ALTERNATIVE BASE PRICES IN FORMULA PRICING FOR THE FED CATTLE AND SLAUGHTER HOG INDUSTRIES

By

JENNIFER ERIN BUTCHER

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Thesis Approved:

Clement E Ward

Thesis Advisor

James N. Trapp

Francis M. Epplin

Wayne B Powell

Dean of the Graduate College

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

Chapter I

Introduction

Problem Statement

Movement to carcass weight pricing and grid pricing has become increasingly significant due to the desire of the beef and pork industries to price to value. Live weight pricing does not represent the true value of cattle sold, therefore improper signals are sent to the cattle owners and price discovery becomes inefficient. In the fed cattle market, formula pricing has become more widespread. With the popularity of formula pricing, controversial issues follow. For this project, formula pricing refers to establishing a base price in price grids for fed cattle. Price grids consist of a base price with premiums and discounts for carcass characteristics. Premiums are paid for desirable characteristics and discounts are paid for undesirable characteristics. A formula price determines the base price for the price grid. Typical formulas use an external price as the reference. The external price is usually tied to plant averages, or cash market prices.

Using plant averages or cash market prices as references can be harmful to price discovery. Plant averages are frequently figured for the week of or weeks before slaughter. This poses a problem because the plant average can vary depending on the type or number of cattle that passed through the plant at that time. The plant average may not accurately represent the type of cattle that are being formula priced. The problem with formula prices being tied to cash market prices is that most of the animals priced with formulas are typically higher quality cattle, so as the higher quality cattle move to formula pricing the average or lower quality cattle are left in the cash market. As a

result, the cash price that is used as a reference may not accurately represent market conditions (Ward, Feuz, and Schroeder 1999).

Research Significance

With the increased use of formula pricing in the beef and pork industries, there is a need to find alternative sources for the base price so that an accurate reflection of market conditions will occur. Non-cash transactions have become more common in both industries. With fewer cash transactions, the reported live price may not accurately represent market conditions. If formula pricing is used to establish a base price, it is critical that the reference prices accurately reflect the market. This research considers alternatives to the current reference prices used in formula pricing.

Objectives

This project evaluates alternative sources for the external price used in formula pricing when grid pricing fed cattle. Two alternatives that will be considered include wholesale prices and futures market prices. Wholesale prices and futures market prices have some appeal to the beef and pork industries from a price discovery perspective.

The comprehensive goal of this research is to determine a method that will move the beef and pork industries toward enhanced price discovery. Specific objectives of this research are (1) to determine past seasonal patterns and trends between the fed cattle (slaughter hog) prices and both wholesale beef (pork) prices and live cattle (lean hog) futures market prices and (2) to estimate a forecasting model to determine alternative base price formulas.

Chapter II

Literature Review

Introduction

Although formula pricing has become popular and useful, there are problems associated with the process. The current base prices that are used in grid pricing have caused price discovery issues in today's cattle and hog markets. These issues and alternative base prices for the grid pricing process will be reviewed. Finally, the relationship between alternative base prices, such as live futures market prices and wholesale prices, and live cattle and live hog prices will be presented.

Formula and Grid Pricing: The Pros and Cons to the Price Discovery Process

Since the industry is striving for a more value-based pricing process, formula and grid pricing has become a useful tool to the livestock markets. Price discovery has become a major issue within the formula and grid pricing systems of the beef and hog industries. Ward (1999) discusses many factors that affect the price discovery process. Some of the factors include competitiveness of buyers and sellers, their number, size, and location, captive supplies, pricing and buyer procurement methods, reliability of information, futures markets, and risk management alternatives. These factors affect the fluctuation of price above or below the market level. Many of the factors relate to formula pricing. For example, the reliability of information is an issue when considering formula pricing. Ward explains that variation in prices, which is due to captive supplies, lack of market information, or pricing methods have an influence on price discovery.

Grid pricing offers the opportunity to base the pricing process on carcass quality. Schroeder et al. (1997) explain that to move towards a value-based pricing system, fed cattle must be priced on their carcass quality. The formulas used in grid pricing systems consist of a base price and premiums and discounts that are imposed on carcasses that are above or below the packers' standards. Schroeder and Jones (1999) express concern for the need by packers and feeders to find ways to market cattle on their carcass value. They explain that pricing on a live basis eliminates the premium and discount process that can motivate producers to produce higher quality cattle. Schroeder et al. (1997) also explain that producers must be knowledgeable about the quality of their cattle to be able to compete in the grid pricing process. They said most packers are willing to provide carcass quality information to producers so they know how their cattle graded and how they need to improve their production or buying practices.

Concerning the hog industry, Kenyon (1997) said that packers' main problem with hogs is their inconsistency in quality, which makes it difficult to meet consumer demand. The adoption of a carcass value pricing system that imposed premiums and discounts has reduced backfat levels, but has not solved the inconsistency problem completely. After all, the ultimate goal of the market is to satisfy the consumers. The improvement of the product to promote satisfaction in the end product will benefit the livestock industry.

Ward and Lee (1999) explain that a value-based system provides a reward system for producers. Those who produce high quality cattle will be rewarded and those who produce lower quality cattle will be punished. The grid pricing process allows for this type of system. They also discuss how crucial it is for the producers to work with the

packer so that they can understand the quality of their cattle and make improvements where needed. They also explain that discounts for lower quality cattle are usually larger than premiums for higher quality cattle. Each packing plant has its own grid, many have several different grids, but all follow a similar procedure. Premiums and discounts send signals to the producers to improve the quality of meat they produce so that the final consumer is satisfied. They also explain that pricing accuracy is improved when pricing on a grid because each animal is priced separately and on its own merit.

Two decades ago Hayenga (1979a) discussed advantages from using formula pricing for beef or pork purchases or sales. Grid pricing in the 1990s uses a formula to determine a base price, but formula pricing does not always include grid pricing. Hayenga discusses formula pricing use in the 1970s as a risk management tool for purchases or sales for packers as well as their larger customers. In the grid pricing system, formula pricing is used to establish a base price for the pricing grid. Hayenga discusses several forms of formula pricing. He does not discuss grid pricing because the present form of grid pricing did not exist in the 1970s. His insights on formula pricing do relate to the grid pricing process. He notes an advantage of formula pricing that can apply to the grid pricing process. Increased efficiency for each transaction is a benefit for both the buyer and seller. Less negotiating skill is required and many times transaction costs can be decreased. Hayenga (1979b) also states cost could be decreased because the basic elements, not including premiums and discounts, would be the same for each animal.

Hayenga and Schrader (1980) surveyed the egg, cheese, beef, pork, and turkey industries and concluded that they realized several benefits from formula pricing. They

viewed formula pricing as a benefit because it guaranteed buyers for their products that were perishable or rare. Formula pricing also offered the quality assurance of products which enhanced positive producer and packer relationships. Reduced price risk and marketing efficiency were other benefits expressed by these industries.

Formula pricing represents a portion of captive supplies. Schroeder and Jones (1999) present several benefits to this process. Cattle feeders benefit from marketing agreements such as formula pricing by reducing price risk, having a guaranteed buyer for their product, improving the opportunity for carcass quality premiums, and decreasing marketing costs. Packers benefit from marketing agreements via formula pricing by being able to secure the slaughter needs for their plant and operate at capacity, having control over the quality of cattle they process, and reducing procurement costs.

Grid pricing and formula pricing generates benefits but these pricing systems do not occur without presenting concerns for the cattle and hog industry. Purcell (1999) expresses his concern for the formula pricing process by stating he believes it has a large negative impact on price and price discovery. Purcell believes pricing grids that incorporate formula pricing need to be reviewed and then determine if the industry would be better without this type of pricing arrangement. He explains that the buyer, who is usually the packer, has the incentive to drive down prices or to not report all prices so the base price can be kept low. Another of Purcell's major concerns is that formula pricing does not allow the feeder or producer to determine when their price will be set. Instead the base price is tied to cash prices which can be low and variable.

While Purcell's major concern is the formation of the base price and its effect on the market, Hayenga and Schrader (1980) state that their major concern with formula

pricing is the issue that the negotiated market, which is the source for the base price, could diminish. The movement to formula pricing results in a more thinly traded cash market. The public reports that are used for base prices are not necessarily an accurate reflection of market prices. When Hayenga and Schrader surveyed the pork, beef, turkey, cheese, and egg industries, they expressed several disadvantages to formula pricing. The disadvantages were: 1) The firm's decreased influence on market price, 2) inaccurate price reports when referring to them to develop a base price, 3) not being able to take advantage of negotiating and forecasting skills, and utilizing market information, 4) and the decrease in the amount of buyers for those suppliers who do not use formula pricing.

Koontz and Purcell (1997) discussed their concerns for the beef industry regarding price discovery. One issue discussed is a proposal by the Western Organization of Resource Councils (WORC) to promote a petition prohibiting formula pricing when forward contracting. Koontz and Purcell state that the WORC will still allow forward contracting but only if a specific base price is determined when the contract is developed. This process would not allow the price at delivery to be related to an observed cash price, which would prohibit the use of formula pricing when forward contracting. All of the contracts will be forced to the open market where public bids will take place. The WORC believes that with implementation of the petition, the industry's requirements for improved price discovery will be met.

Pricing System Problems When Using Current Formula Base Prices

Formula pricing refers to determining a price for a transaction that uses an external source for the base price in the formula (Ward, Feuz, and Schroeder 1999). Ward, Feuz, and Schroeder describe several references for base prices that were discovered when interviews were conducted with packers and feeders.

The references that packers and feeders used were: (1) average price of cattle purchased by a slaughter plant in which the cattle were to be slaughtered for the week before or the week of slaughter, (2) certain market reports of reported prices for the week before or week of slaughter, (3) boxed beef cutout value, (4) futures market price, (5) and negotiated price. Ward, Feuz, and Schroeder (1999) explain that grid pricing can be independent of formula pricing and formula pricing can be independent of grid pricing. Grid pricing can be established through negotiation by the packers and feeders or through formula pricing. The goal of the grid pricing process is to match high quality cattle with higher prices and low quality cattle with lower prices.

Although there are benefits to grid pricing, there are also disadvantages. One major problem with the grid pricing process is the determination of the base price in the formula. Each packer may have a different grid containing various premiums, discounts, and formulas for constructing the final price. Ward, Feuz, and Schroeder (1999) present several different external sources that are used by packers to determine a base price. Many packers refer to plant averages, live price quotes, either live or dressed weight, and plant or cash market prices as a source for their base in their pricing grids, which impose price discovery problems. Purcell (1999) explains that the main issue facing a grid pricing system using a formula is how the base price is established.

It is not beneficial to the price discovery process when a plant average is used as an external reference price for a formula when using a pricing grid. Ward, Feuz, and Schroeder (1999) state that one of the problems with using plant averages as a base price is that the averages vary over time because of types of cattle processed in a plant during a particular time period. They explain that the value of the cattle brought to market is

based on the plant average and not the actual quality of the cattle. The quality of cattle that the producer brings to market may be of higher quality than the plant average. Schroeder and Mintert (1999a) are in agreement with Ward, Feuz, and Schroeder's statements and suggest on days that are thinly or irregularly traded, inaccurate reflections of the market can occur, which will affect the plant average. Ward, Feuz, and Schroeder (1999) expand their reasoning and reveal that the plant average could keep declining as more non-cash market transactions are being made. Therefore this is sending inefficient signals to producers and results in a low base price that may not be an accurate representation of the market.

Base prices that refer to live or carcass market price reports as an external source could cause price discovery problems that are similar to problems associated with plant averages. Schroeder and Mintert (1999a) explain that cash prices are commonly used for reference prices for obtaining a base price. At times the market may not have a significant amount of livestock traded on a particular day which results in poor representation of the market. There has been an increase in the amount of livestock that are traded through contracts. The increase of contracts trading and formula pricing results in a decrease in the amount of cattle that are traded on the live cash market. This, in turn, may result in poor representation of the amount of cattle or hogs marketed in the industry. Schroeder et al. (1997) found that many feeders they interviewed during their survey preferred to market their cattle on a live weight basis because they understood the process and had the experience in the live market.

Schroeder and Mintert (1999a) also explain that many hogs are traded on a carcass weight basis. Kenyon (1997) states that many carcass pricing systems use a live

hog price, reported for the Iowa-Southern Minnesota market, which is used to produce a standard base price. Even though hogs are moving to a carcass value pricing system, the live cash price still has an impact on the carcass price.

All of the present base prices used in formula pricing have issues and concerns for the cattle and hog industries. Plant averages, or live or dressed weight prices do not represent the cattle and hog markets effectively. The changing industries and improved technology affect the way prices are reported. Marketing contracts between buyers and sellers reduce the amount of publicly reported prices. When feeders and packers use prices that are publicly reported to determine a formula that represents a value for their cattle or hogs, it can result in inefficient pricing.

Wholesale and Futures Market Prices as Base Prices

It has been argued that base prices currently in use are causing problems with price discovery in the beef and hog industries. There are alternative base prices that are more appealing to the industries and the price discovery process. Wholesale meat prices and futures market prices are sources that need to be examined as possible options.

Schroeder and Mintert (1999a) suggest that futures prices are a potential option because they promptly reveal new information, are a reasonable source of price expectations, the information is available, and they are less likely to experience manipulation. Schroeder et al. (1997) state that many researchers have concluded that nearby live cattle futures are substantially important when determining transaction prices for fed cattle. Ward, Feuz, and Schroeder (1999) also state that futures prices are

inexpensive to negotiate and trading volumes ensures they are representative of market conditions.

The futures market and its effect on price discovery has been an issue for many years. Many producers and feeders use futures prices as a price expectation, and adjust their production practices to those expectations. When this adjustment takes place, with respect to expectations in supply and demand, it encourages the proper allocation or storage of goods. Since the futures price is used as a tool when making decisions concerning the industry or individual practices, it is important that futures prices accurately reflect the industry. Hudson (1987) argues that futures prices can seem to be inefficient, but inefficiency is a result of the information base and not the market itself. Livestock price variation results from the variability of supply and other economic factors and could be responsible for the sometimes poor performance of the futures market as a guide for expectations. Hudson also explains that the futures market has the ability to register information quickly and accurately, and will discover price before other markets. Hudson states that a price change in the market will be noticed in the futures market first, because it is geographically centralized which results in a low cost information source. Evans, Streeter, and Hudson (1992) present a different reason than Hudson to explain the variability in the futures market. They explain that volatility in the futures market can be explained by seasonality. They used market structure, information flow, and economic variables to develop a model that would explain the factors contributing to volatility. Their model suggested that as price increases, volatility declined and as inventory increased, volatility increased as well. The results of his model also demonstrated the Samuelson effect, which shows the time-to-maturity variable, a part of the information

flow variable, which is evident in the live cattle futures market. As a result of this effect, and as the futures contract reaches maturity, more information is available about the commodity and volatility will increase.

Schroeder and Mintert (1999a) express a different approach than Evans, Streeter, and Hudson, on some issues that need to be addressed when considering futures prices as a reference. They explain that the specifications of futures contracts, such as delivery dates, do not always match with the cash market dates. They also stress that basis changes need to be taken into consideration when using futures prices as the base in a formula. Their other concern is when the futures market does not reflect changes until the cash market has already been aware of the changes. They suggest that when using futures prices a lag formula be involved. Schroeder and Mintert (1999b) express concern that if the cash lean hog market disappears, then the futures market for that commodity will collapse.

Wholesale meat prices are another alternative when examining external sources for a base price in a formula for grid pricing. Schroeder and Mintert (1999a) explain that wholesale prices can be used as a favorable source for a base price because wholesale prices are representative of all meat products in the market. The wholesale price will also represent the price that processors receive for their meat. The price that processors receive for their meat is a price that processors strive to keep high. Ward's (1999) reasons for being able to use wholesale prices as a reference agrees with Schroeder and Mintert and suggests referring to wholesale prices when formula pricing in a grid. Wholesale prices are a useful reference as a base price for the formula because packers have an incentive to keep the boxed beef cutout values high, resulting in high packer

revenue. The packers want to keep wholesale prices high and live prices or plant averages low. Referring to wholesale prices may result in a higher base price in a formula for grid pricing, meaning a higher price for the seller. Ward (1999) also explains that wholesale prices are less likely to experience inaccurate reflections of market conditions, than base prices that refer to plant averages that are part of a formula.

When considering wholesale prices as a reference for the base price Schroeder and Mintert (1999a) present issues that need to be evaluated. They recognize that there are problems associated with using wholesale prices as a base when formula pricing in grids. Schroeder and Mintert (1999a) describe two problems that are associated with using wholesale prices. Non-cash methods have become more common in today's wholesale markets. Many wholesale transactions are taking place through marketing agreements, forward contracts, or other means. This shift to non-cash methods may cause wholesale prices to inaccurately reflect the prices that are publicly reported. Schroeder also discusses that slaughter and processing costs change which result from a change in the relationship between wholesale and farm level prices and the relationship between raw farm products and processed meat cuts.

Relationship between Live vs. Wholesale and Live vs. Futures Prices

When using wholesale prices or futures prices in the beef and pork industries as an external reference for the base price to develop a formula, the relationship between the live and wholesale values and the live and futures values must be examined. The examination of the relationships will help determine the impact on fed prices if futures prices or wholesale prices are used to determine a base price when developing a formula.

Schroeder and Mintert (1999a) describe in text and graphically the relationships between the live and wholesale prices and the live and futures prices for the beef market industry. When considering wholesale prices they combined the hide and offal values and the boxed beef value and deducted the fed steer value to present their relationship. This value is the difference between what the farmer receives and what the processor receives, or the margin. This difference shows the gain or loss the processor receives and what is used to cover their processing costs. They concluded that there is some variability between the live and wholesale values. This could be due to increasing processing costs. The decrease in fed cattle values proportionate to wholesale, shown by a downward sloping trend line, could also be due to the fact that higher quality cattle are being removed from the cash market and sold by non-cash means. This leaves the poorer quality cattle left for the cash markets which is what is publicly reported. On the other hand, Schroeder and Mintert (1999a,b) note in both of their articles concerning price discovery in beef and pork that the variability in weekly wholesale prices is acceptable as long as low prices are compensating for high prices. The producer who sells more frequently will have less trouble than those who sell inconsistently. Schroeder and Mintert (1999a,b) state that more research is needed to examine why the cash market has declined.

Mathews et al. (1999) present reasons why wholesale prices could be used as a reference. They discussed and presented graphically reasons for the price spreads and cattle cycles. This shows that the net farm value and the wholesale value move similarly. The net farm value is lower relative to the wholesale value, but they move in similar directions. When the price of the farm value increases, the value in the wholesale market

value usually increases. This illustration shows that the live and wholesale prices move similarly and could be a useful reference.

