are calculated.

The residuals and actual sale prices were used to calculate the Mean Absolute Percent Error (MAPE). The MAPE of the model was 7.836. This indicates that our model predicts price with an average error of approximately eight percent. The Root Mean Square Error (RMSE) was also calculated using the residuals from the 61,835 forecasts, and the RMSE of the model was 10.477. This estimation is based on residuals alone, not taking into its calculation the actual or predicated price, and indicates the mean model prediction error is approximately ten percent. Both MAPE and RMSE account for the effect of residuals offsetting each other since some are negative and

others are positive. While these measurements are relative and cannot be compared to a similar model and data set since none exists, these results for MAPE and RMSE are considered to be relatively low and indicators of the good predictive power of this model.

Summary

The objective of this research was to determine the value of characteristics of feeder cattle sold through auction markets and value added sales. The hedonic model used to estimate the impact of these explanatory variables on sale price successfully achieved this objective and the results are contained in Table 4.3. It was determined that value added and MFA sales garnered a premium over regular auction market sales at JRS. The out of sample forecasting demonstrated the effectiveness and accuracy of the hedonic model in terms of its predictive ability.

Table 4.3. Estimated Premiums and Discounts for MFA, Value Added, and Joplin Regional Stockyard Sales for Specific Feeder Cattle Characteristics, 2000-2006.

Dependent Variable: (SP) Sale Price in $/cwt
Number of Observations: 92,752 lots, $R^2 = 0.738$

Variable	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	63.28893	1.21706	52.00	<.0001
MFA	5.71407	0.22316	25.61	<.0001
Value Added	4.53417	0.15441	29.36	<.0001
January	-5.54407	0.19054	-29.10	<.0001
February	-2.97718	0.21695	-13.72	<.0001
March	-0.46527	0.19319	-2.41	0.0160
April	1.13590	0.18874	6.02	<.0001
June	-2.95010	0.17439	-16.92	<.0001
July	-1.89828	0.27867	-6.81	<.0001
August	-2.34927	0.22981	-10.22	<.0001
September	-7.14072	0.19706	-36.24	<.0001
October	-10.36631	0.20026	-51.76	<.0001
November	-7.89148	0.19903	-39.65	<.0001
December	-3.08394	0.18584	-16.59	<.0001
2001	-0.15451	0.69296	-0.22	0.8236
2002	-6.34540	0.68609	-9.25	<.0001
2003	1.01205	0.68279	1.48	0.1383
2004	7.94603	0.69264	11.47	<.0001
2005	13.34204	0.70856	18.83	<.0001
2006	12.34403	0.73872	16.71	<.0001
Lot Size	0.31324	0.00471	66.45	<.0001
Lot Size Squared	-0.00118	0.00002962	-39.95	<.0001
Heifer	-7.45185	0.07077	-105.29	<.0001
Weight	-0.11862	0.00119	-99.87	<.0001
Weight Squared	0.00004242	9.966191E-7	42.57	<.0001
Black	1.83805	0.08720	21.08	<.0001
Red	-0.52033	0.11159	-4.66	<.0001
Continental	0.95287	0.11762	8.10	<.0001
Black White Face	0.58665	0.22524	2.60	0.0092
Holstein	-19.05861	0.23823	-80.00	<.0001
White Face	-4.91950	0.20870	-23.57	<.0001
Unknown	1.23504	0.78373	1.58	0.1151
Commingled	-4.94447	0.24240	-20.40	<.0001
Fed Cattle Futures Price	1.15458	0.01258	91.76	<.0001
Corn Price ($/bu)	-1.71401	0.15152	-11.31	<.0001

Bases: JRS sales, May, 2000, Steer, Mix Breed

CHAPTER V

SUMMARY AND CONCLUSIONS

In 2005, there were 52.7 million marketings of cattle through live and internet auction markets and other venues (USDA, NASS, April 2006). At a national average herd size of 43 head, most producers have limited bargaining power when it comes to marketing and auctioning their cattle (Cattle-Fax, January 2006). This has led to the birth of numerous value added cattle programs in the U.S. Value added programs are named as such because they add additional value to the cattle before they are sold, but this value is difficult to quantify.

The primary objective of this research was to analyze the value of characteristics of feeder cattle sold through auction markets and special source verified feeder cattle sales. Data summarization, OLS regression models, and out of sample forecasting were used to achieve the objective.

The data came from sales at Joplin Regional Stockyards (JRS) in Carthage, Missouri. JRS sells more head of cattle each year than any other regional auction market in the country. Sale price observations were taken from regular Monday feeder cattle auctions as well as special Thursday value added sales. Many of the cattle sold in the special sales were marketed through the MFA Health Track Beef Alliance.

The data summarization showed an average mean price of $102.26/cwt for JRS sales, $101.53/cwt for MFA sales, and $104.57/cwt for other value added sales, and JRS sales had the greatest standard deviation in sale price. Mean lot sizes for MFA and other value added sales were more than double the average lot size of JRS sales. Average

weights were 65 to 78 pounds lighter for the JRS sales than for the value added and MFA sales, respectively.

A hedonic model was designed to estimate the effect of explanatory variables on sale price. The ordinary least squares regression results showed 32 of the 35 independent variables used in the model to have a statistically significant impact on price. MFA calves bring a $5.71/cwt premium and calves sold through other value added programs brought a $4.53/cwt premium over regular JRS sales. MFA and value added parameters were statistically different. Monthly and yearly dummy variables showed the effects of seasonality and the cattle cycle on sale price. Breed type impacted price, with black calves bringing the largest premium at $1.84/cwt over the crossbred base, and Holsteins taking a $19.06/cwt discount. Commingled cattle had a $4.94/cwt discount compared to calves that were not commingled. The model had an R^2 value of 0.738.

