IMPROVING MONTHLY FED CATTLE PRICE FORECASTS WITH INFORMATION ON MARKET-READY INVENTORIES

By

KENDALL LEE MCDANIEL

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Thesis Approved:

Stephen R. Koontz
Thesis Advisor

James N. Trapp

Wade Brorsen

Thomas C. Collins
Dean of the Graduate College

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CHAPTER 1

INTRODUCTION

1.1 The U.S. Cattle Industry and Usefulness of Price Forecasts

The cattle industry is an important part of the agricultural sector of the U.S. economy. The value of cattle and calf production in 1992 was $29.1 billion. Receipts from marketing agricultural commodities in the U.S. during the same time was over $171 billion. The receipts from marketing cattle and calves was $38 billion (U.S. Statistical Abstracts 1994). Efficient operation of the fed cattle market is important to the agricultural sector of the U.S. economy.

Improving fed cattle price forecasts should improve efficiency in the fed cattle market. Prices coordinate producer decisions in the cattle industry. Producers make decisions concerning production, marketing, hedging and financial planning based on price forecasts. The payoff to a firm from making an accurate forecast can be large if there is time to alter production decisions (Tomek and Robinson). Accurate price forecasts help reduce costs associated with variable production and variable use of marketing facilities. However, good management decisions can result in bad outcomes due to planning based on inaccurate price forecasts.

Untimely or inadequate information in public situation and outlook reports may lead to inaccurate price forecasts. Past research has dealt with various forecasting techniques (Zapata and Garcia; Garcia *et al.*; Bessler and Brandt; Harris and Leuthold). However, past research does not identify the effect of inadequate or untimely public data reports on price forecasts. Any information in public situation and outlook reports that reduces forecast errors is valuable to producers (Irwin). Public information on feedlot inventories is important to the cattle industry. In order to improve fed cattle price forecasts, accurate and timely information on feedlot inventories should be publicly available.

Trapp showed that tracking feedlot inventories can help forecast short-run fed cattle supply. Feedlot operators can hold cattle for three or four weeks to take advantage of high expected future prices. The cattle held are market-ready inventories. Bacon *et al.* showed that market-ready inventories and fed cattle prices were correlated using private data, public data, and data from an experimental fed cattle market. The USDA seven state *Cattle On Feed* report is widely used in the cattle industry, but it does not contain information on market-ready inventories. Information on market-ready inventories should improve fed cattle price forecasts. Improved fed cattle price forecasts should allow producers to make decisions that improve fed cattle market efficiency.

Improving fed cattle price forecasts may help the industry avoid scenarios which result in large unexpected price decreases. If many feedlots decide to hold cattle, future cattle numbers and weight increase causing future prices to decrease even when increased prices were expected. An example of the problems caused by not accounting for large market-ready inventories occurred during the summer of 1994. During the first quarter of 1994, cattle outlook publications predicted the second and third quarter choice fed cattle prices to be $71 to $77 per hundredweight (USDA Livestock, Dairy, and Poultry Situation and Outlook; Western Livestock Round Up). However, actual prices were $60 to $68 per hundredweight during the months of May, June and July. Feedlots during May and June of 1994 on average lost $150 per head (Western Livestock Round Up). Outlook publications recognized large numbers of cattle on feed, but they did not account for feedlots holding large market-ready inventories. Feedlot operators held large market-ready inventories in expectation of higher future fed cattle prices. Market-ready inventories were high in the spring before fed cattle prices fell during the summer. This indicates that feedlots were holding a large amount of cattle to be marketed in May, June and July. Information on market-ready inventories could have helped the industry realize price decreases were eminent. Thus, they could have stopped holding cattle and possibly avoided large unexpected price decreases.

Improving public information on market-ready inventories is important to the cattle industry. Information on market-ready inventories should help producers identify sources of market inefficiency, reduce forecast errors, make more informed decisions, and reduce the chance of large unexpected price decreases.

1.2 Hypotheses

The general hypothesis is that public information on market-ready inventories will increase market efficiency. This study maintains two specific hypotheses.

1. Information on market-ready inventories can be used to explain fed cattle prices.
2. Information on market-ready inventories can be used to improve fed cattle price forecasts.

1.3 Objectives

The general objective is to increase efficiency of the fed cattle market. There are two specific objectives.