Ward (1981) also presents evidence that supports the use of wholesale prices as a reference for base prices in a formula when grid pricing. He states that derived demand is the tie between wholesale carcass beef price and by-product values and fed cattle prices. Due to this relationship, when the wholesale price changes, the fed cattle price will change also.

To support the option that futures prices could be used as a reference for a base price, Schroeder and Mintert (1999a) compared the relationship between nearby live cattle futures price and fed price to help explain why fed cattle quality may be a reason for the decline in fed steer prices. They found that the fed price followed the futures price relatively closely in the early 1990s and then began to fall below the futures price later in the 1990s. While the fed price did decline in proportion to the futures price shown by the downward sloping trend line, they concluded that the futures price could be used as reference for the base price.

In a research project on the hog industry, Schroeder and Mintert (1999a) examined the relationships between live and futures and live and wholesale value. The process was very similar to the process conducted in the beef markets. The live hog values were deducted from the wholesale values as well as the futures prices. The live hog price did experience a decline in proportion to the wholesale price according to the trend line in their model. Schroeder and Mintert state that the decline in weekly live hog prices proportionate to pork cutout shows that pork producers need to consider several factors before using wholesale prices as a base price. Processors need to consider

processing costs and storage capacity when evaluating wholesale values as a base. They explain that storage usage has an effect on processing margins that can affect the decline.

When Schroeder and Mintert (1999b) compared the live hog price to lean nearby hog futures price they found that the trend variable in his model showed cash prices declined relative to the lean nearby hog futures price. However, they concluded that the futures price could be used as a base. The relationship of live to wholesale and live to futures had similar results in the hog industry.

Summary

Determining a base price that will accurately reflect market conditions is essential for grid pricing to be an effective marketing tool. Reasons for the use of current base prices and their negative effect on price discovery are issues that concern many people in the beef and hog industries.

Previous research suggests two alternatives to the base prices currently used. Wholesale prices and futures prices are potential external sources for formula pricing in grids. Wholesale and futures prices are expected to have small negative effects on price discovery. They follow the live beef and hog prices closely and are less likely than the cash market to experience manipulation from market participants. There are benefits and disadvantages to using wholesale or futures prices as an external source for base prices, but with careful research by participants in the market, the benefits are expected to outweigh the disadvantages.

Chapter III

Data and Procedure

Data

All data collected for this research were reported as weekly average prices. Live and wholesale data needed were obtained from the Agricultural Marketing Service, United States Department of Agriculture (AMS-USDA). Data were gathered for a ten-year period, starting January 1989 through December 1998. Data collected for the beef analysis consisted of live prices for Texas Panhandle fed steers and for Nebraska fed steers. Choice 1-3 box beef cutout values for 700 to 800 pound carcasses were used to represent the wholesale prices. Futures market prices used were nearby live cattle futures market prices from the Chicago Mercantile Exchange (CME). A change in the delivery process for the futures contract occurred in June 1995. The estimation procedure will reflect the change.

Data collected for the pork analysis were live prices for barrows & gilts-1-2 230-240 pound for the Iowa-Southern Minnesota direct trade. Wholesale values used were weekly pork cutout value for #2, 175 pound carcasses. The week of October 30th, 1997, AMS changed the pork cutout formula to a 185 pound carcass. Futures market prices were the nearby live hog futures from the Chicago Mercantile Exchange. In February 1997, the live hog futures contract changed to the lean hog contract. This change was reflected in the estimation procedure. Each raw data series is presented in line graphs located in Appendix Tables 1-6.

Ratios between the cash and wholesale prices and cash and futures market prices for hogs and cattle were calculated. Differences between cash and futures prices and

cash and wholesale prices for hogs and cattle were also calculated but not used in this analysis. Each series of differences is shown in Appendix Tables 7-10. Line graphs of the weekly ratios from 1989 to 1998 for beef and hogs are presented in Figures 1-4.

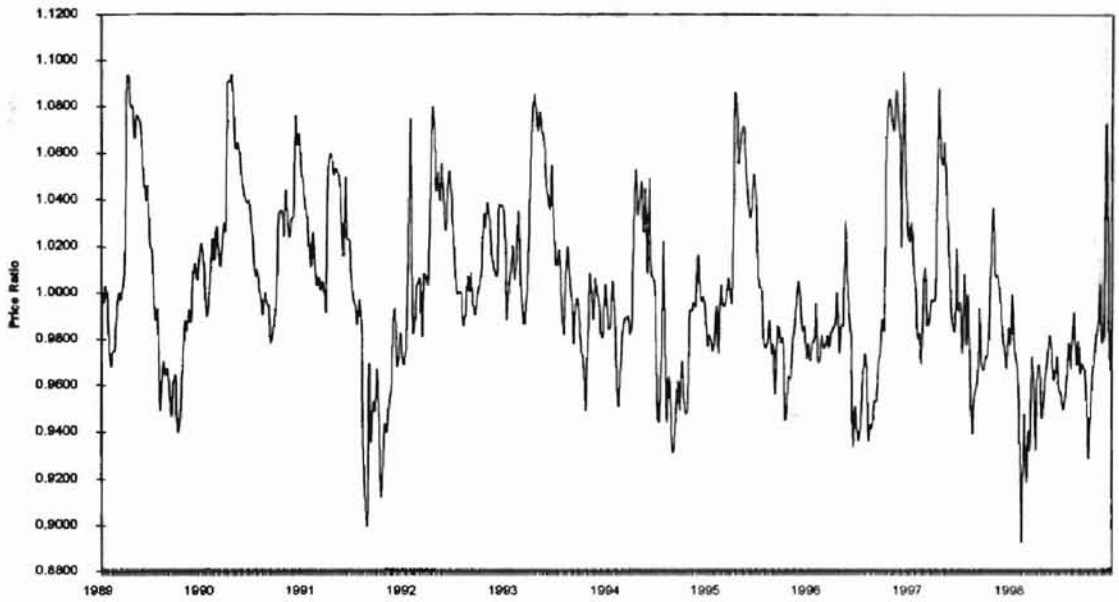

Figure 1: Ratio of Nebraska Fed Steer Prices to Live Cattle Futures Market Prices, 1989-1998

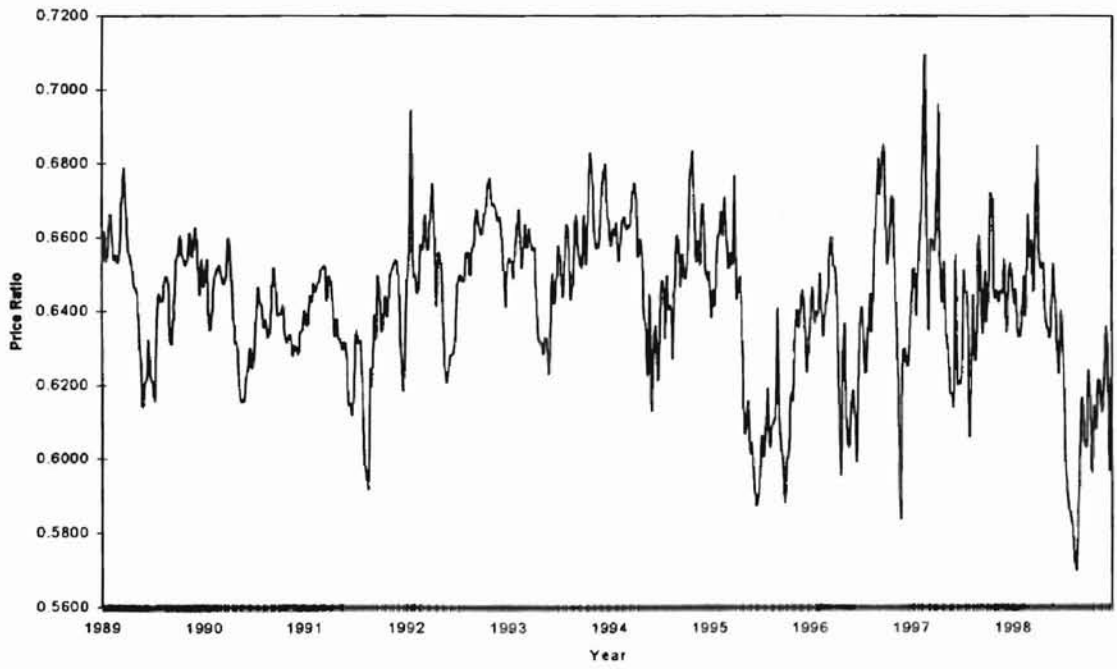

Figure 2: Ratio of Nebraska Fed Steer Prices to Choice Box Beef Cutout Values, 1989-1998

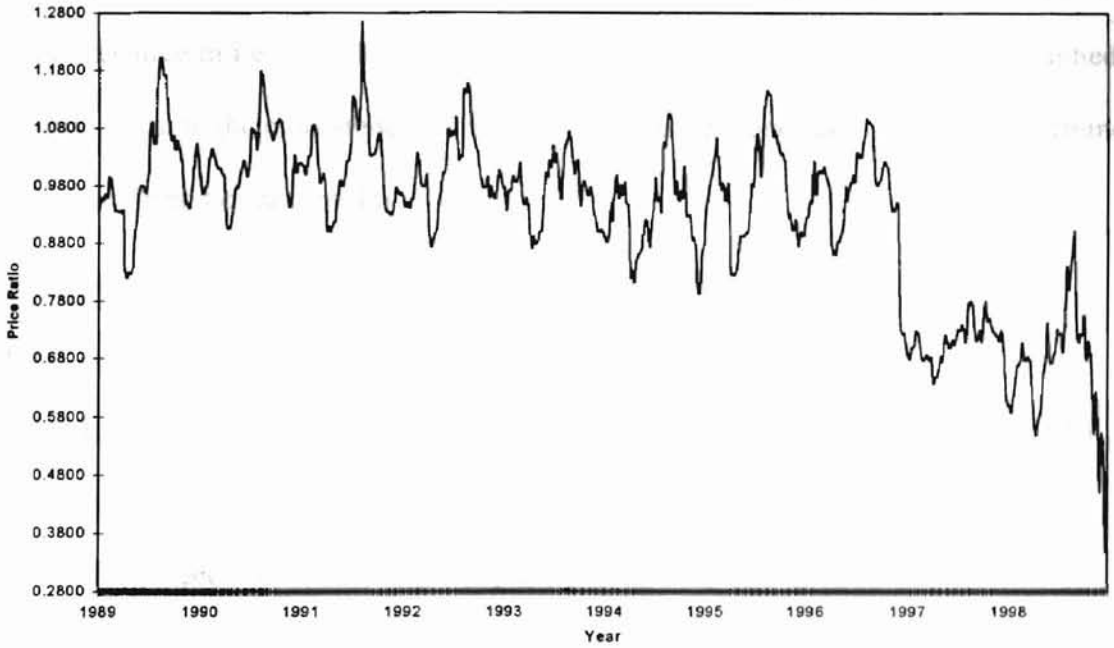

Figure 3: Ratio of Live Hog Prices at Ia.-So.Minn Direct to Live Hog Futures Market Prices, 1989-1998

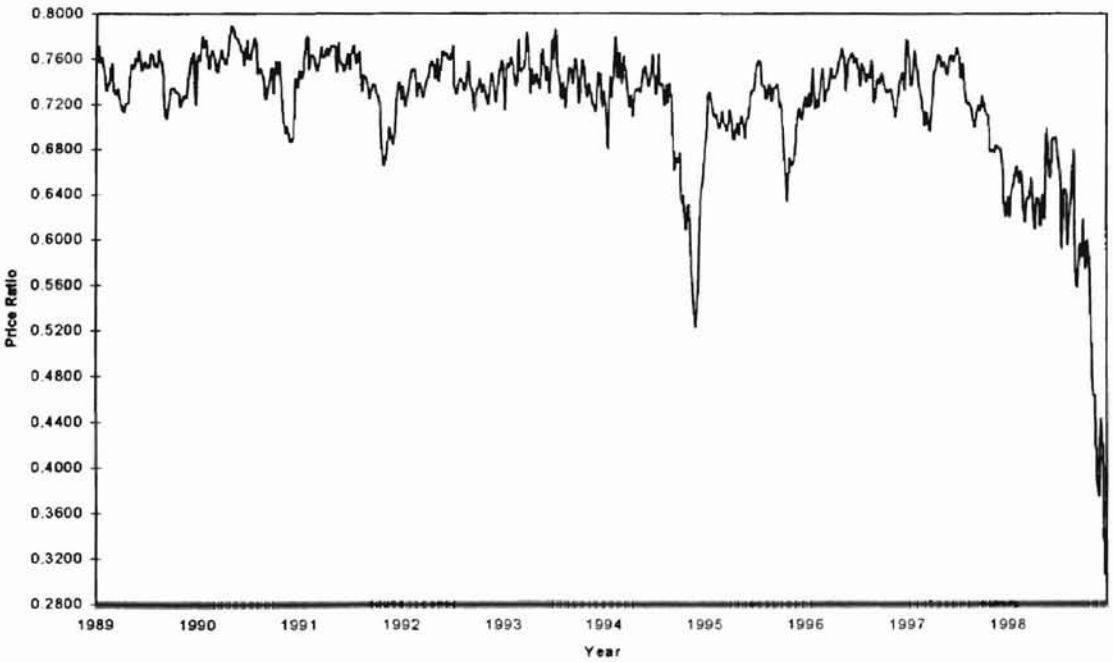

Figure 4: Ratio of Live Hog Prices at Ia.-So.Minn Direct to Pork Cutout Values, 1989-1998

The large change in the ratio for live hog and futures, shown in Figure 3, was due to the contract change in February 1997. Differences and ratios were calculated and graphed to visually examine the consistency of the relationships between each year, and determine evidence of trend or seasonality.

Procedure

Raw data series were tested for normality. Then ordinary least squares (OLS) regression models were specified for the raw data and the ratios and estimated using SHAZAM, an econometrics computer program. For the regression analysis, ratio series were converted to monthly averages. Residuals were examined and first-order autocorrelation was found. Regression models were corrected for first-order autocorrelation by using the Cochrane-Orcutt method. One model specified live prices as a function of wholesale values, a trend variable, and dummy variables for each month of the year. The trend variable was represented by each observation. A second model estimated live prices as a function of nearby futures market prices, a trend variable, and monthly dummy variables. This estimation procedure, using the live prices as the dependant variable, was completed for both Nebraska fed steers and Iowa – Southern Minnesota direct hog prices. The regression models estimated for the ratios specified the ratios as a function of seasonal dummy variables and a trend variable.

For one hog model, a dummy variable was added to account for the change in reported wholesale prices that occurred October 30, 1997. Dummy variables were also added to the beef and hog models to account for the futures market contract changes during the ten-year period. The CME changed the delivery for the live cattle futures

contract, beginning June 1995. The June 1995 contract change was not statistically significant so it was not included in the model reported here. The CME changed the live hog futures contract to the lean hog futures contract in February 1997. This change was accounted for by adding a dummy variable to the regression model.

The four regression models specified for the raw data were:

1)

$$P_{wb} = \alpha + B_1 Box + \sum_{i=1}^{12} B_2 X_{1i} + B_3 Trend + e$$

P_{wb} = Live cattle prices

Box = Choice box beef cutout value

X_{1i} = Zero-one dummy variable for month of the year

$Trend$ = Trend variable

2)

$$P_{cf} = \alpha + B_1 Fut + \sum_{i=1}^{12} B_{2i} X_{1i} + B_3 Trend + e$$

P_{cf} = Live cattle prices

Fut = Nearby live cattle futures market prices

Other variables are as defined above

3)

$$P_{wh} = \alpha + B_1 Cutout + \sum_{i=1}^{12} B_{2i} X_{1i} + B_3 Trend + B_4 WPR + e$$

P_{wh} = Live hog prices

$Cutout$ = Pork cutout value

WPR = Wholesale price report contract change

Other Variables are as defined above

4) $$P_{fh} = \alpha + B_1 HFUT + \sum_{i=1}^{12} B_{2i} X_{1i} + B_3 Trend + B_4 FCC + e$$

P_{fh} = Live hog prices

$HFUT$ = Nearby live hog futures

FCC = Futures market contract change to lean hog contract

Other variables are as defined above

The definition of each variable is presented in Table 1.

The four regression models specified for the ratios were:

5) $$P_{blw} = \alpha + \sum_{i=1}^{12} B_{1i} X_{1i} + B_2 Trend + e$$

P_{blw} = ratio of live cattle to beef cutout value

Other variables are as defined above

6) $$P_{blf} = \alpha + \sum_{i=1}^{12} B_{1i} X_{1i} + B_2 Trend + e$$

P_{blf} = ratio of live cattle to futures market prices

Other variables are as defined above

7) $$P_{hlc} = \alpha + \sum_{i=1}^{12} B_{1i} X_{1i} + B_2 Trend + e$$

P_{hlc} = ratio of live hog to pork cutout value

Other variables are as defined above

8) $$P_{hlf} = \alpha + \sum_{i=1}^{12} B_{1i} X_{1i} + B_2 Trend + e$$

P_{hlf} = ratio of live hog to hog futures market price

Other variables are as defined above

The definition of each variable is presented in Table 1.

Table 1: Variable Definitions for Models 1-8

Variables	Definition of Variable
Dependent Variables	
P_{wb}, P_{cf}	Nebraska Fed steers price Choice 2-4 100-1300#
P_{wh}, P_{fh}	Barrows & gilts-1-2 230-240# prices for the Iowa-Southern Minnesota direct trade
P_{blw}	Ratio of Nebraska fed steers live prices to Choice box beef cutout values for 700 to 800 #. carcasses
P_{blf}	Ratio of Nebraska fed steers live prices to live cattle futures prices
P_{hlc}	Ratio of barrows & gilts-1-2 230-240# prices for the Iowa-Southern Minnesota direct trade to pork cutout value for #2 175 # carcass and 185 #. carcass(beginning the week of October 30)
P_{hlf}	Ratio of barrows & gilts-1-2 230-240# prices for the Iowa-Southern Minnesota direct trade to nearby lean hog futures market prices
Independent Variables	
Box	Choice 1-3 box beef cutout values for 700 to 800 # Carcasses
X_{1i}	Zero-one dummy variable for each month of the year, i=1-12, 1=January, 2=February, 3=March, 4=April(Base), 5=May, 6=June, 7=July, 8=August, 9=September, 10=October, 11=November, 12=December
Fut	Nearby live cattle futures market prices from Chicago Mercantile Exchange
Cutout	Pork cutout value for #2 175 Carcasses
WPR	Pork cutout formula change to 185 # carcasses beginning the week of October 30, 1997
HFUT	Nearby live hog futures market prices from Chicago Mercantile Exchange
FCC	Futures market contract change from live hog contract to lean hog contract, February 1997

Models 1-4 were estimated to identify economic and temporal relationships among live weight prices and other markets. Weekly average ratios were converted to monthly average ratios for the analysis. Table 2 presents summary statistics for raw data series and ratios. The estimation of models 5-8 recognizes the relationship between the ratios and the seasonal and trend variables. After the models for the raw monthly averaged data and ratio were estimated, the coefficients for each model were graphed for the beef and hog results.