The out of sample forecasting was done with 40 percent of the original data set that was randomly selected and not used in the regression. The simple mean of the residuals of the forecasts was $0.106/cwt, the Mean Absolute Percent Error of the model was 7.836, and the Root Mean Square Error was 10.477. These tests are indicators of the predictive power of the model.

The number of observations available in this data set is one unique aspect of this research, with over 154,500 records of lots of feeder cattle sold at Joplin Regional Stockyards, including more than 1.2 million head of cattle. The data set spans a historic

time frame in the U.S. beef industry, from 2000-2006, which includes the first case of BSE in the United States and record high cattle prices in the history of the country.

While previous research examined the prices and impact of explanatory variables on specific types of sales, such as commingled sales, Internet video auctions, and feeder cattle sales for a particular value added program, this research begins to look at prices from a perspective of having combined some of the independent variables previously isolated in studies. This research has sales of cattle that were and were not in commingled lots, that were in MFA Health Track and other unnamed value added programs, and that were sold through regular and special sales.

Future research could be done to explore the affect of explanatory variables on other value added programs in addition to MFA Health Track. Many other value added programs are available for producers to participate, but the majority of research done on such programs focuses only on analyzing one instead of comparing several programs.

Since the last sale analyzed in this research in June, 2006, the U.S. beef industry has continued to experience changes and challenges, particularly that of higher corn prices as corn supply is being absorbed through higher ethanol production. A study to extending this research into the last year would provide further insight into the impacts of such changes on the sale price of feeder cattle.

With the unexpected negative parameter for commingling delivered by the OLS regression, there are more questions providing opportunities for additional research on the relationship between sale price and commingling. Are buyers concerned about increased risk for spread of disease? Would commingling be more beneficial for regular

or value added sales? Is there a relationship between commingling and lot size that creates a premium and/or discount for truck loads, full pens in the feedlot, and other unknown sizes that are particularly desired or avoided?

In conclusion, this research does well to fill a hole in the literature for research on measuring variables contributing to feeder cattle sale prices with an extensive data set over a large time period. It also identifies that MFA and value added feeder cattle bring a statistically significant premium over feeder cattle sold through regular auctions. Whether this premium outweighs the costs of participating in these programs must be determined by individual producers. The model does have some predicting power as measured by out of sample forecasts. While more questions surrounding feeder cattle characteristics and price relationships remain available for further research, this study contributes additional knowledge to the existing literature base.

REFERENCES

Bailey, D., M.C. Peterson, and B.W. Brorsen. 1991. "A Comparison of Video Cattle Auction and Regional Market Prices." *American Journal of Agricultural Economics* 73:465-475.

Buccola, S.T. 1980. "An Approach to the Analysis of Feeder Cattle Price Differentials." *American Journal of Agricultural Economics* 62:574-580.

Faminow, M.D., and R.L. Gum. 1986. "Feeder Cattle Price Differentials in Arizona Auction Markets." *Western Journal of Agricultural Economics* 11(2):156-163.

Johnson, J.L. 1992. "Explaining Price Differentials at a Southeast Texas Feeder Cattle Auction Market." MS Thesis, Texas A&M University.

King, M.E., M.D. Salman, T.E. Wittum, K.G. Odde, J.T. Seeger, D.M. Grotelueschen, G.M. Rogers, and G.A. Quakenbush. 2005. "Effect of Certified Health Programs on the Sale Price of Beef Calves Marketed Through a Livestock Videotape Auction Service From 1995 Through 2005." *Journal of the American Veterinary Medical Association* 229(9):1389-1400.

Lawrence, J.D., and G. Yeboah. 2002. "Estimating the Value of Source Verification of Feeder Cattle." *Journal of Agribusiness* 20(2):117-129.

Marsh, J.M. 1985. "Monthly Price Premiums and Discounts Between Steer Calves and Yearlings." *American Journal of Agricultural Economics* 67:307-314.

National Cattlemen's Beef Association. *Beef Bytes.* Available at http://www.beefusa.org/udocs/beefbytescomplete03-28-05.pdf. Accessed August 2006.

_____. *Beef Industry at a Glance.* Available at http://www.beefusa.org/newsindustrystatistics.aspx. Accessed January 2007.

Pate, F.M., and J.R. Crockett. 1978. "Value of Preconditioning Beef Calves." University of Florida Institute of Food and Agricultural Sciences. Bull. No. 799.

Rosen, S. 1974. "Hedonic Prices and Implicit Markets: Product Differentiation in Pure Competition." *The Journal of Political Economy* 82(1):34-55.

Schroeder, T., J. Mintert, F. Brazle, and O. Grunewald. 1988. "Factors Affecting Feeder Cattle Price Differentials." *Western Journal of Agricultural Economics* 13(1):71-81.

Schulte, J.R. 2001. “Economic Viability of a Commingled/Backgrounded Cattle Sale.” MS Thesis, Texas A&M University.

Vaaler, B., T. Schroeder, and M. Boland. 2005. “Costs and Benefits of Marketing Differentiated Beef through Process Verification Systems.” Agricultural Issues Center, University of California.

Ward, C.E, C.D. Ratcliff, and D.L. Lalman. 2004. “Price Premiums from the Oklahoma Quality Beef Network.” Oklahoma Cooperative Ext. Fact Sheet F-599, Oklahoma State University.

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