1. Determine if information on market-ready inventories derived from public data can be used to explain fed cattle prices.
2. Determine if information on market-ready inventories derived from public data can be used to improve fed cattle price forecasts.

1.4 Contribution of this Research

By accomplishing the objectives and informing producers, feedlots, and packing plants, this research will identify areas for improved market efficiency. Conclusions regarding public information on feedlot inventories can be drawn. Accurate and timely public data reports help agricultural producers make more informed decisions, reduce forecast errors, and increase efficiency in the cattle markets. Increasing the understanding of market-ready inventories will reduce the possibility of behavior resulting in large unexpected fed cattle price decreases.

1.5 Outline of Thesis

Chapter 2 will summarize literature in the areas of current forecasting methods, fed cattle inventories, and information and efficiency. The methods used in this study will be compared to previous studies. Chapter 3 describes the theory used to derive the empirical models. Understanding the theory and procedures used will allow further research to be done. Chapter 4 presents the results of this study. The results indicate areas for improving market efficiency through improved public information. Chapter 5 will briefly summarize this study and draw conclusions from the results.

CHAPTER 2

FORECASTING, INVENTORY, INFORMATION AND EFFICIENCY

2.1 Introduction

This chapter summarizes previous literature concerning fed cattle price forecasting, fed cattle inventory, and information and efficiency. Section 2.2 summarizes past studies that forecasted fed cattle prices. Section 2.3 summarizes previous studies that view cattle as either a storable or nonstorable commodity. Section 2.4 summarizes literature on the value of information. Inadequate, untimely, or inaccurate public information causes market inefficiency. Section 2.5 will compare this study to past studies identifying how this study contributes to the body of literature.

2.2 Forecasting Fed Cattle Prices

Current methods used to forecast fed cattle prices range from simple time series models to elaborate econometric models. These models have been used to forecast fed cattle prices monthly and quarterly. The following studies compare various estimation and evaluation methods used in forecasting fed cattle prices.

Zapata and Garcia evaluated the forecasting performance of various multivariate and univariate time series models in the presence of nonstationarity. They forecasted average monthly slaughter steer prices from the Omaha market. The models were estimated using data from 1975 to 1983. Out-of-sample forecasts used prices from 1984 to 1985. The multivariate models used were vector autoregressive (VAR) with and without differenced data, Bayesian vector autoregressive (BVAR), and an error corrected model. The univariate model used was an autoregressive integrated moving average model (ARIMA(2,1,2)). The forecasting performance of the models was evaluated using the root mean square error and turning point criterion at forecast horizons of one-to-six months ahead. All of the models were updated monthly. When forecasts were evaluated by the RMSE criteria, the ARIMA model provided relatively accurate forecasts in the short run, but its performance deteriorated at longer horizons of three to six months. At longer forecast horizons, the VAR models were more accurate. According to turning point analysis, the VAR and BVAR models followed movements in slaughter steer prices closely. Accuracy of all models deteriorated significantly at longer forecast horizons. They concluded that except in the short-run, VAR and BVAR models provide more accurate forecasts than the simpler ARIMA specification. They state that appropriate model specification in the presence of nonstationarity, the stability of parameter estimates, and the use of Bayesian prior information are all important in forecasting, especially at longer forecast horizons.

Garcia et al. forecasted monthly fed cattle prices using econometric, ARIMA, and composite models that were updated monthly. The econometric model used was a recursive demand-supply model. The supply model used average price of slaughter steers (Omaha, Choice, 11-13 cwt.), average price of feeder steers (average of eight markets), price of corn, U.S. prime interest rate, and seasonal variables to explain U.S. cattle slaughter. The demand model used cattle slaughter, hog slaughter, broiler slaughter, income per capita, and seasonal variables to explain the price of slaughter steers. For forecasting purposes, a reduced-form equation was formulated by substituting the supply equation into the demand equation and expressing the price of cattle as a function of all of the previously mentioned variables. The econometric model was combined with an ARIMA(2,1,2) model to form a composite model. Out-of-sample forecasts were evaluated using the mean square error criteria. They also used the models in simulated trading to test semi-strong efficiency and assess the effectiveness of price discovery in the live cattle futures market. According to the MSE criteria, at least one model outperformed the futures market for the forecast horizon of one-to-six months. The composite model was slightly better at forecasting. However, the simple ARIMA model was within $3.00 per hundredweight of the composite model for one-to-three months ahead. Whenever simulated trading was used, large profits compared to their risks could not be generated. They also did not include the cost of building and updating the model to their simulated trading. They concluded that using MSE is not sufficient for evaluating futures market efficiency. Their results do indicate that MSE is good for evaluating alternative forecasting models.