Table 2: Summary Statistics for each data series

Variables	N	Mean	Standard Deviation	Variance	Minimum	Maximum
Beef						
Live Fed Cattle	120	71.2520	6.2665	39.2690	58.5000	83.0200
Box Beef	120	110.3900	9.0324	81.5840	93.3900	128.8600
Live Futures	120	70.8780	5.4394	29.5880	59.0500	81.8900
Ratio Live to Box	120	0.6423	0.0189	0.0004	0.5784	0.6800
Ratio Live to Futures	120	1.0020	0.0356	0.0013	0.9246	1.0872
Pork						
Live Hogs	120	46.0020	8.4527	71.4480	13.9500	63.7000
Pork Cutout	120	63.5440	8.5833	73.6740	36.7400	82.1800
Live Futures	120	50.4440	10.5910	112.1600	30.7400	82.6200
Ratio Live to Cutout	120	0.7190	0.0593	0.0035	0.3797	0.7818
Ratio Live to Futures	120	0.9241	0.1441	0.0208	0.4538	1.1846

To determine if the wholesale prices or futures prices for cattle and hogs were appropriate references for the base price, the following procedure was followed. First, the monthly average ratios were separated into a series of five-year moving ratios estimation periods, as shown in Table 3. Then, the five-year moving ratio series were

estimated as a function of seasonal dummy variables. Since the time period for the estimation procedure included only five years, a trend variable was not included. Next, a model was developed to determine if the use of historical ratios could accurately forecast ratios for one year ahead. A series of five-year moving ratio forecasts were estimated. For example, the first five years of monthly average ratios, 1989-1993, were used to forecast for each month of 1994. This process was repeated for the years 1990-1994, dropping the first year then adding the next year and estimating the ratios for 1995. Duplication of this process continued until the 1994-1998 period was reached and the estimation was completed for 1999. Each model time period and its corresponding forecast estimate year are shown in Table 3.

Table 3: Five-Year Moving Ratio Estimation Periods and Forecast Periods

Estimation Period	Forecast Period
1989-1993	1994
1990-1994	1995
1991-1995	1996
1992-1996	1997
1993-1997	1998
1994-1998	1999

An evaluation of the forecasting techniques was necessary to determine if the techniques used were accurate. For each forecast estimation period, the difference between the estimated value and the actual value was calculated. The estimated ratio for each month of the forecasted year was multiplied by the actual corresponding variable to determine the estimated live price. For example, if the estimated ratio representing Nebraska fed steers and the wholesale price in January of 1994 was 0.6529, then the ratio

was multiplied by the actual wholesale price for the corresponding time period to determine the estimated live price for Nebraska fed steers in January 1994, $71.70.

Graphs were constructed that visually examined the monthly averages for the estimated live price, the actual live price, and the wholesale or futures prices. Actual and forecasted ratios for each data series were graphed to examine how closely the forecasted ratio followed the actual ratio. Graphs were also constructed that examined the differences in the estimated and actual ratios for each forecast period of each data series. Summary statistics are shown in Tables 1 and 2 for the differences between the estimated and actual ratios of the forecasted periods for each data series.

Table 4: Summary statistics for differences between actual and estimated ratios for Beef[a]

	N	Mean	Standard Deviation	Variance	Minimum	Maximum
Nebraska Live vs. Wholesale						
1994	12	-0.0060	0.0046	0.00002	-0.0139	0.0035
1995	12	0.0200	0.0184	0.0003	-0.0107	0.0511
1996	12	0.0057	0.0204	0.0004	-0.0355	0.0366
1997	12	-0.0023	0.0101	0.0001	-0.0272	0.0094
1998	12	0.0176	0.0239	0.0006	-0.0143	0.0575
Nebraska Live vs. Futures						
1994	12	0.0225	0.0113	0.0001	-0.0032	0.0414
1995	12	0.0068	0.0152	0.0002	-0.0111	0.0328
1996	12	0.0076	0.0554	0.0031	-0.0997	0.0848
1997	12	0.0083	0.0125	0.0002	-0.0097	0.0336
1998	12	0.0321	0.0303	0.0009	-0.0153	0.0878

[a] Differences are the actual ratio less the estimated ratio

Table 5: Summary statistics for differences between actual and estimated ratios for Pork[a]

	N	Mean	Standard Deviation	Variance	Minimum	Maximum
Live Hog vs. Wholesale						
1994	12	0.0455	0.0498	0.0025	-0.0084	0.1450
1995	12	0.0120	0.0189	0.0004	-0.0146	0.0417
1996	12	-0.0111	0.0187	0.0003	-0.0412	0.0200
1997	12	0.0059	0.0221	0.0005	-0.0224	0.0544
1998	12	0.1289	0.0763	0.0058	0.0663	0.3133
Live Hog vs. Futures						
1994	12	0.0659	0.0348	0.0012	0.0096	0.1442
1995	12	0.0110	0.0337	0.0011	-0.0319	0.0548
1996	12	0.0199	0.0596	0.0355	-0.0236	0.1992
1997	12	0.0742	0.0427	0.0018	0.0207	0.1465
1998	12	0.0600	0.0607	0.0037	-0.0137	0.2052

[a] Differences are the actual ratio less the estimated ratio

Chapter IV

Empirical Results

Regression Analysis

The regression analysis results for Model 1, Nebraska fed steers as a function of beef cutout values and Model 2, Nebraska fed steers as a function of live cattle futures prices are shown in Table 1 in the Appendix. Model 1 accounted for 94.2 percent of the variation in Nebraska fed steer prices. Model 2, accounted for 94.3 percent of the variation in Nebraska fed steer prices. The *Box* and *Fut* variables were found to be significant in models 1 and 2 respectively. The *Trend* variable was found to be significant in model 1, but not in model 2. Results for model 2 show that each of the seasonal dummy variables were statistically significant, but in model 1, dummy variables for *February* and *March* were not significantly different from zero.

The pork industry regression results for Model 3, Iowa-Southern Minnesota live hogs as a function of pork cutout values and Model 4, live hogs as a function of live hog futures market prices are represented in Appendix Table 2. Model 3 accounted for 98.5 percent of the variation in live hog prices and Model 4 accounted for 96.8 percent of the variation in live hog prices. The results for Model 3 show that the *Cutout*, *Trend*, seasonal dummy variables *September* through *December*, and the dummy variable that represents the price reporting change in pork cutout values were significant. However, the seasonal dummy variables for *January* through *July* were not found to be significantly different from zero. Regression results for Model 4 show that all explanatory variables were significantly different from zero.

The regression analysis results for models 5, fed cattle live-to-wholesale ratio and 6, fed cattle live-to-futures ratio are presented in Table 6. The results indicate that model 5 accounted for 68.2 percent of the variation in the ratio of live cattle prices to wholesale prices. Model 6 accounted for 68.7 percent of the variation in the ratio of live cattle prices to futures market prices. A dummy variable for the futures contract change in the beef industry was not included in model 6 because it was not statistically significant. Results indicate that the *Trend* variable was not significant in Model 5. The only variables considered significantly different from zero in Model 5 were the seasonal dummy variables *May* through *August*. On the other hand, Model 6 found that all variables specified in the model were statistically significant.

Model 7, live hogs live-to-wholesale ratios, accounted for 84.1 percent of the variation in the ratio of live hog prices to wholesale pork prices. Model 8, live hogs live-to-futures prices accounted for 94.4 percent of the variation in the ratio of live hog prices to hog futures market prices. Regression results for models 7 and 8 are exhibited in Table 7. Results for Model 7 indicate that the *Trend*, and the seasonal variables *May* through *June*, and *November* and *December* were statistically significant. The dummy variable for the change in price reporting for the cutout values was not found to be significant in Model 7. Regression results for Model 8 show that every explanatory variable was significant.

Table 6: Regression Results for Ratios Between Nebraska Fed Steer Price and Choice Boxed Beef 700-800# and Nearby Live Futures

Explanatory Variables	Estimated Coefficients Fed Steers to Choice Box Beef Cutout Ratio	Fed Steers to Nearby Live Futures Ratio
Intercept	0.6583***[a]	1.0648***
	(92.970)[b]	(89.260)
Trend	-0.0001	-0.0003*
	(-1.312)	(-1.918)
January	-0.0050	-0.0523***
	(-.896)	(-5.500)
February	0.0031	-0.0602***
	(0.640)	(-7.220)
March	0.0047	-0.0530***
	(1.252)	(-8.185)
April	Base	Base
May	-0.0222***	-0.0131**
	(-5.853)	(-2.017)
June	-0.0284***	-0.0373***
	(-5.796)	(-4.461)
July	-0.0199***	-0.0623***
	(-3.605)	(-6.635)
August	-0.0215***	-0.0783***
	(-3.661)	(-7.837)
September	-0.0068	-0.0732***
	(-1.118)	(-7.103)
October	-0.0043	-0.0573***
	(-.708)	(-5.507)
November	-0.0064	-0.0423***
	(-1.058)	(-4.095)
December	-0.0073	-0.0391***
	(-1.231)	(-3.892)
Observations	120	120
Adjusted R^2	0.6816	0.6869

[a] Significance levels are donated as follows:
*** significant @ the 1% level of significance,
** significant @ the 5% level of significance,
and * significant @ the 10% level of significance.

[b] Figures presented in parenthesis are the calculated t-ratio for each coefficient

Table 7: Regression Results from Monthly Regression for Ratios between Ia.-So.Minn Barrows & Gilts Price and Pork Cut-Out Value and Nearby Live Hog Futures

Explanatory Variables	Estimated Coefficients: Live hogs to Pork Cut-Out Value Ratio	Live hogs to Live Hog Futures Ratio
Intercept	0.8083***[a]	0.9144***
	(10.80)[b]	(48.6800)
Trend	-0.0021**	-0.0009***
	(-2.211)	(-3.087)
January	-0.0080	0.0754***
	(-.7340)	(4.6640)
February	-0.0014	0.1224***
	(-.1482)	(8.5070)
March	-0.0056	0.0944***
	(-.8161)	(8.2860)
April	Base	Base
May	0.0135**	0.0671***
	(1.9620)	(5.8920)
June	0.0228**	0.1207***
	(2.4580)	(8.3800)
July	0.0213**	0.1730***
	(1.9720)	(10.8600)
August	0.0112	0.2516***
	(0.9516)	(15.0300)
September	-0.0050	0.1630***
	(-.4043)	(9.4960)
October	-0.0114	0.1390***
	(-.9054)	(8.0300)
November	-0.0458***	0.0679***
	(-3.686)	(3.9440)
December	-0.0339***	0.0629***
	(-2.837)	(3.7390)
Dummy for Change in the Market[c]	0.0018	-0.2510***
	(0.0744)	(-11.36)
Observations	120	120
Adjusted R^2	0.8406	0.9436

[a] Significance levels are donated as follows:
*** significant @ the 1% level of significance,
** significant @ the 5% level of significance,
and * significant @ the 10% level of significance.

[b] Figures presented in parenthesis are the calculated t-ratio for each coefficient.

[c] The wholesale market experienced a change in price reporting and the futures market experienced a change in the contract.

Therefore, for all four ratio models, the ratios exhibited a definite seasonal pattern. A downward trend was significant for three of the four models. To show the downward trend, a line graph of the ratios with a trend line is presented in Figures 5-8. The trend line for Figure 8 was less steep for the years 1989-1996, but due to the contract change in 1997 a large drop in the ratios occurred which made the trend line more steep for the ten year period.

A graph of the coefficients for each model, 1-8 were constructed to examine the seasonal patterns. The coefficients for Models 1-4 and Models 5-8 presented in Figures 9-12 display similar seasonal patterns. The monthly data and ratios exhibited similar seasonal patterns. Fed cattle prices and the fed cattle-beef wholesale ratios peaked in March (Figure 9) and then decreased until June before increasing. Fed cattle prices and fed cattle-futures ratios peaked in April (Figure 10) and reached a low in August. Live hog prices and the live hog-pork wholesale ratios indicated a fairly steady increase in price until June (Figure 11) and began to decrease until November. Figure 11 exhibits an unexplained difference between Model 3 and Model 7 for the first three months. Live hog prices and live hog pork-futures ratios were lowest in April (Figure 12) and highest in August.

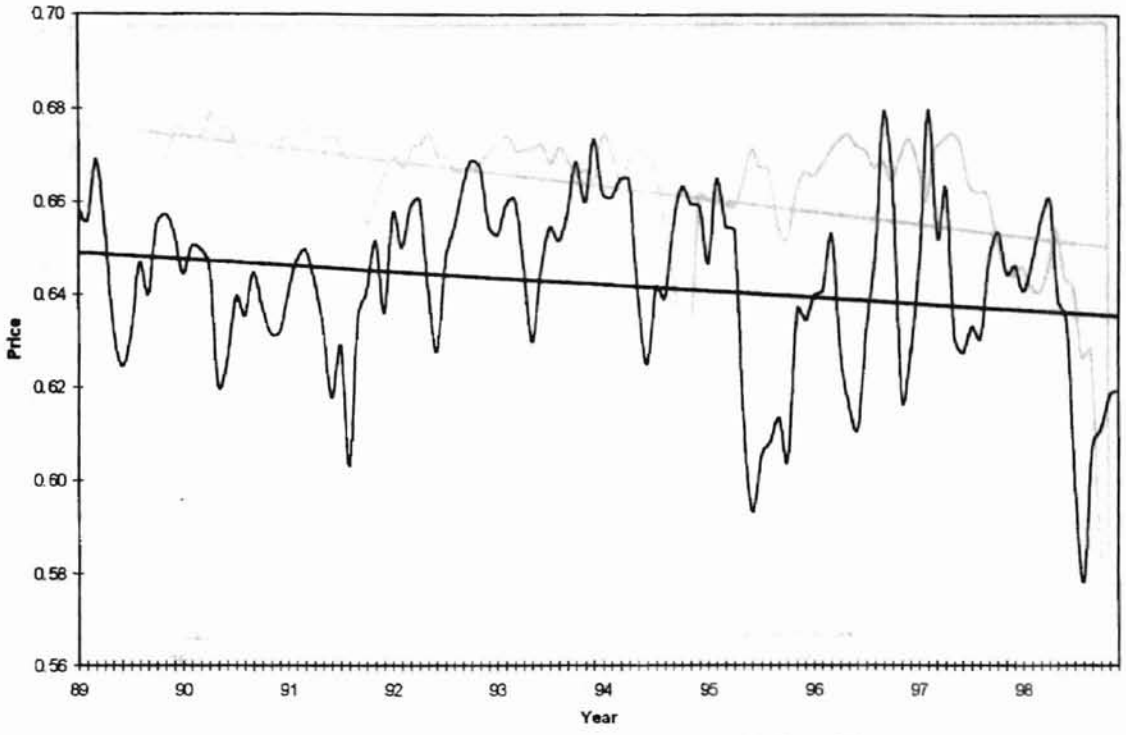

Figure 5: Ratio and Trend Line of Nebraska Fed Steers to Choice Box Beef 700-800 Lbs., 1989-1998

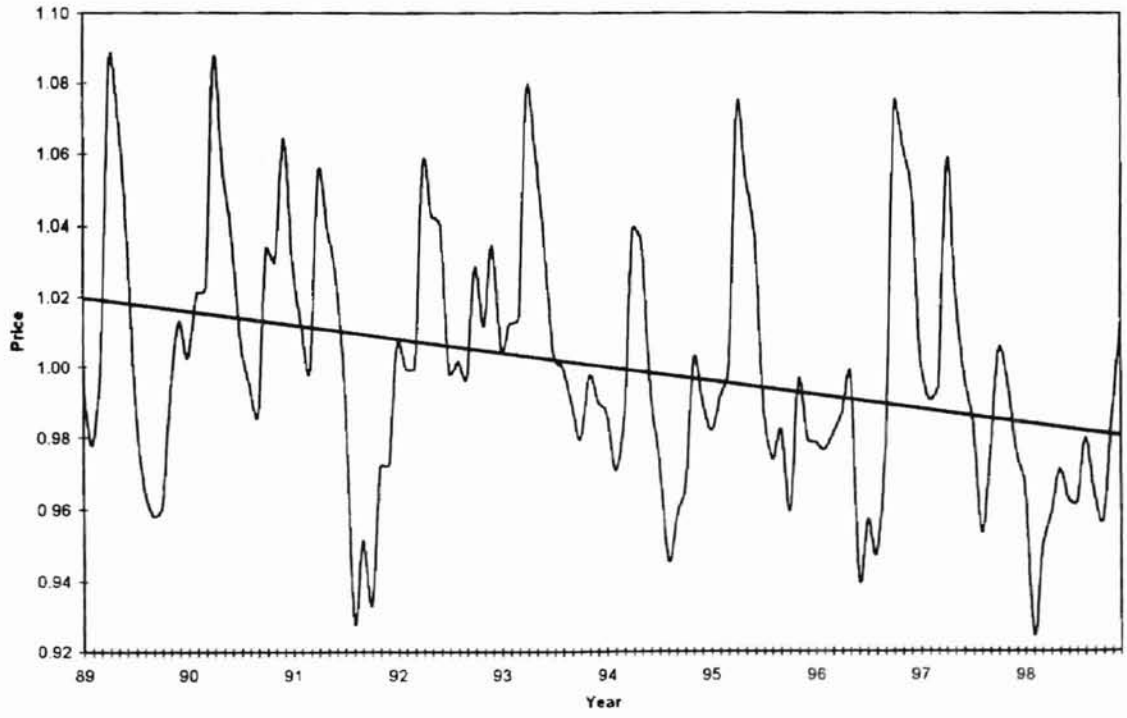

Figure 6: Ratio and Trend Line of Nebraska Fed Steers to Live Cattle Futures Prices 1989-1998

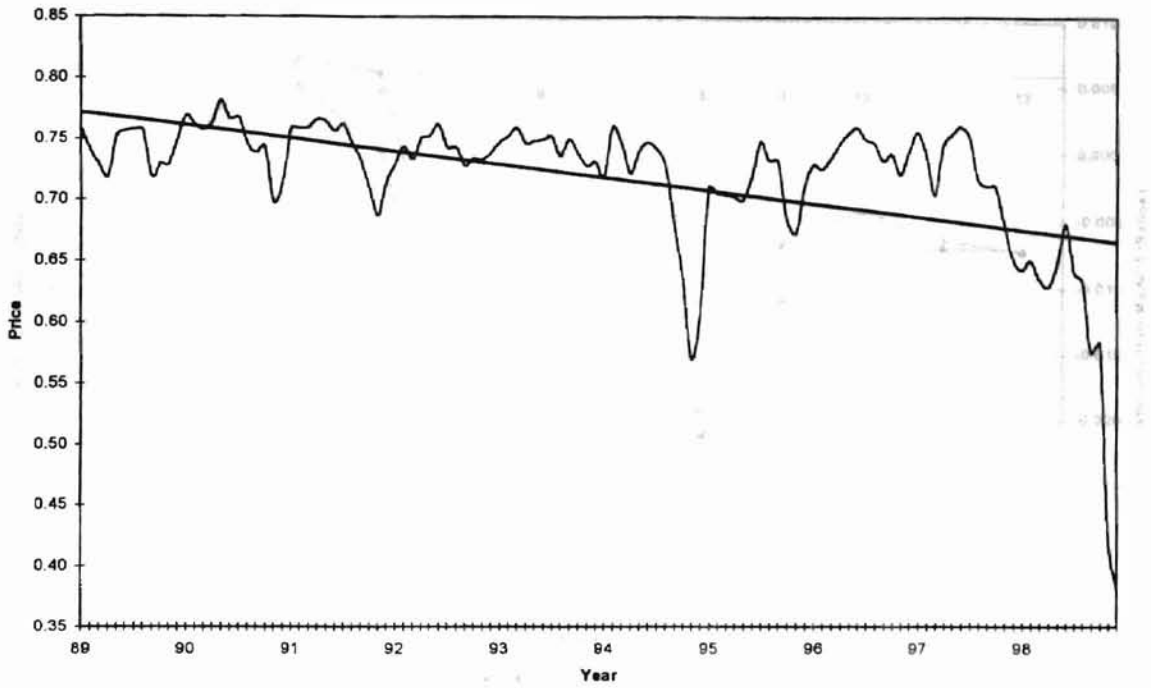

Figure 7: Ratio and Trend Line of Live Hog Prices to Pork Cutout Values 1989-1998

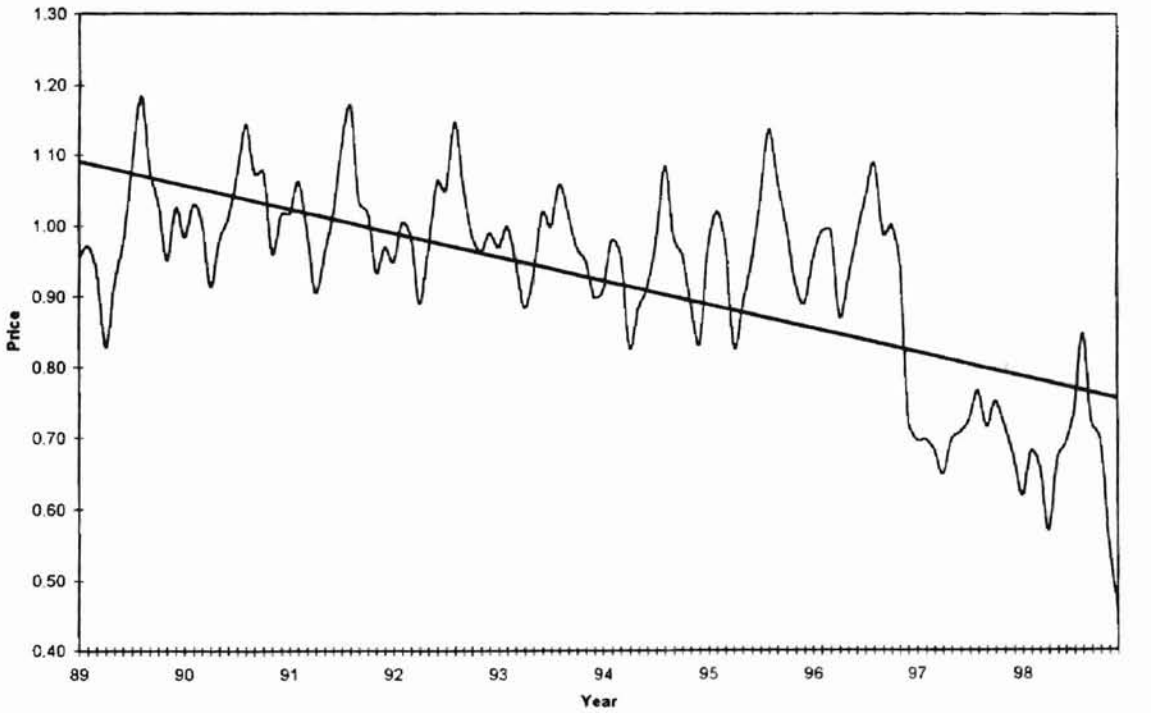

Figure 8: Ratio and Trend Line of Live Hog Prices to Nearby Live Hog Futures Market Prices 1989-1998

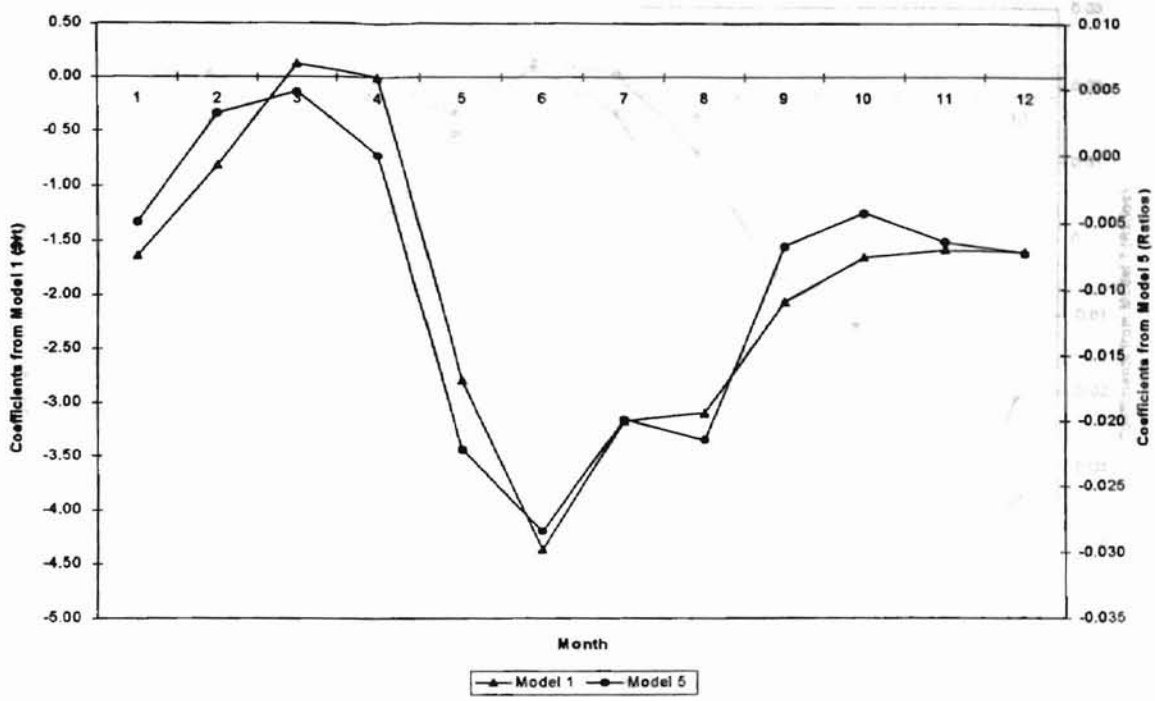

Figure 9: Coefficient graph of Model 1 (Live Cattle vs. Wholesale) and Model 5 (Ratio: Live Cattle vs. Wholesale)

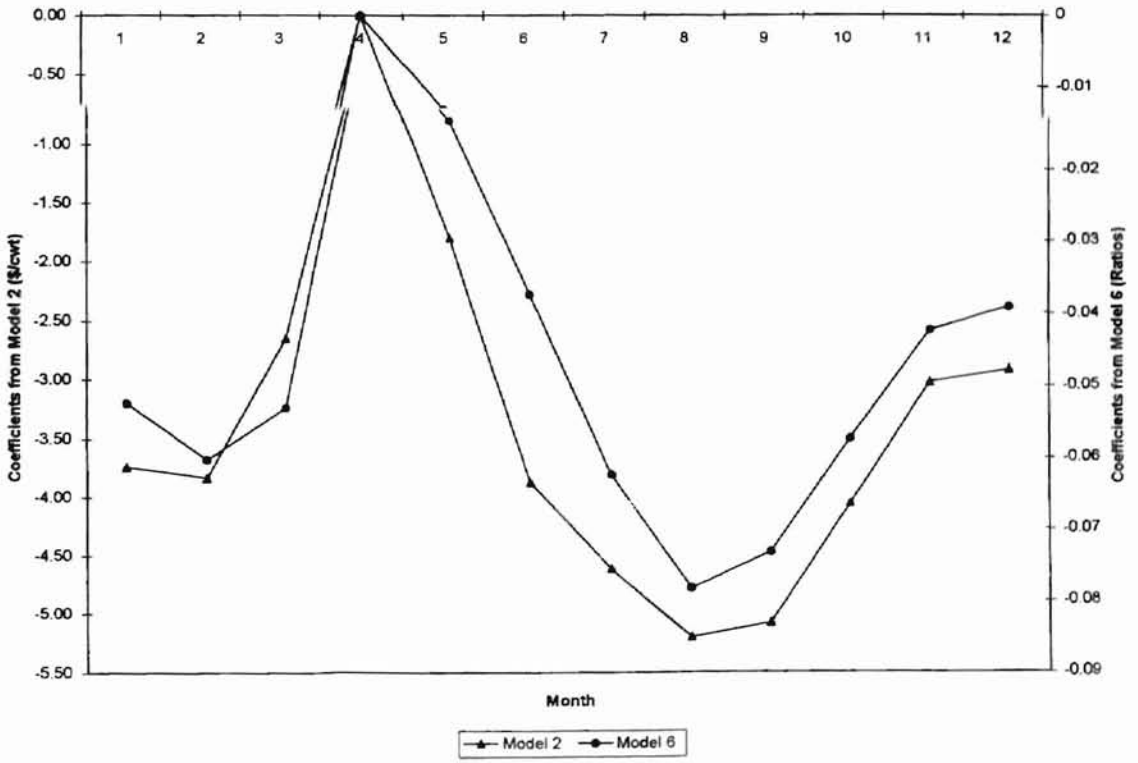

Figure 10: Coefficient Graph of Model 2 (Live Cattle vs. Futures Market) and Model 6 (Ratio: Live Cattle vs. Futures Market)

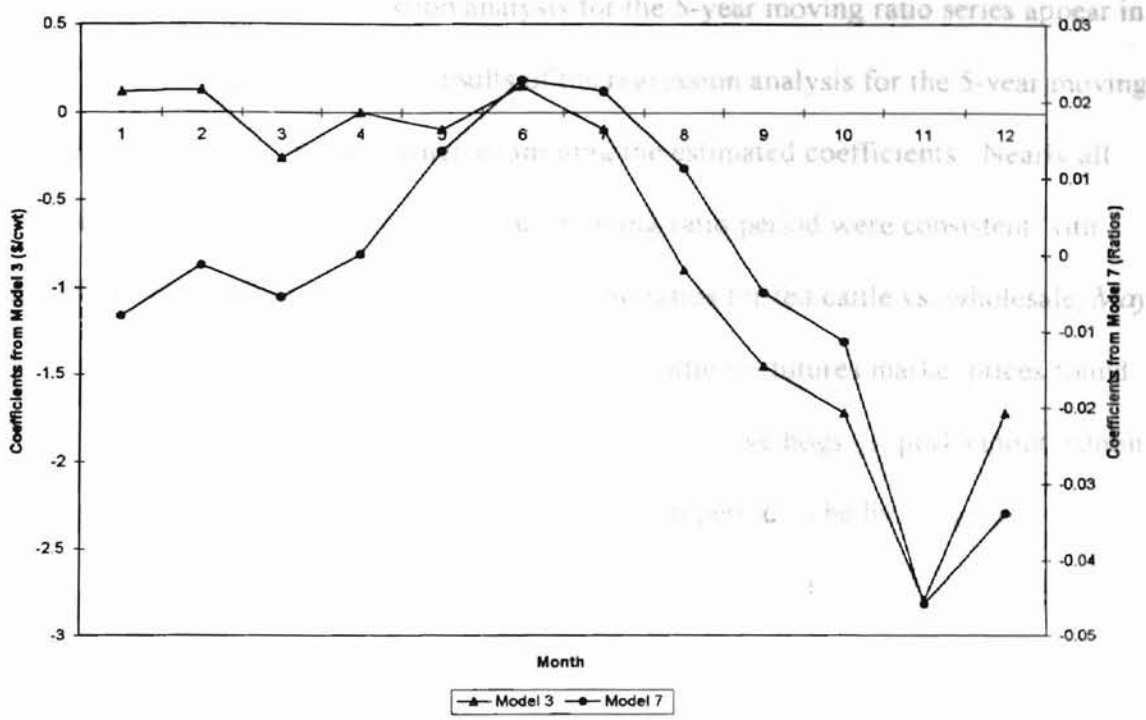

Figure 11: Coefficient Graph of Model 3 (Live Hog vs. Pork Cutout) and Model 7 (Ratio: Live Hog vs. Pork Cutout)

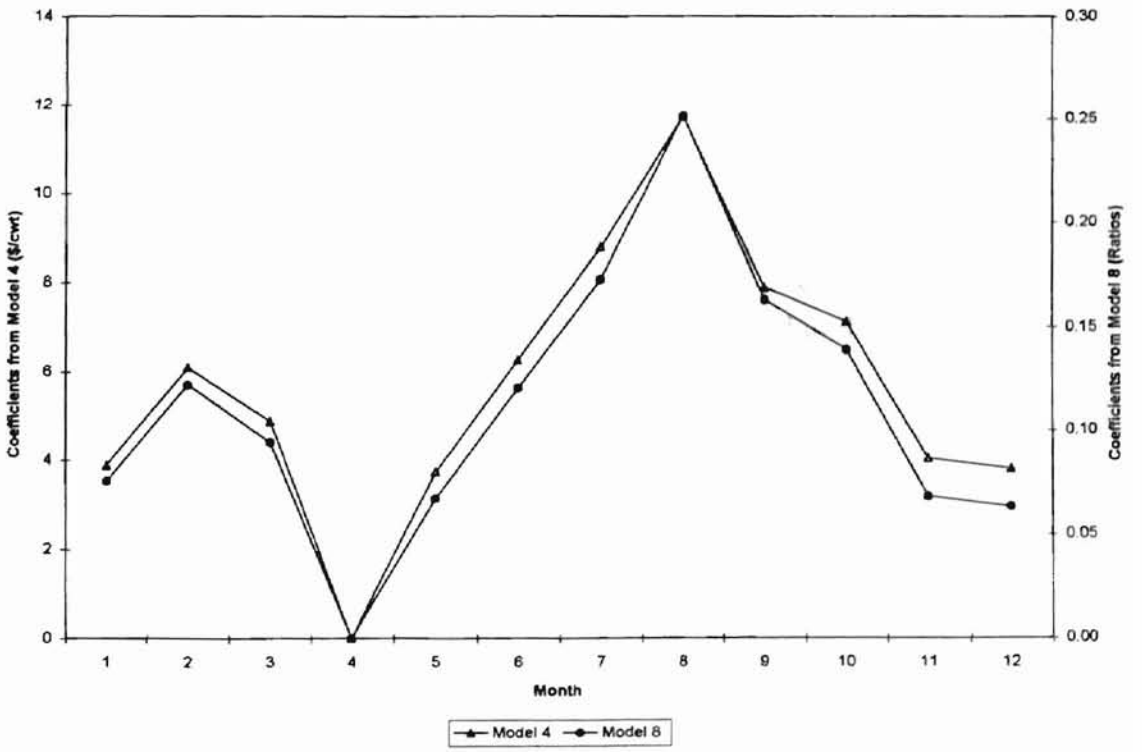

Figure 12: Coefficient Graph of Model 4 (Live Hog vs. Futures Market) and Model 8 (Ratio: Live Hog vs. Futures Market)

The results of the regression analysis for the 5-year moving ratio series appear in Tables 3-6 in the Appendix. The results of the regression analysis for the 5-year moving ratio series indicate robustness when examining the estimated coefficients. Nearly all coefficients for the each month across each moving ratio period were consistent with each other. For each of the 5-year period moving ratios for fed cattle vs. wholesale, *May* through *August* were statistically significant. Fed cattle vs. futures market prices found each variable significant for each moving ratio period. Live hogs vs. pork cutout exhibits *October* through *December* as significant across each period. The live hogs to futures market prices found each variable significant for each time period.

Forecast Model Interpretation

The forecasted ratios were based on a simple method, which accounted for a seasonal pattern only. The results for each forecasted year are shown in Tables 7-10 in the Appendix. Graphs shown in Figures 13-16, which were constructed to compare the actual ratio and estimated ratio revealed that the estimated ratios exhibited less variation than the actual ratios. The differences between the estimated and actual ratios during 1994 exhibited a smaller standard deviation than 1995-1998, but the standard deviation was somewhat consistent from 1995-1998. The standard deviation for fed cattle live-to-wholesale for the entire 5-year period was 0.0109 for the estimated values and 0.022 for the actual values. The fed cattle, live-to-futures standard deviation over the entire time period were 0.0253 for the estimated values and 0.0331 for the actual values. For live hogs, live-to-wholesale the standard deviation for the 5-year period was 0.0207 for the estimated values and 0.0737 for the actual values. The standard deviation for the live

hog, live-to-futures was 0.1339 for the estimated values and 0.1567 for the actual values. The standard deviations for the entire 5-year period for each series exhibit that there was less variation in the estimated ratios than in the actual ratios. The results also revealed the accuracy of the forecasted ratios varied from year to year. Buyers and sellers will accept certain forecasted ratios while some will be considered unacceptable.