Bessler and Brandt compared composite, ARIMA, and econometric model forecasts using quarterly fed cattle, hog, and broiler prices. They hypothesized that combining expert opinions with ARIMA or econometric models could improve forecasting performance. The econometric model used sow farrowings, cattle slaughter, chicken hatchings, and disposable income to explain cattle prices. Forecasts were evaluated using mean square error and turning point criterion. Results indicated that hog and cattle prices were forecasted best using an ARIMA model according to the mean square error criteria. The ARIMA and econometric models were joined to form composite models with different weighting measures. The composite models had smaller MSE when forecasting cattle prices. Expert opinions were included in the composite models and did not improve or hinder the composite model forecasts. Turning point analysis confirmed the results of the MSE criteria. Namely that composite models performed better and avoided large forecast errors. In concluding, the authors suggest combining expert opinions with ARIMA or econometric models to improve the overall quality of a set of forecasts.

Harris and Leuthold used five alternative econometric and time series models to forecast quarterly fed cattle and hog prices. The econometric model for cattle used broiler production, pork production, beef production, and disposable personal income to explain the average quarterly farm price of cattle (Omaha choice steers). An ARIMA model was also specified. The econometric and ARIMA models were combined to form a composite model. A multivariate model was also specified using beef production, pork production, broiler production, disposable income, and cattle price. Thus, the models used to forecast steer prices were an econometric model, an ARIMA model, a composite model, and a multivariate time series model. The data used was from 1961 to 1979 with the period 1961 to 1975 used for estimation, and the period 1975 to 1979 used for forecasting. Forecasts were evaluated using the root mean square error and turning point criterion. The purpose of their study was to examine the efficiency in forecasting gained by combining econometric and time series models. Their hypothesis was that the performance of econometric models can be improved by incorporating time series techniques without seriously complicating procedures. The time series models used were a multivariate ARMA and a univariate ARIMA model. The models were reestimated quarterly before forecasting. The results indicate that the ARMA performed best over every forecast interval. ARIMA was a close second according to RMSE criteria. However, turning point analysis indicated that the econometric and composite models performed better than the time series models on average. Their results did not strongly support their hypothesis that composite models forecast fed cattle prices better than econometric models. They suggested that the econometric model used may have been misspecified causing results to be different than expected. Thus, they concluded that the econometric models should be respecified and compared to the composite and time series models again.

There are two important things to observe from previous fed cattle price forecasting literature. First, all of these studies use Ashley, Granger, and Schmalensee mean square error approach and/or turning point analysis to evaluate forecasts. Second, the previous studies all use the simple time series models to forecast fed cattle prices. These models generally perform as well or better than more complicated econometric or composite forecasting techniques. Time series models are also useful as a base-line for comparing alternative models and for evaluating the pricing efficiency of the live cattle futures market. This study uses an autoregressive model and a transfer function to evaluate the usefulness of public data for montitoring feedlot inventories. Public information on market-ready inventories is used to explain and forecast monthly fed cattle prices. The models are not updated monthly. The models are derived by inserting the supply equation into the inverse demand equation similar to Garcia *et al*. The models presented in this study can be used in further research to evaluate futures market efficiency and as a base-line for comparison of future models. The results of this study provide evidence that the *Cattle On Feed* report should include additional information to help producers make more informed decisions. The primary focus is to follow traditional methods to develop a simple model.

2.3 Fed Cattle Inventory

Traditional literature views fed cattle as a non-storable commodity (Tomek and Gray; Leuthold). However, recent literature has suggested that if more information concerning feedlot inventories is included in public information, cattle can be viewed as a storable commodity in the short-run (Trapp; Bacon et al.). This section summarizes the results of studies based on each view in order to identify the advantages and disadvantages of each, and to develop the rationale for this study.