Table 8: Mean and Standard Deviation of Estimated and Actual Ratios for Beef and Pork

	Wholesale		Futures	
	Estimated	Actual	Estimated	Actual
Beef				
Mean	0.6453	0.6383	1.0045	0.9890
Standard Deviation	0.0109	0.0220	0.0253	0.0331
Pork				
Mean	0.7295	0.6936	0.8926	0.8464
Standard Deviation	0.0207	0.0737	0.1339	0.1567

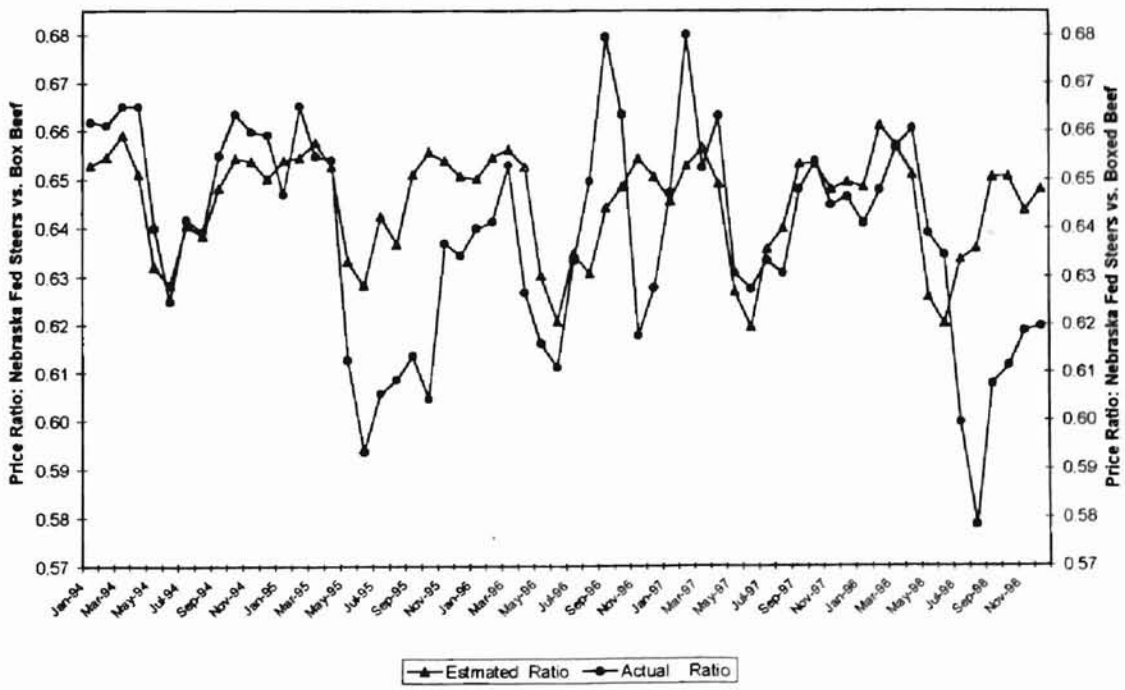

Figure 13: Ratios of Nebraska Fed Steers to Box Beef: Actual vs. Forecasted, 1994-1998

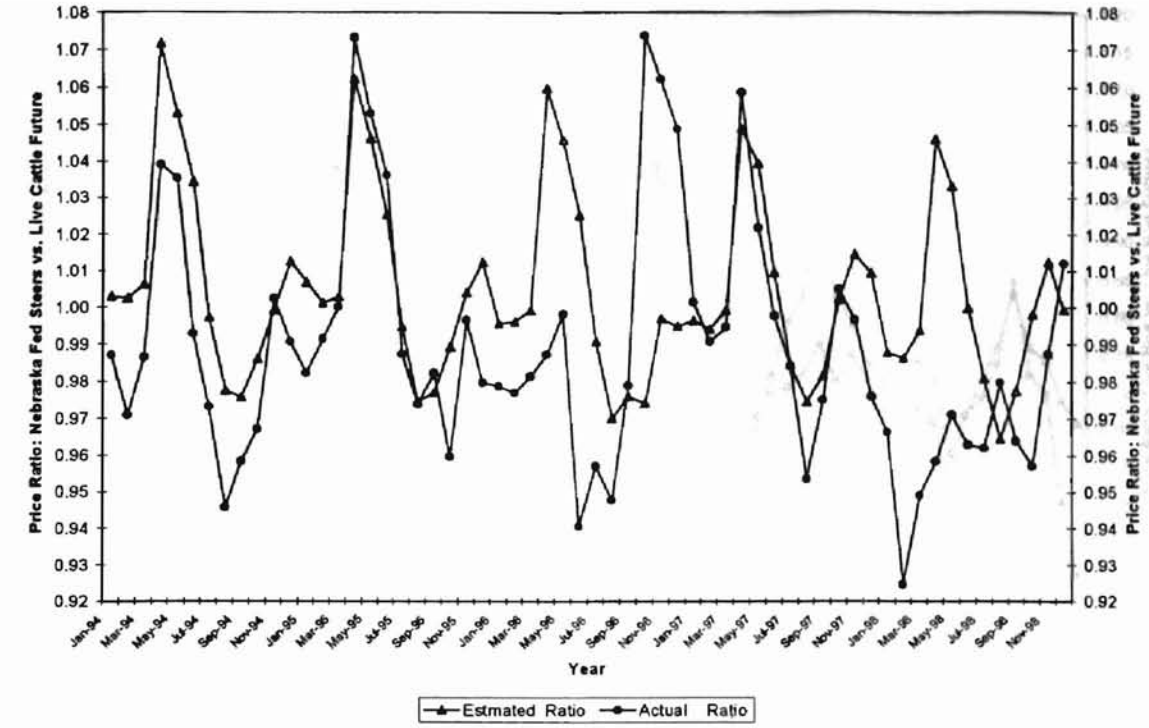

Figure 14: Ratios of Nebraska Fed Steers Prices to Live Cattle Futures Market Prices: Actual vs. Forecasted, 1994-1998

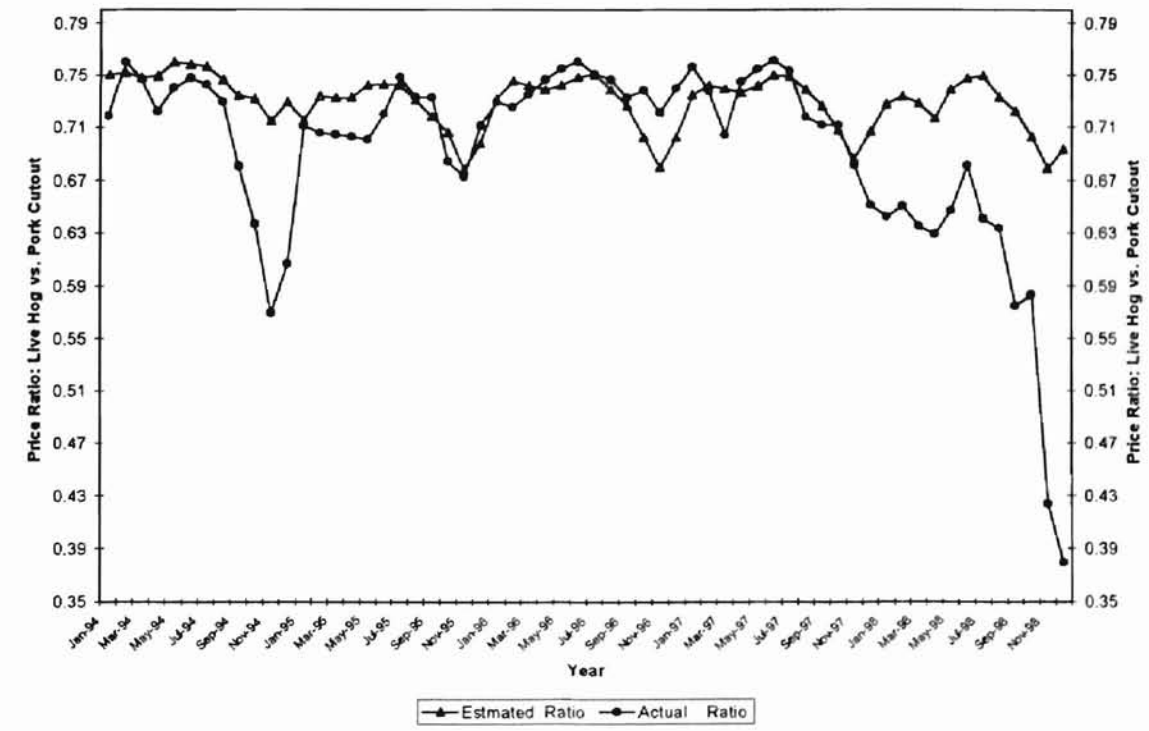

Figure 15: Ratios of Live Hog Prices to Pork Cutout Values: Estimated vs. Actual, 1994-1998

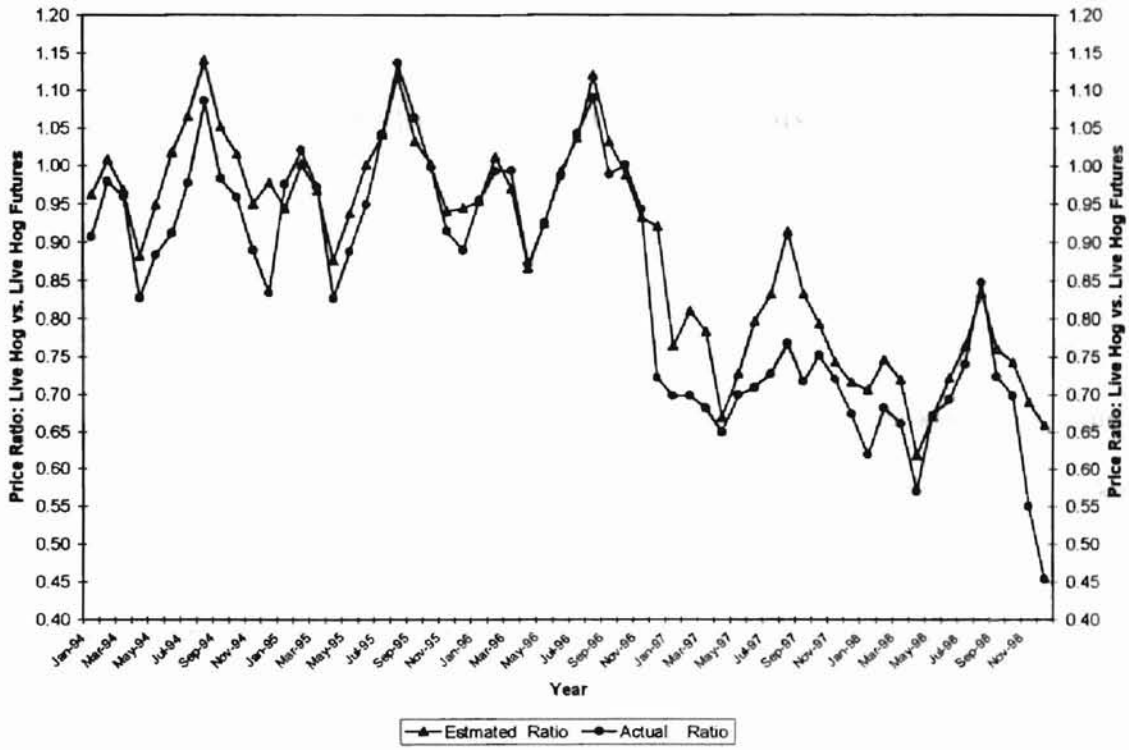

Figure 16: Ratios of Live Hog Prices to Live Hog Futures Market Prices: Estimated vs. Actual, 1994-1998

Chapter V

Implications and Conclusions

Implications and Conclusions

Wholesale prices and futures market prices could be argued as an acceptable reference for base prices in formulas. Wholesale prices and futures market prices could improve the use of formulas by using a base price that is an accurate reflection of market conditions, thereby improving the price discovery process. Figures 13-16 showed that the estimated ratios exhibited less variation than the actual ratios. The reduced variability in the estimated ratios could be a benefit to formula pricing. Neither wholesale prices nor futures market prices are the perfect solution to the problem, but they do represent suitable alternatives.

In figures 17-20 the monthly averages of the estimated live price derived from the live-to-wholesale or live-to-futures ratios and actual live price are shown for the years 1994-1998 for beef and pork. This model used only seasonal adjustment factors in the model to minimize the differences. Since the accuracy of the forecasted ratios varied from year to year, a more complex model could be utilized in further research. The regression results for the ratios of the beef data series concluded that there is still thirty percent of unexplained variation. This suggests that other variables could be added to improve the forecast model.

For the beef industry, the use of futures prices seems to be a better alternative than using wholesale prices. On the other hand, in the pork industry, the use of wholesale prices seems to track closer to live prices than does futures prices. The comparison to

live prices is used because at this point there is no other pricing alternative for comparison. Since the wholesale prices and futures prices may follow closely to live prices, the concern may be raised that we should still use live prices. The use of live prices is likely to decrease over time as has been discussed earlier in this research and the need to find an alternative base price now is important. In further research, the use of weekly data could be beneficial. Determining other variables that could account for the unexplained variation in the models could also benefit future research.

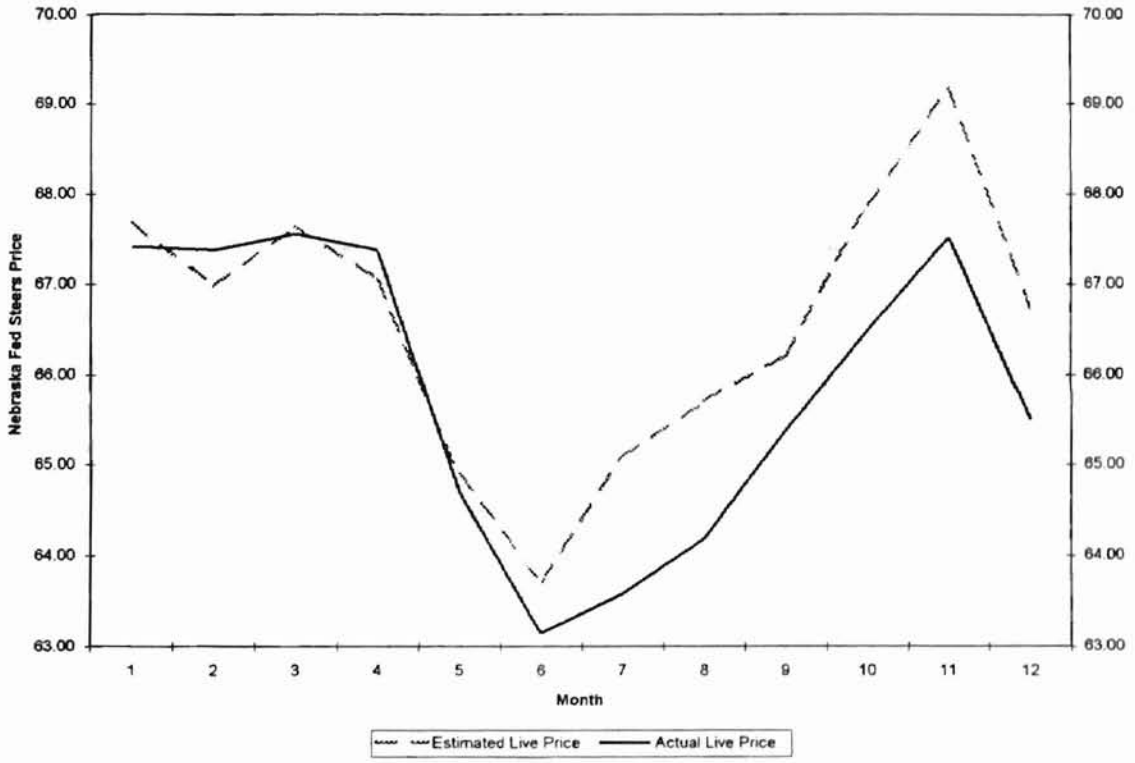

Figure 17: Comparison of 1994-1998 Monthly Average Estimated Nebraska Fed Steers Price from Live-to-Wholesale Ratio and Monthly Average Actual Nebraska Fed Steers Price

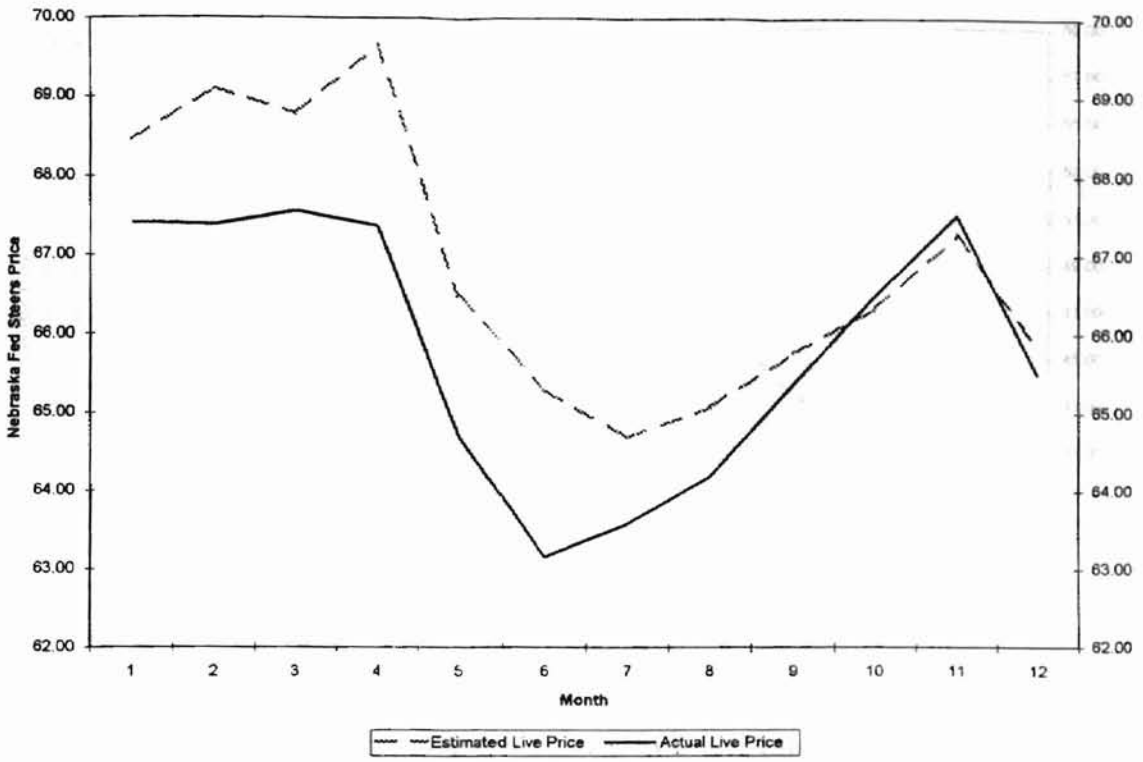

Figure 18: Comparison of 1994-1998 Monthly Average Estimated Nebraska Fed Steers Price from Live-to-Futures Ratio and Monthly Average Actual Nebraska Fed Steer Price

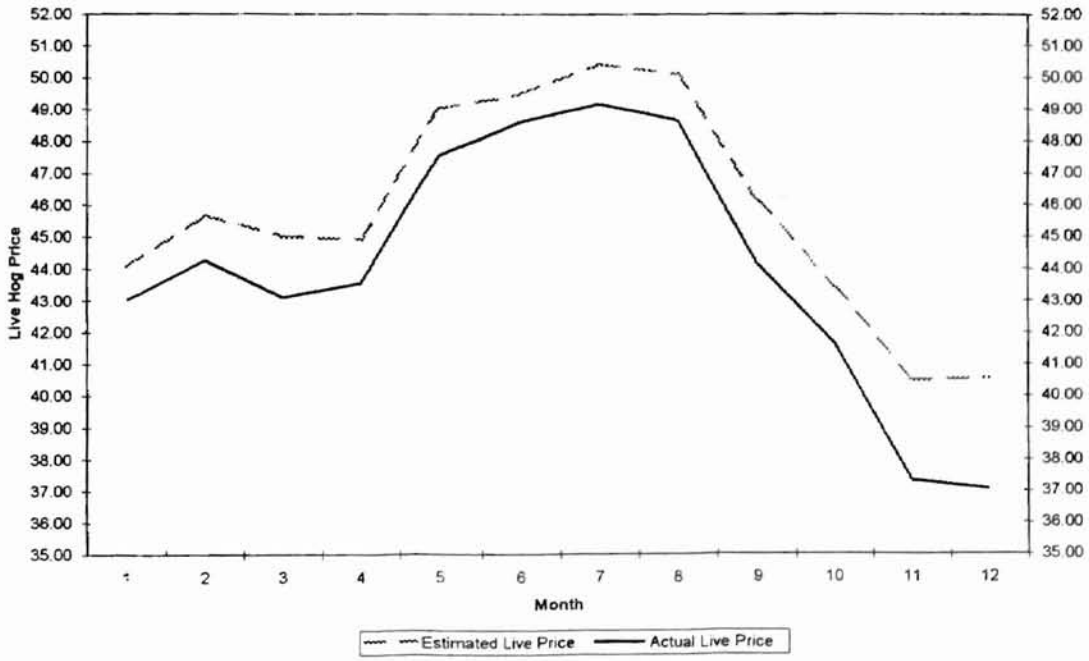

Figure 19: Comparison of 1994-1998 Monthly Average Estimated Live Hog Price derived from Live-to-Wholesale Ratio and Monthly Average Actual Live Price

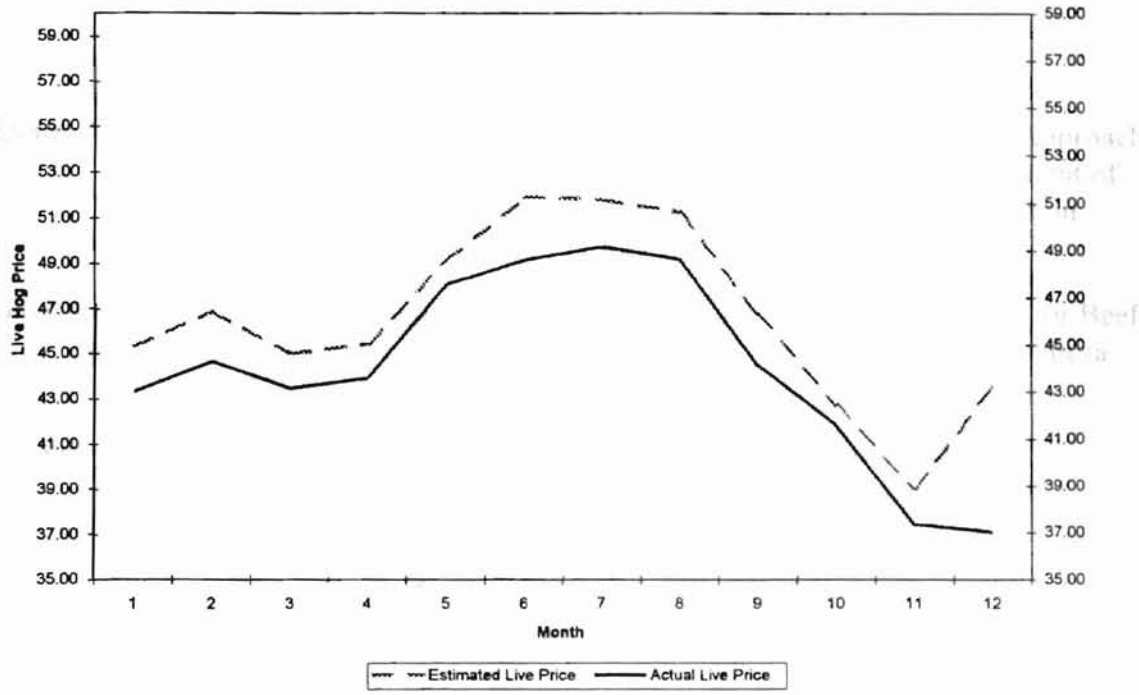

Figure 20: Comparison of 1994-1998 Monthly Average Estimated Live Hog Price, Monthly Average Actual Live Price, and Monthly Average Live Hog Futures Market Price

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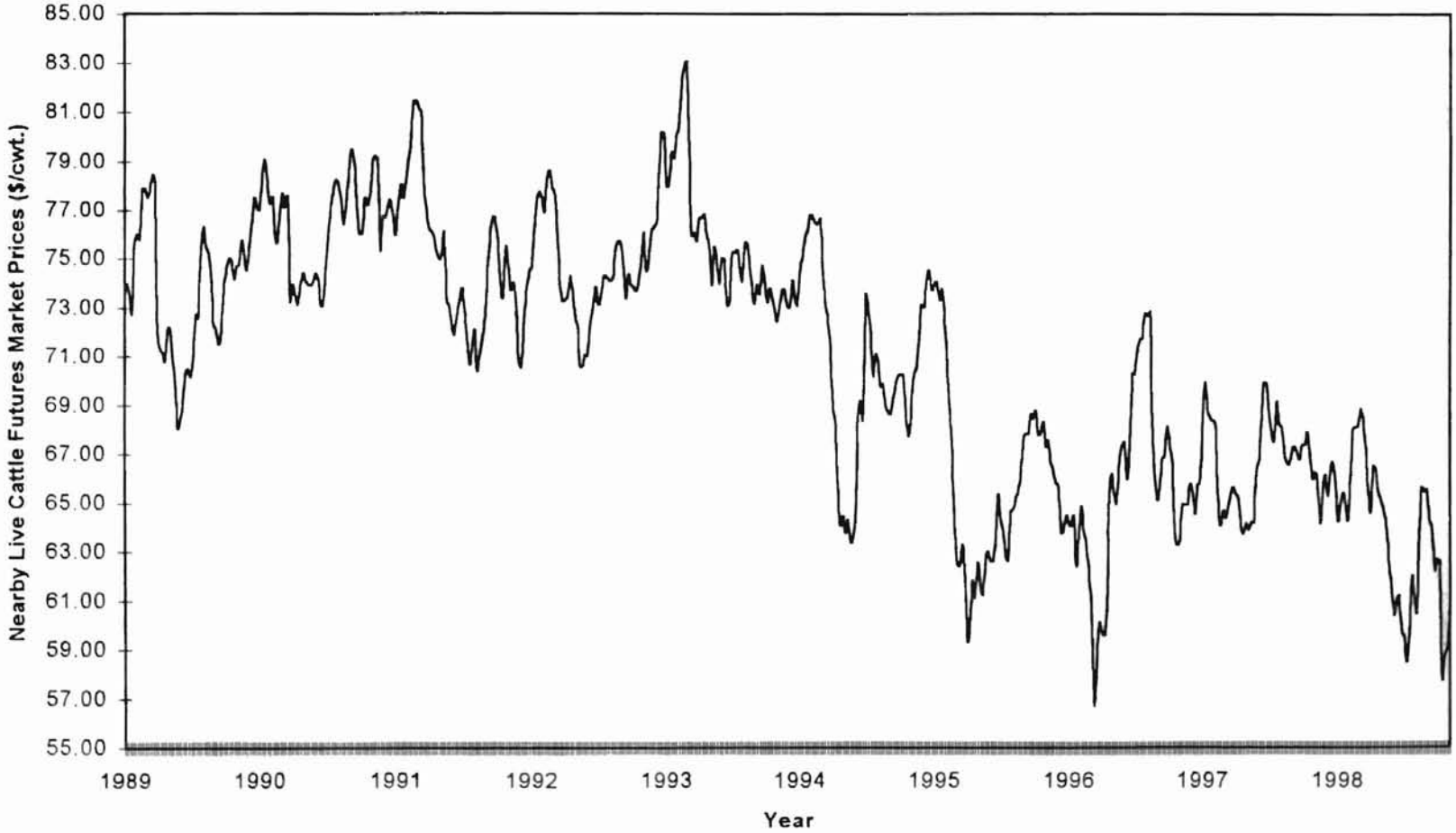
APPENDIX

Appendix - Figure 1: Nebraska Fed Steers Weekly Prices, 1989-1998

Appendix - Figure 2: Choice Box Beef 700-800 Lbs. Weekly Data, 1989-1998

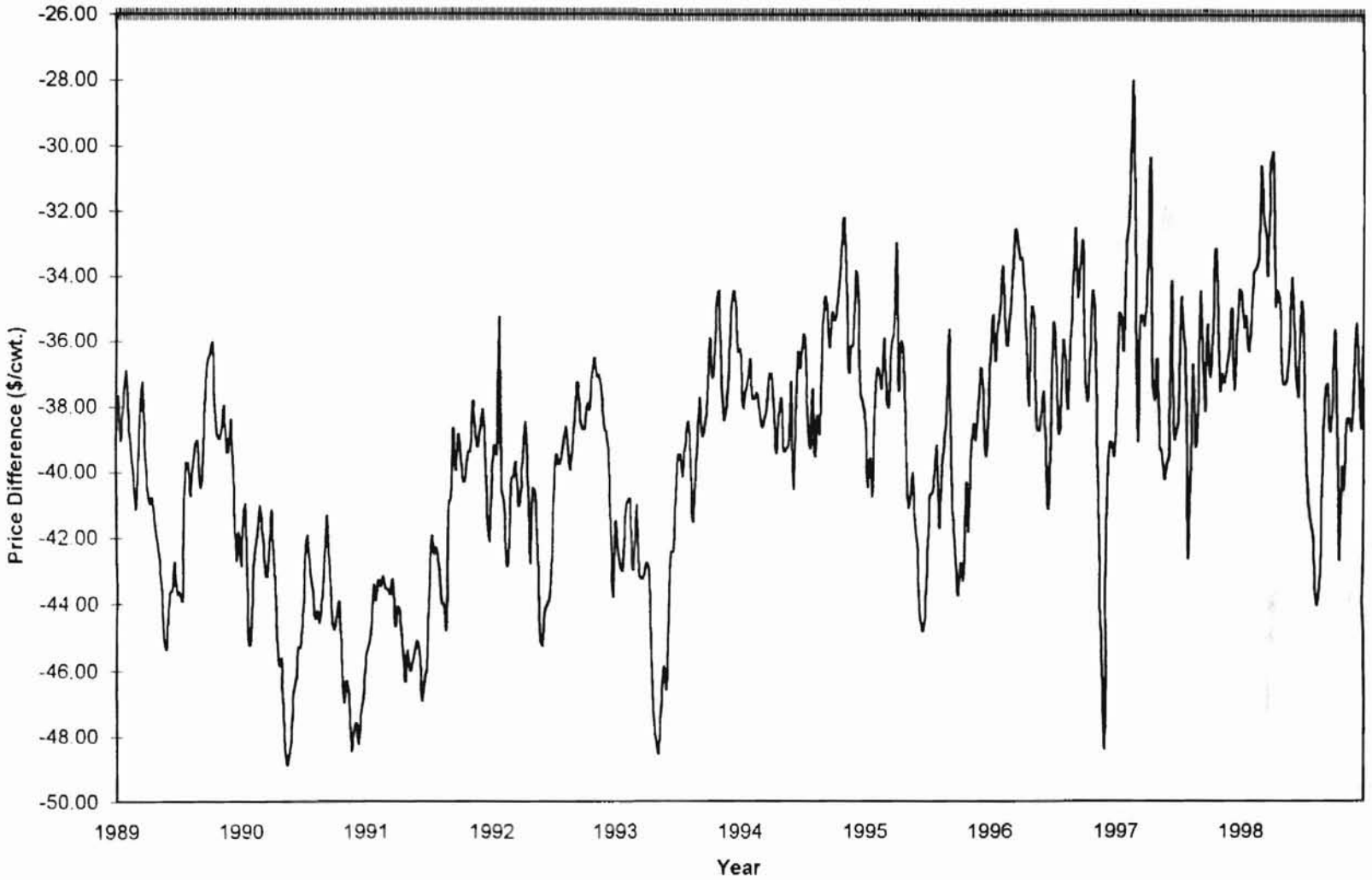


Appendix - Figure 3: Nearby Live Cattle Futures Market Prices Weekly Data, 1989-1998

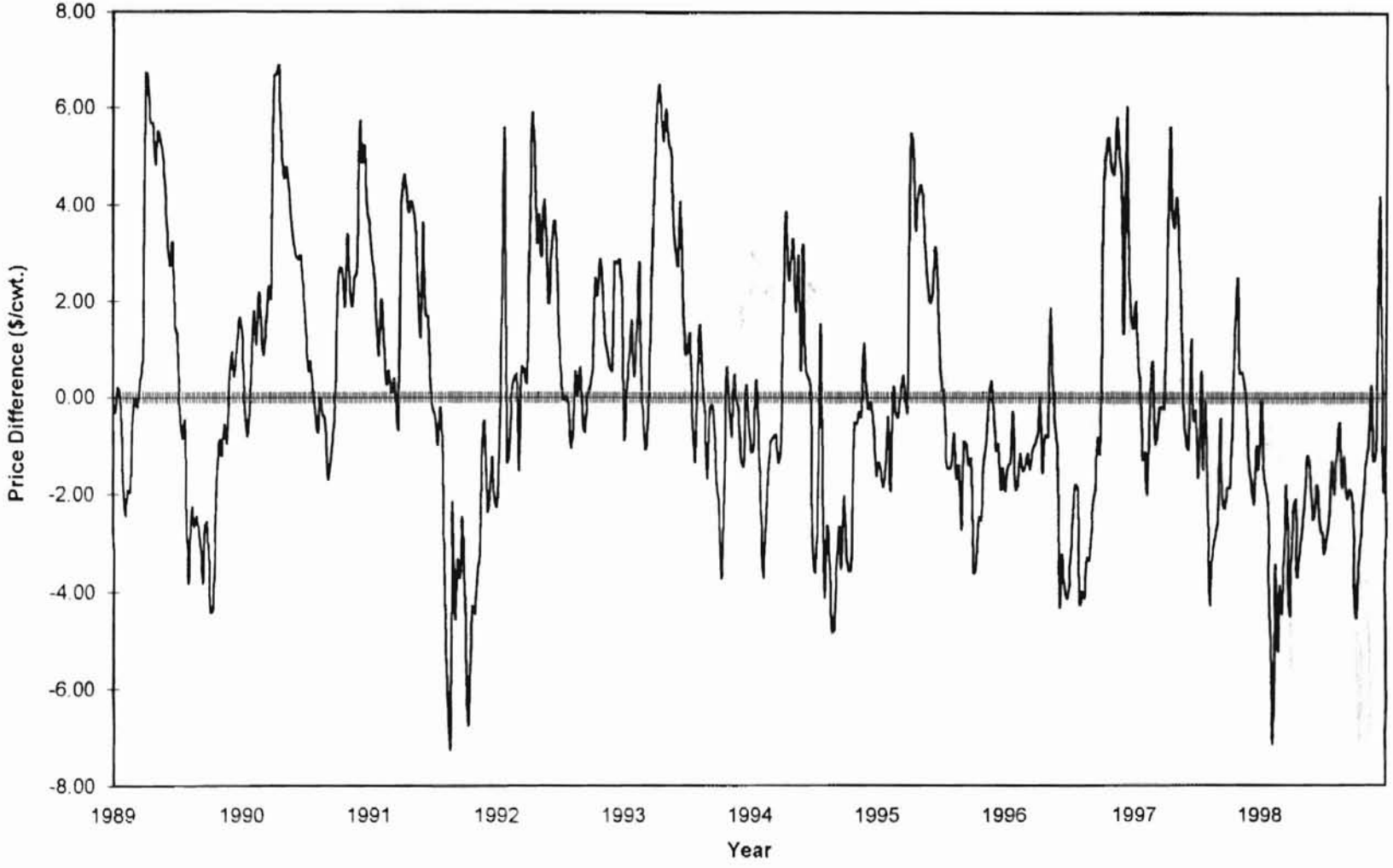
Appendix - Figure 4: Iowa-Southern Minnesota Live Hog Prices Weekly Data, 1989-1998