One traditional piece of literature that held the view that cattle are a non-storable commodity is Tomek and Gray. They define live cattle and fresh eggs as seasonally produced commodities with no inventory. Tomek and Gray did not specifically address cattle. However, Leuthold did use the methods of Tomek and Gray to evaluate the pricing efficiency of the live cattle market. Leuthold is summarized in the next paragraph. Tomek and Gray is summarized here to provide background into the traditional literature concerning futures market efficiency. Tomek and Gray identified two functions performed by futures markets. They were guidance of inventory levels and establishment of forward prices. Their goal was to clarify the relationship between the allocative and stabilizing role of futures prices. They used Maine potatoes to show the allocative role. Maine potatoes were defined as a seasonally produced commodity with discontinuous inventory. The stabilizing role was shown by corn and soybeans which are storable commodities. Results indicated that corn and soybean futures prices provide better forecasts than potato futures. Potato futures prices were strictly for forward pricing since there is no inventory in the ordinary sense. Corn and soybean futures prices were found to be for stabilizing revenue and guiding inventory. They state that eggs and live cattle are intermediate cases. Thus, the futures prices for eggs and live cattle have both an allocative and stabilizing role. They state that the gains in stability to a producer hedging program, while nominal for continuously stored commodities, may be substantial for other commodities. Thus, they recognize the influence of futures markets on commodities such as cattle. However, they do not analyze the exact influences for cattle. The question still remains of whether or not cattle can be held in the feedlot to stabilize producer revenue. Leuthold provided more insight.

Leuthold hypothesized that cash prices were a more accurate indicator of subsequent cash cattle conditions than futures prices for distant contracts. He says the advent of contracts on non-storable commodities has emphasized the forward pricing function of futures markets. Leuthold extends Tomek and Gray by analyzing a commodity where inventory changes in form, and production of the final product is continuous rather than once a year. Thus, he is analyzing the intermediate case of Tomek and Gray. Leuthold found that the futures market is more accurate the closer to maturity date. He compared the live cattle futures contract to the corn futures contract to see if cattle futures reflected subsequent spot prices efficiently. He found similar results with cattle and corn. He stated that one would not expect cash prices of non-storable commodities (cattle as he defined it) to indicate subsequent cash prices as accurately as futures prices, especially for distant contracts. He used mean square error to compare the cash and future prices. Results indicated that from about 15-to-36 weeks prior to delivery, one can expect a better estimate of the future cash price of cattle by looking at the present cash price than by studying futures prices. This was contrary to his theoretical expectations. He states that it appears futures prices for live cattle forecast subsequent spot prices as efficiently as do corn futures prices, despite the obvious differences between the two commodities with respect to production and inventory. The implications of his research were that producers looking at futures prices may receive misleading signals which causes inefficiency. Producers can receive better guidance by looking at cash prices. He concludes that the implication of futures prices not performing effectively 15 weeks prior to delivery may indicate that little hedging is done for longer than 4 months, which is the length of time cattle are in feedlots. Thus, hedges longer than 4 months may not stabilize revenue. He finds the results puzzling and states that they may be due to thin markets, excessive speculation, or problems with theory. He also thought that the market may be destabilizing and misdirecting resources. Finally, he states that the idea of cattle being non-storable might be irrelevant in the short-run, which is the opinion of this research and other recent studies.

One recent study holding the view that cattle can be considered a storable commodity in the short-run is Trapp. Trapp estimated placement weight, growth rate, and sex of cattle placed into feedlots using a growth and inventory simulation model. He hypothesized that estimating an aggregate physical data series for cattle on feed combined with a knowledge of the cattle growth process would provide information that would improve short-run fed-cattle supply forecasts. The estimated series of placement weight, growth rate, and sex was incorporated into a traditional econometric fed beef supply model. The result was improved forecasts of fed beef supplies in the short-run. The reason for improved forecasting ability is that placement weight and growth rate allows cattle on feed to be tracked until they are marketed. The sex variable captures the expansion in the cow herd. Another forecasting model was developed using proxy variables from the *Cattle On Feed* report. Results suggested that the estimated data series was useful for understanding the cattle market, and that short-run fed cattle supply forecasts were improved. He concluded that public data is lacking, and that inventory levels in cattle feedlots should be recognized. Since inventory affects the supply of fed cattle, prices are also affected by inventory. Bacon *et al.* provides more insight into the effects of feedlot inventories on fed cattle prices.