Appendix - Figure 5: Pork Cutout Values Weekly Data, 1989-1998

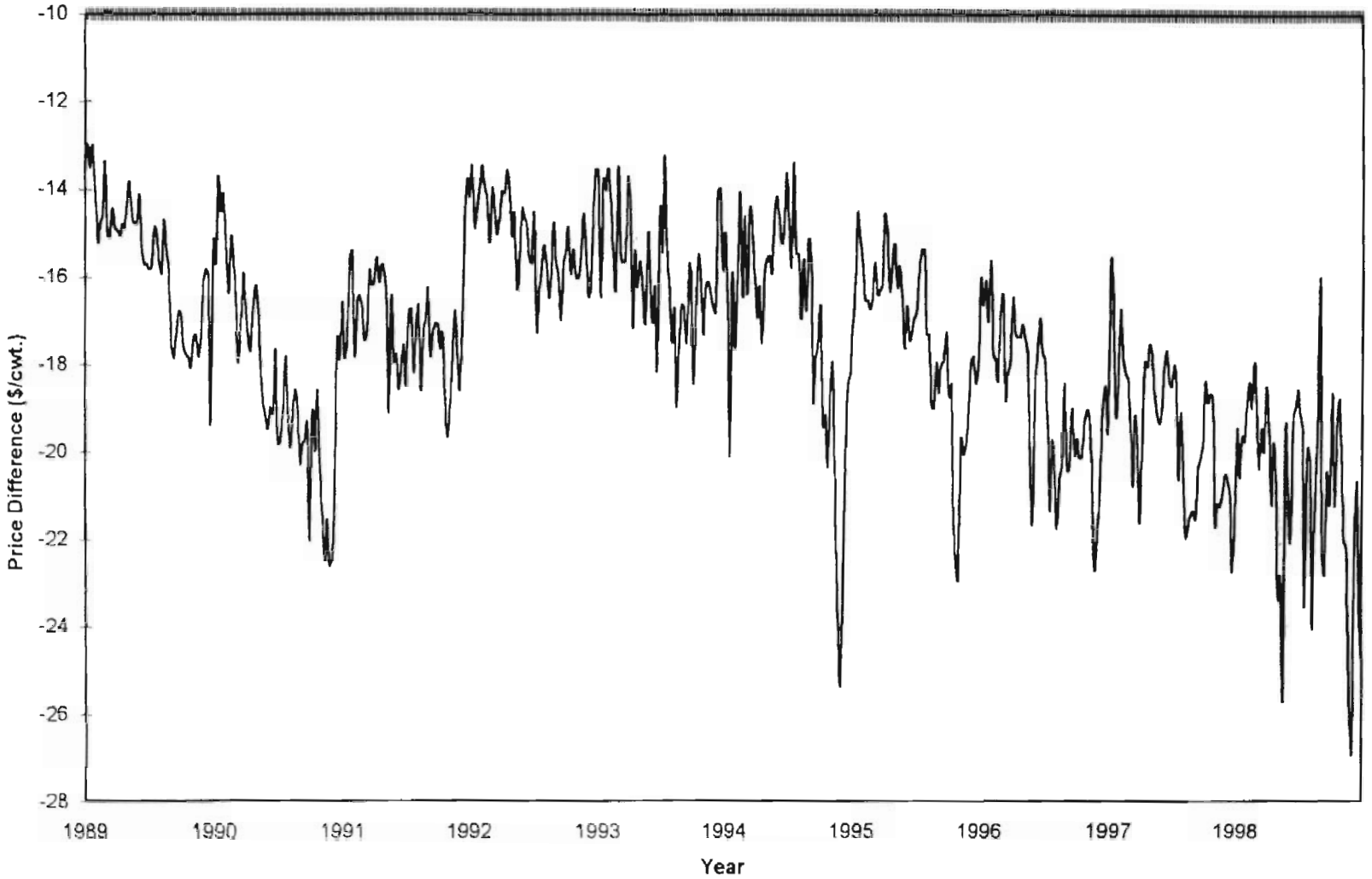
Appendix - Figure 6: Nearby Live Hog Futures Market Prices Weekly Data, 1989-1998



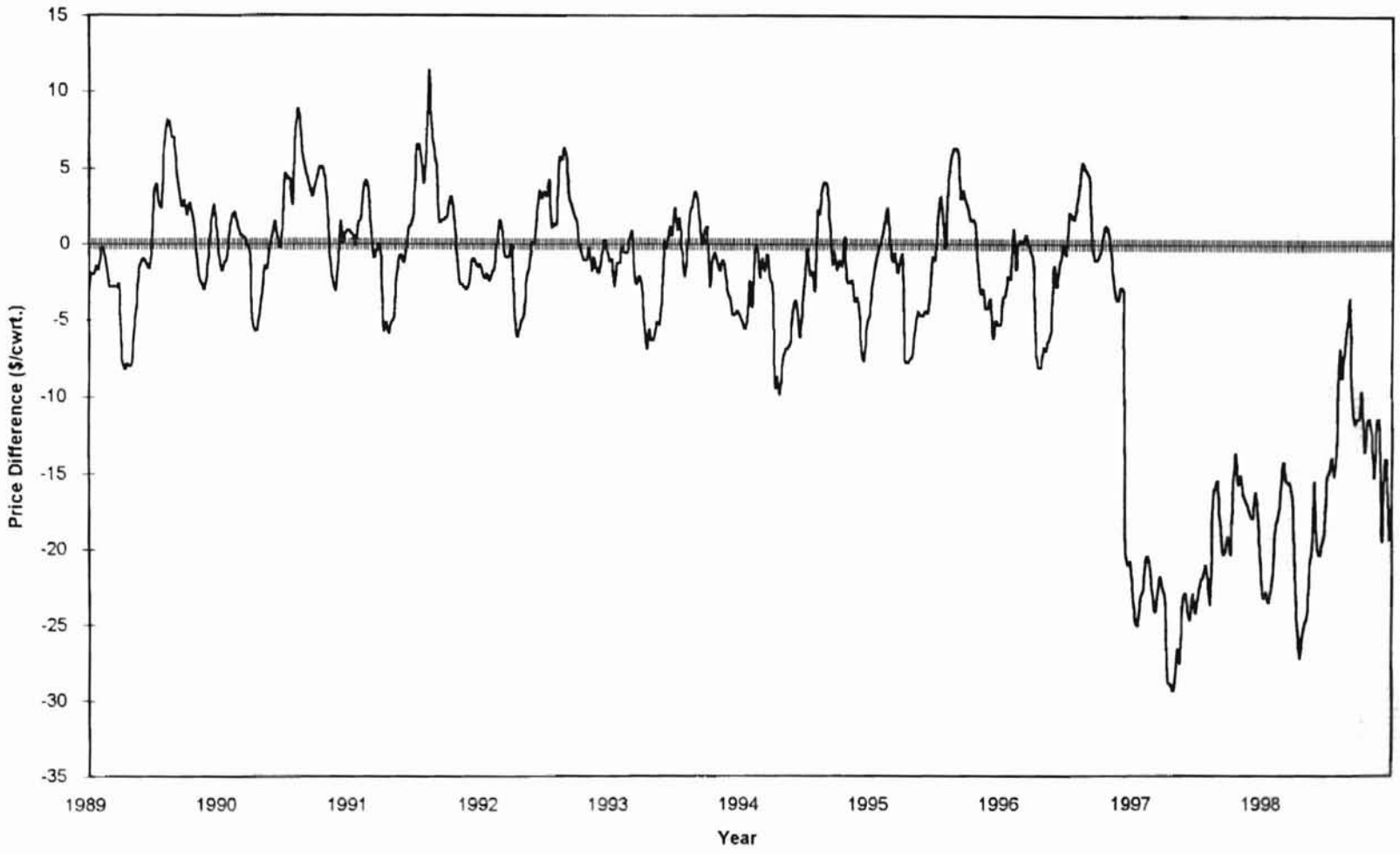
Appendix - Figure 7: Weekly Data Difference between Nebraska Fed Steers and Choice Box Beef Values, 1989-1998



Appendix - Figure 8: Weekly Data Differences between Nebraska Fed Steers and Nearby Live Cattle Futures Market Prices, 1989-1998



Appendix - Figure 9: Weekly Data Differences between Live Hogs and Pork Cutout Values, 1989-1998



Appendix - Figure 10: Weekly Data Differences between Live Hogs and Nearby Live Hog Futures Market Prices, 1989-1998

Appendix - Table 1: Regression Results for Models 1-2

Explanatory Variables	Estimated Coefficients: Nebraska Fed Steers as a function of Choice Box Beef Cutout	Estimated Coefficients: Nebraska Fed Steers as a function of Nearby Live Futures
Intercept	23.1160***[a]	31.2330***
	(4.186)[b]	(5.852)
Box	0.4753***	N/A
	(10.860)	N/A
Fut	N/A	0.6452***
	N/A	(9.629)
Trend	-0.0413***	-0.0186
	(-2.940)	(-0.770)
January	-1.6433**	-3.7415***
	(-2.265)	(-5.148)
February	-0.8191	-3.8346***
	(-1.277)	(-5.920)
March	0.1229	-2.6504***
	(0.2482)	(-5.040)
April	Base	Base
May	-2.7864***	-1.8102***
	(-5.637)	(-3.861)
June	-4.3679***	-3.8754***
	(-6.826)	(-6.138)
July	-3.1668***	-4.6168***
	(-4.331)	(-6.501)
August	-3.0941***	-4.6168***
	(-4.023)	(-6.501)
September	-2.0631***	-5.2062***
	(-2.559)	(-6.772)
October	-1.6528**	-4.0584***
	(-2.070)	(-4.990)
November	-1.5814**	-3.0273***

Appendix - Table 1: Regression Results for Models 1-2 (Continued)

	(-2.022)	(-3.754)
December	-1.5998**	-2.9203***
	(-2.094)	(-3.790)
Observations	120	120
Adjusted R^2	0.9416	0.9433

[a] Significance levels are donated as follows:
*** significant @ the 1% level of significance,
** significant @ the 5% level of significance,
and * significant @ the 10% level of significance.

[b] Figures presented in parenthesis are the calculated t-ratio for each coefficient

Appendix - Table 2: Regression Results for Models 3-4 (Continued)

Explanatory Variables	Estimated Coefficients Live hogs as a function of pork cutout values	Live hogs as a function of live futures market prices
Intercept	-8.1814***[a]	2.5981
	(-5.517)[b]	(1.167)
Cutout	0.8931***	N/A
	(39.720)	N/A
HFUT	N/A	0.8376***
	N/A	(23.22)
Trend	-0.0255***	-0.0259*
	(-3.864)	(-1.750)
January	0.11656	3.8799***
	(0.2384)	(5.037)
February	0.1280	6.0931***
	(0.293)	(8.796)
March	-0.2637	4.8746***
	(-0.750)	(9.015)
April	Base	Base
May	-0.1004	3.7326***
	(-0.272)	(7.633)
June	0.1503	6.2704***
	(0.328)	(9.939)
July	-0.1006	8.7802***
	(0.2015)	(12.210)
August	-0.9021*	11.7280***
	(-1.751)	(14.450)
September	-1.4564***	7.8823***
	(-2.848)	(9.553)
October	-1.7203***	7.1168***
	(-3.358)	(8.480)
November	-2.7955***	4.0314***

Appendix - Table 2: Regression Results for Models 3-4 (Continued)

	(-5.487)	(7.762)
December	-1.7209***	3.8039***
	(-3.431)	(4.639)
Dummy for Change in Market	-2.9004***	-14.496***
	(-4.262)	(-11.630)
Observations	120	120
Adjusted R^2	0.9848	0.9681

[a] Significance levels are donated as follows:
*** significant @ the 1% level of significance,
** significant @ the 5% level of significance,
and * significant @ the 10% level of significance.

[b] Figures presented in parenthesis are the calculated t-ratio for each coefficient.

[c] The wholesale market experienced a change in price reporting and the futures market experienced a change in the contract

Appendix - Table 3: Regression Results of Moving Ratios for Nebraska Fed Steers to Choice Box Beef 700-800 Lbs.

	Estimated Coefficients				
	Beef : Live to Wholesale				
Explanatory Variables	89-93	90-94	91-95	92-96	93-97
Intercept	0.6511***[a]	0.6527***	0.6526***	0.6492***	0.6511***
	(130.800)[b]	(133.100)	(96.530)	(88.490)	(94.610)
January	0.0019	0.0012	-0.0025	-0.0036	-.0027
	(0.307)	(0.211)	(-0.360)	(-0.460)	(-0.322)
February	0.0036	0.0018	0.0019	0.0036	0.0101
	(0.690)	(0.369)	(0.328)	(0.547)	(1.412)
March	0.0081**	0.0048	0.0037	0.0074	0.0060
	(1.991)	(1.308)	(0.823)	(1.468)	(1.071)
April	Base	Base	Base	Base	Base
May	-0.0191***	-0.0195***	-0.0223***	-0.0223***	-0.0252***
	(-4.705)	(-5.315)	(-4.990)	(-4.424)	(-4.528)
June	-0.0227***	-0.0245***	-0.0318***	-0.0297***	-0.0308***
	(-4.355)	(-5.114)	(-5.402)	(-4.486)	(-4.294)
July	-0.0104*	-0.0102*	-0.0177***	-0.0134*	-.0174**

Appendix - Table 3: Regression Results of Moving Ratios for Nebraska Fed Steers to Choice Box Beef 700-800 Lbs. (Continued)

	(-1.783)	(-1.888)	(-2.637)	(-1.774)	(-2.164)
August	-0.0126**	-0.0159***	-0.0219***	-0.0090	-0.0152*
	(-2.029)	(-2.750)	(-3.021)	(-1.112)	(-1.772)
September	-0.0028	-0.0017	-0.0085	0.0041	-0.0005
	(-0.444)	(-0.284)	(-1.121)	(0.481)	(-0.053)
October	0.0033	.0029	-0.0041	0.0041	-.0004
	(0.504)	(0.482)	(-0.538)	(0.484)	(-0.049)
November	0.0027	0.0011	0.0017	-0.0012	-0.0074
	(0.413)	(0.187)	(0.229)	(-0.143)	(-0.836)
December	-0.0010	-0.0020	-0.0020	0.0003	-.0030
	(-0.157)	(-0.336)	(-0.2698)	(0.038)	(-0.351)
N	60	60	60	60	60
Adjusted R^2	0.5768	0.6562	0.6902	0.6404	0.5847

[a] Significance levels are denoted as follows: *** significant @ the 1% level of significance,
** significant @ the 5% level of significance, and
*significant @ the 10% level of significance.

[b] Figures presented in parenthesis are the calculated t-ratio for each coefficient.

Appendix - Table 4: Regression Results of Moving Ratios for Nebraska Fed Steers to Live Cattle Futures Market Prices

	Estimated Coefficients				
	Beef: Live to Futures				
Explanatory Variables	89-93	90-94	91-95	92-96	93-97
Intercept	1.0716***[a]	1.0621***	1.0598***	1.0489***	1.0462***
	(116.400)[b]	(107.200)	(131.000)	(90.320)	(95.390)
January	-0.0686***	-0.0552***	-0.0643***	-0.0526***	-0.0584***
	(-6.192)	(-4.900)	(-6.402)	(3.930)	(-4.496)
February	-0.0691***	-0.0611***	-0.0638***	-0.0548***	-0.0600***
	(-7.239)	(-6.333)	(-7.331)	(-4.778)	(-5.372)
March	-0.0653***	-0.0593***	-0.0606***	-0.0497***	-0.0524***
	(-8.799)	(-7.977)	(-8.885)	(-5.624)	(-6.049)
April	Base	Base	Base	Base	Base
May	-0.0186**	-0.0160**	-0.0139**	-0.0095	-0.0130
	(-2.509)	(-2.149)	(-2.040)	(-1.076)	(-1.501)
June	-0.0375***	-0.0367***	-0.0345***	-0.0393***	-0.0464***
	(-3.915)	(-3.795)	(-3.946)	(-3.413)	(-4.140)
July	-0.0745***	-0.0675***	-0.0691***	-0.0644***	-0.0653***
	(-6.934)	(-6.161)	(-7.098)	(-4.958)	(-5.181)

Appendix - Table 4: Regression Results of Moving Ratios for Nebraska Fed Steers to Live Cattle Futures Market Prices (Continued)

August	-0.0941***	-0.0877***	-0.0897***	-0.0745***	-0.0818***
	(-8.249)	(-7.492)	(-8.713)	(-5.369)	(-6.091)
September	-0.0960***	-0.0850***	-0.0839***	-0.0672***	-0.0688***
	(-8.151)	(-7.013)	(-7.919)	(-4.680)	(-4.961)
October	-0.0856***	-0.0728***	-0.0857***	-0.0467***	-0.0482***
	(-7.190)	(-5.930)	(-8.013)	(-3.213)	(-3.434)
November	-0.0725***	-0.0581***	-0.0630***	-0.0343**	-0.0336**
	(-6.122)	(-4.759)	(-5.920)	(-2.377)	(-2.412)
December	-0.0590***	-0.0497***	-0.0650***	-0.0395***	-0.0468***
	(-5.119)	(-4.193)	(-6.260)	(-2.813)	(-3.451)
N	60	60	60	60	60
Adjusted R^2	0.7631	0.7396	0.7780	0.6276	0.6425

[a] Significance levels are denoted as follows: *** significant @ the 1% level of significance,
** significant @ the 5% level of significance, and
* significant @ the 10% level of significance.

[b] Figures presented in parenthesis are the calculated t-ratio for each coefficient.

Appendix - Table 5: Regression Results of Moving Ratios for Live Hogs to Pork Cutout Values

	Estimated Coefficients				
	Pork: Live to Wholesale				
Explanatory Variables	89-93	90-94	91-95	92-96	93-97
Intercept	0.7420***[a]	0.7324***	0.7386***	0.7365***	0.7304***
	(135.500)[b]	(31.960)	(56.060)	(53.850)	(54.960)
January	0.0010	-0.0173	-0.0074	-0.0024	-0.0050
	(0.137)	(-1.613))	(-0.570)	(-0.180)	(-0.350)
February	0.0026	0.0012	0.0068	0.0054	0.0016
	(0.3969)	(0.138)	(0.620)	(0.481)	(0.129)
March	-0.0012	-0.0005	0.0032	0.0028	-0.0035
	(-0.232)	(-0.076)	(0.381)	(0.326)	(-0.380)
April	Base	Base	Base	Base	Base
May	0.0108**	0.0096	0.0034	0.0050	0.0078
	(2.048)	(1.438)	(0.411)	(0.578)	(0.832)
June	0.0091	0.0105	0.0094	0.0133	0.0165
	(1.388)	(1.167)	(0.853)	(1.172)	(1.343)
July	0.0074	0.0094	0.0120	0.0124	0.0186
	(1.035)	(0.901)	(0.948)	(0.950)	(1.332)

Appendix - Table 5: Regression Results of Moving Ratios for Live Hogs to Pork Cutout Values (Continued)

August	-0.0032	-0.0020	-.0000	0.0023	0.0021
	(-0.4247)	(-0.178)	(-0.004)	(0.163)	(0.140)
September	-0.0153**	-0.0146	-0.0125	-0.0108	-0.0086
	(-2.015)	(-1.213)	(-0.881)	(-0.740)	(-0.555)
October	-0.0179**	-0.0263**	-0.0365**	-0.0290**	-0.0275*
	(-2.345)	(-2.149)	(-2.524)	(-1.956)	(-1.745)
November	-0.0344***	-0.0544***	-0.0590***	-0.0580***	-0.0545***
	(-4.524)	(-4.483)	(-4.115)	(-3.447)	(-3.485)
December	-0.0201***	-0.0349***	-0.0363***	-0.0302**	-0.0401***
	(-2.685)	(-2.982)	(-2.614)	(-2.119)	(-2.644)
N	60	60	60	60	60
Adjusted R^2	0.5960	0.7894	0.7058	0.6640	0.6515

[a] Significance levels are denoted as follows: *** significant @ the 1% level of significance,
** significant @ the 5% level of significance, and
* significant @ the 10% level of significance.

[b] Figures presented in parenthesis are the calculated t-ratio for each coefficient.

Appendix - Table 6: Regression Results of Moving Ratios for Live Hogs to Live Hog Futures Market Prices

	Estimated Coefficients				
	Pork: Live to Futures				
Explanatory Variables	89-93	90-94	91-95	92-96	93-97
Intercept	0.8821***[a]	0.8763***	0.8659***	0.8599***	0.8602***
	(59.970)[b]	(43.68)	(52.370)	(60.84)	(61.580)
January	0.0802***	0.0679***	0.0878***	0.0937***	0.0873***
	(4.220)	(3.306)	(4.113)	(4.895)	(4.505)
February	0.1264***	0.1262***	0.1458***	0.1401***	0.1271***
	(7.612)	(7.241)	(7.822)	(8.366)	(7.300)
March	0.0873***	0.0913***	0.1046***	0.1128***	0.1004***
	(6.625)	(6.884)	(7.067)	(8.360)	(6.897)
April	Base	Base	Base	Base	Base
May	0.0671***	0.0618***	0.0587***	0.0573***	0.0520***
	(5.088)	(4.656)	(3.967)	(4.244)	(3.570)
June	0.1357***	0.1248***	0.1269***	0.1261***	0.1031***
	(8.150)	(7.131)	(6.788)	(7.523)	(5.915)
July	0.1824***	0.1644***	0.1706***	0.1621***	0.1455***
	(9.920)	(8.220)	(8.263)	(8.865)	(7.856)

Appendix - Table 6: Regression Results of Moving Ratios for Live Hogs to Live Hog Futures Market Prices (Continued)

August	0.2581***	0.2430***	0.2542***	0.2437***	0.2159***
	(13.370)	(11.290)	(11.720)	(12.800)	(11.380)
September	0.1694***	0.1560***	0.1658***	0.1619***	0.1421***
	(8.569)	(6.962)	(7.467)	(8.346)	(7.421)
October	0.1333***	0.1264***	0.1218***	0.1229***	0.1241***
	(6.689)	(5.559)	(5.437)	(6.298)	(6.460)
November	.0681***	0.0646***	0.0666***	0.0723***	0.0715***
	(3.432)	(2.862)	(2.987)	(3.719)	(3.731)
December	0.0958***	0.0684***	0.0546**	0.0454**	0.0406**
	(4.930)	(3.131)	(2.503)	(2.283)	(2.113)
Dummy for Contract Change	N/A	N/A	N/A	-0.1899***	-0.2418***
				(-6.410)	(-16.860)
N	60	60	60	60	60
Adjusted R^2	0.8283	0.8162	0.8058	0.8482	0.9367

[a] Significance levels are denoted as follows: *** significant @ the 1% level of significance,
** significant @ the 5% level of significance, and
* significant @ the 10% level of significance.

[b] Figures presented in parenthesis are the calculated t-ratio for each coefficient.

Appendix - Table 7: Forecast Results of Ratios from Nebraska Fed Steers to Choice Box Beef

	1994			1995			1996		
Variables	Estimated Monthly Ratio	Actual Monthly Ratio	Difference	Estimated Monthly Ratio	Actual Monthly Ratio	Difference	Estimated Monthly Ratio	Actual Monthly Ratio	Difference
January	0.6529	0.6618	-0.0089	0.6539	0.6469	0.0070	0.6501	0.6400	0.0101
February	0.6547	0.6611	-0.0065	0.6545	0.6651	-0.0107	0.6545	0.6413	0.0132
March	0.6591	0.6650	-0.0058	0.6575	0.6547	0.0028	0.6562	0.6530	0.0033
April	0.6511	0.6650	-0.0139	0.6527	0.6540	-0.0013	0.6526	0.6268	0.0258
May	0.6320	0.6401	-0.0081	0.6332	0.6127	0.0205	0.6303	0.6161	0.0142
June	0.6284	0.6249	0.0035	0.6282	0.5936	0.0346	0.6208	0.6112	0.00957
July	0.6406	0.6417	-0.0011	0.6425	0.6056	0.0368	0.6348	0.6333	0.0016
August	0.6385	0.6393	-0.0008	0.6368	0.6085	0.0283	0.6307	0.6497	-0.0190
September	0.6482	0.6549	-0.0067	0.6510	0.6136	0.0374	0.6441	0.6796	-0.0355
October	0.6543	0.6634	-0.0091	0.6556	0.6045	0.0511	0.6485	0.6633	-0.0148
November	0.6537	0.6597	-0.0060	0.6538	0.6369	0.0169	0.6543	0.6177	0.0366
December	0.6501	0.6591	-0.0090	0.6507	0.6344	0.0163	0.6506	0.6277	0.0229
Mean	0.6470	0.6530	-0.0060	0.6475	0.6275	0.0200	0.6440	0.6383	0.0057
Standard Deviation	0.0098	0.0131	0.0046	0.0098	0.0239	0.0184	0.0118	0.0205	0.0204

Appendix - Table 7: Forecast Results of Ratios from Nebraska Fed Steers to Choice Box Beef (Continued)

	1997			1998		
Variables	Estimated Monthly Ratio	Actual Monthly Ratio	Difference	Estimated Monthly Ratio	Actual Monthly Ratio	Difference
January	0.6456	0.6474	-0.0018	0.6484	0.6409	0.0075
February	0.6528	0.6800	-0.0272	0.6612	0.6478	0.0134
March	0.6566	0.6524	0.0042	0.6571	0.6567	0.0004
April	0.6492	0.6631	-0.0139	0.6511	0.6605	-0.0095
May	0.6269	0.6308	-0.0039	0.6258	0.6390	-0.0132
June	0.6195	0.6275	-0.0080	0.6203	0.6346	-0.0143
July	0.6358	0.6334	0.0024	0.6337	0.5996	0.0341
August	0.6402	0.6307	0.0094	0.6359	0.5784	0.0576
September	0.6532	0.6480	0.0052	0.6506	0.6075	0.0431
October	0.6533	0.6538	-0.0005	0.6507	0.6114	0.0393
November	0.6480	0.6447	0.0032	0.6437	0.6187	0.0249
December	0.6495	0.6464	0.0031	0.6481	0.6196	0.0284
Mean	0.6442	0.6465	-0.0023	0.6439	0.6262	0.0176
Standard Deviation	0.0115	0.0151	0.0101	0.0125	0.0247	0.0239

Appendix - Table 8: Forecast Results of Ratios for Nebraska Fed Cattle to Live Cattle Futures Market Prices

	1994			1995			1996		
Variables	Estimated Monthly Ratio	Actual Monthly Ratio	Difference	Estimated Monthly Ratio	Actual Monthly Ratio	Difference	Estimated Monthly Ratio	Actual Monthly Ratio	Difference
January	1.0030	0.9872	0.0159	1.0069	0.9821	0.0248	0.9955	0.9786	0.0169
February	1.0025	0.9708	0.0318	1.0010	0.9913	0.0097	0.9960	0.9768	0.0192
March	1.0063	0.9864	0.0198	1.0028	1.0001	0.0028	0.9992	0.9813	0.0178
April	1.0716	1.0390	0.0326	1.0621	1.0731	-0.0111	1.0598	0.9872	0.0726
May	1.0530	1.0352	0.0178	1.0461	1.0529	-0.0068	1.0459	0.9981	0.0478
June	1.0341	0.9927	0.0414	1.0254	1.0362	-0.0108	1.0253	0.9406	0.0848
July	0.9971	0.9731	0.0240	0.9946	0.9872	0.0074	0.9907	0.9571	0.0336
August	0.9775	0.9457	0.0318	0.9744	0.9738	0.0005	0.9701	0.9477	0.0224
September	0.9756	0.9583	0.0174	0.9771	0.9821	-0.0051	0.9759	0.9789	-0.0030
October	0.9860	0.9670	0.0190	0.9893	0.9595	0.0297	0.9741	1.0738	-0.0997
November	0.9991	1.0023	-0.0032	1.0040	0.9964	0.0077	0.9968	1.0621	-0.0653
December	1.0126	0.9906	0.0220	1.0124	0.9796	0.0328	0.9948	1.0488	-0.0540
Mean	1.0099	0.9874	0.0225	1.0080	1.0012	0.0068	1.0020	0.9942	0.0078
Standard Deviation	0.0293	0.0281	0.0113	0.0260	0.0345	0.0152	0.0279	0.0040	0.0554

Appendix - Table 8: Forecast Results of Ratios for Nebraska Fed Cattle to Live Cattle Futures Market Prices (Continued)

	1997			1998		
Variables	Estimated Monthly Ratio	Actual Monthly Ratio	Difference	Estimated Monthly Ratio	Actual Monthly Ratio	Difference
January	0.9963	1.0015	-0.0051	0.9878	0.9663	0.0215
February	0.9941	0.9906	0.0035	0.9862	0.9246	0.0616
March	0.9992	0.9945	0.0046	0.9938	0.9491	0.0447
April	1.0489	1.0586	-0.00973	1.0462	0.9584	0.08782
May	1.0394	1.0218	0.0176	1.0332	0.9710	0.0622
June	1.0096	0.9976	0.0121	0.9998	0.9629	0.0369
July	0.9845	0.9841	0.0004	0.9809	0.9619	0.0190
August	0.9744	0.9535	0.0209	0.9644	0.9797	-0.0153
September	0.9817	0.9749	0.0068	0.9774	0.9640	0.0134
October	1.0022	1.0050	-0.0028	0.9980	0.9572	0.0409
November	1.0146	0.9964	0.0181	1.0126	0.9873	0.0252
December	1.0094	0.9758	0.0336	0.9994	1.0122	-0.0129
Mean	1.0045	0.9962	0.0083	0.9983	0.9662	0.0521
Standard Deviation	0.0022	0.02616	0.0125	0.0231	0.0213	0.0303

Appendix - Table 9: Forecast Results of Ratios for Live Hogs to Pork Cutout Values

	1994			1995			1996		
Variables	Estimated Monthly Ratio	Actual Monthly Ratio	Difference	Estimated Monthly Ratio	Actual Monthly Ratio	Difference	Estimated Monthly Ratio	Actual Monthly Ratio	Difference
January	0.7502	0.7188	0.0314	0.7151	0.7107	0.0043	0.7312	0.7293	0.0019
February	0.7517	0.7602	-0.0084	0.7336	0.7056	0.0281	0.7454	0.7254	0.0220
March	0.7479	0.7469	0.0011	0.7319	0.7042	0.0277	0.7418	0 7348	0.0070
April	0.7492	0.7219	0.02728	0.7324	0.7027	0.0297	0.7386	0.7467	-0.0081
May	0.7600	0.7398	0.0201	0.7420	0.7004	0.0417	0.7420	0.7548	-0.0128
June	0.7583	0.7476	0.0107	0.7429	0.7201	0.0228	0.7480	0.7604	-0.0124
July	0.7566	0.7424	0.0141	0.7418	0.7484	-0.0065	0.7506	0.7507	-0.0002
August	0.7460	0.7290	0.0169	0.7304	0.7327	-0.0024	0.7385	0.7467	-0.0081
September	0.7339	0.6802	0.0536	0.7179	0.7325	-0.0146	0.7260	0.7323	-0.0063
October	0.7312	0.6369	0.0943	0.7061	0.6842	0.0219	0.7021	0.7380	-0.0358
November	0.7147	0.5697	0.1450	0.6780	0.6726	0.0054	0.6796	0.7208	-0.0412
December	0.7291	0.6069	0.1222	0.6975	0.7111	-0.0136	0.7023	0.7396	-0.0373
Mean	0.7441	0.7000	0.0440	0.7225	0.7104	0.0120	0.7288	0.7400	-0.0111
Standard Deviation	0.0138	0.0626	0.0498	0.0202	0.0210	0.0189	0.0224	0.0122	0.0187

Appendix - Table 9: Forecast Results of Ratios for Live Hogs to Pork Cutout Values (Continued)

	1997			1998		
Variables	Estimated Monthly Ratio	Actual Monthly Ratio	Difference	Estimated Monthly Ratio	Actual Monthly Ratio	Difference
January	0.7340	0.7564	-0.0224	0.7273	0.6427	0.0847
February	0.7419	0.7374	0.0044	0.7333	0.6509	0.0824
March	0.7392	0.7040	0.0352	0.7279	0.6356	0.0922
April	0.7365	0.7450	-0.0086	0.7167	0.6292	0.0875
May	0.7414	0.7546	-0.0132	0.7387	0.6474	0.0913
June	0.7497	0.7611	-0.0114	0.7472	0.6809	0.0663
July	0.7488	0.7531	-0.0043	0.7492	0.6408	0.1084
August	0.7387	0.7176	0.0211	0.7326	0.6339	0.0987
September	0.7256	0.7113	0.0144	0.7218	0.5752	0.1466
October	0.7074	0.7115	-0.0041	0.7029	0.5835	0.1194
November	0.6857	0.6809	0.0048	0.6787	0.4238	0.2549
December	0.7062	0.6519	0.0544	0.6930	0.3797	0.3133
Mean	0.7296	0.7237	0.0059	0.7225	0.5936	0.1288
Standard Deviation	0.0198	0.0339	0.0221	0.0215	0.0944	0.0763

Appendix - Table 10: Forecast Results of Ratios for Live Hogs to Live Hog Futures Market Prices

	1994			1995			1996		
Variables	Estimated Monthly Ratio	Actual Monthly Ratio	Difference	Estimated Monthly Ratio	Actual Monthly Ratio	Difference	Estimated Monthly Ratio	Actual Monthly Ratio	Difference
January	0.9623	0.9076	0.0548	0.9442	0.9762	-0.0319	0.9537	0.9551	-0.0014
February	1.0085	0.9804	0.0281	1.0025	1.0208	-0.0183	1.0117	0.9930	0.0187
March	0.9694	0.9599	0.0096	0.9676	0.9722	-0.0046	0.9705	0.9941	-0.0236
April	0.8821	0.8272	0.0549	0.8763	0.8270	0.0493	0.8659	0.8710	-0.0051
May	0.9492	0.8836	0.0656	0.9381	0.8878	0.0504	0.9246	0.9251	-0.0005
June	1.0178	0.9115	0.1063	1.0011	0.9497	0.0515	0.9928	0.9861	0.0067
July	1.0645	0.9773	0.0871	1.0407	1.0419	-0.0012	1.0365	1.0418	-0.0053
August	1.1401	1.0856	0.0545	1.1194	1.1367	-0.0173	1.1201	1.0893	0.0308
September	1.0515	0.9836	0.0679	1.0323	1.0634	-0.0312	1.0317	0.9887	0.0431
October	1.0154	0.9585	0.0569	1.0027	0.9980	0.0048	0.9877	1.0014	-0.0137
November	0.9502	0.8893	0.0608	0.9409	0.9150	0.0260	0.9325	0.9430	-0.0105
December	0.9779	0.8337	0.1442	0.9448	0.8900	0.0548	0.9205	0.7213	0.1992
Mean	0.9991	0.9332	0.0659	0.9842	0.9732	0.0110	0.9790	0.9591	0.0199
Standard Deviation	0.0667	0.0726	0.0348	0.0631	0.0863	0.0337	0.0670	0.0931	0.0596

Appendix - Table 11: Forecast Results of Ratios for Live Hogs to Live Hog Futures Market Prices (Continued)

	1997			1998		
Variables	Estimated Monthly Ratio	Actual Monthly Ratio	Difference	Estimated Monthly Ratio	Actual Monthly Ratio	Difference
January	0.9536	0.6977	0.2559	0.9475	0.6189	0.3286
February	1.0001	0.6982	0.3019	0.9873	0.6822	0.3051
March	0.9728	0.6814	0.2914	0.9606	0.6607	0.3000
April	0.6701	0.6494	0.0207	0.6184	0.5700	0.0484
May	0.9172	0.6986	0.2186	0.9122	0.6720	0.2401
June	0.9860	0.7083	0.2777	0.9633	0.6932	0.2700
July	1.0220	0.7269	0.2951	1.0057	0.7396	0.2660
August	1.1036	0.7672	0.3364	1.0761	0.8480	0.2282
September	1.0218	0.7162	0.3056	1.0023	0.7231	0.2792
October	0.9828	0.7517	0.2311	0.9843	0.6985	0.2858
November	0.9322	0.7194	0.2128	0.9317	0.5505	0.3812
December	0.9053	0.6736	0.2317	0.9008	0.4538	0.4470
Mean	0.7816	0.7074	0.0742	0.7192	0.6592	0.0600
Standard Deviation	0.0642	0.0325	0.0427	0.0567	0.1014	0.0607

VITA

Jennifer Erin Butcher

Candidate for the Degree of

Master of Science

Thesis: ALTERNATIVE BASE PRICES IN FORMULA PRICING FOR THE FED CATTLE AND SLAUGHTER HOG INDUSTRIES

Major Field: Agricultural Economics

Biographical:

Personal Data: Born in Stillwater, Oklahoma on July 26, 1976, the daughter of Fred and Linda Butcher.

Education: Graduated from Yale High School in May 1994; received Associate in Arts degree from Northeastern Oklahoma A & M College in Miami, Oklahoma in May 1996; received Bachelor of Science degree in Agricultural Economics from Oklahoma State University, Stillwater, Oklahoma in May 1998. Completed the requirements for the Master of Science degree with a major in Agricultural Economics at Oklahoma State University in May 2000.

Experience: Raised in an agricultural setting in rural Yale, Oklahoma; employed as a salesperson for the Student Union Bookstore at Oklahoma State University as an undergraduate; employed as an information processing assistant at the Student Union Bookstore at Oklahoma State University 1998-1999; employed as a graduate research assistant at Oklahoma State University, Department of Agricultural Economics, 1999-2000.