Bacon *et al.* defined a marketing window of four weeks where the endpoints identified the earliest and latest marketing date for an animal in the feedlot. The animals inside this window are market-ready inventories. Bacon *et al.* hypothesized that these inventories are a better measure of short-run fed cattle supply than slaughter levels. This hypothesis was tested by calculating correlations between fed cattle price and market-ready inventories, and between fed cattle price and slaughter levels using three data sources. The three data sources were a private data set from Professional Cattle Consultants (PCC), a public data set from the USDA *Cattle On Feed* and *Livestock, Meat, and Wool Market News* reports, and data obtained from an experimental fed cattle market (Koontz *et al.*). Market-ready inventories were estimated from past marketings using the public data. Correlations indicated that market-ready inventories and fed cattle prices were more strongly correlated than slaughter levels and fed cattle prices for the experimental and private data. When public data was employed, market-ready inventories and prices were correlated but not as strongly as slaughter levels and prices. The results suggest that market-ready inventories are a better measure of short-run fed cattle supply than slaughter levels, and that public data is lacking. They concluded that market-ready inventories buffer fed cattle prices. However, when cattle are marketed early (at the front end of marketing window) or late (at the back end of marketing window) inventory can significantly affect price. They also state that in order to do useful short-run beef market price forecasting timely, accurate, and publicly available data on market-ready inventories are necessary. Bacon *et al.* confirms the initial premise that market-ready inventories affect fed cattle prices, and public information is inadequate for measuring market-ready inventories.

Recent literature indicates that feedlot inventories affect fed cattle prices. This study will view cattle as a storable commodity for three or four weeks in the feedlot and will measure market-ready inventories using public data. Then, the measures of market-ready inventories are used to forecast fed cattle prices. If fed cattle price forecasts can be improved using information on market-ready inventories, fed cattle can be viewed as a storable commodity in the short-run. Then, further research into the effect of market-ready inventories on market efficiency can be done. If fed cattle price forecasts cannot be improved, more information concerning the number and weight of cattle held as market-ready inventories should be included in public data. If fed cattle continues to be viewed as a storable commodity even in the short-run, more research into the what causes prices to fall like the summer of 1994 should be done. Either way, producers need more information on feedlot inventories to form better price expectations.

2.4 Information and Efficiency

This section summarizes previous literature concerning information and efficiency. The literature identifies several aspects of public information that results in market inefficiencies. Some of these aspects are the accuracy, adequacy, timing, availability, cost, dispersion, and value of public information.

Hayek believed the problem of society was one concerning the utilization of knowledge. He stated that no one person has all available knowledge with which he/she can make a logical decision. The problem of lack of information causes misconceptions concerning economic policy. Since most research is done by assuming perfect information, the results are often misleading. Hayek argues research should focus on improving the information structure rather than advancing mathematical techniques used in analyzing problems. He recognizes that lack of information is only part of the problem. The questions of what types of information, and who should collect and disseminate information also arise. Should private firms be able to collect information and charge for its dispersement, or should public institutions collect it? Hayek also believes the common knowledge of day-to-day experience should not be overlooked. He states that individuals, when given information concerning problems they face daily, will make rational decisions. He realizes the need for economic theory and the research that is derived from the assumption of perfect knowledge. However, he states that results based on these theories and research should not be used to make serious policy decisions. Information should be given to the public to allow them to make decisions. In conclusion, he states the problem of the unavoidable imperfection of man's knowledge and the consequent need for a process by which knowledge is constantly communicated and acquired should be dealt with. Any approach, such as much of mathematical economics, which in effect starts from the assumption of perfect knowledge, ignores the primary problem.

Stigler stated that information is a valuable resource, knowledge is power, but it occupies a "slum dwelling" in economics. He systematically analyzes one important problem of information. The problem is its ascertainment of market price. Unless a market is completely centralized, no one knows all available prices. This leads to a search by the consumer for information concerning prices. He focuses on the nature and cost of searching for different prices. He states that price dispersion between firms is a manifestation, and a measure of ignorance in the markets. If price dispersion is large, it will pay a consumer to search for lower prices. He states that advertising is a powerful tool for eliminating ignorance in the market, but that each individual should be willing to search for lower prices. He concludes by saying that quality and form of information received is also a concern, but each individual should seek out information for himself/herself and determine its validity.

Demsetz addresses the problem of efficiently allocating resources to production of information. He says that free enterprise does not result in an ideal allocation of resources to the production of knowledge. The optimal allocation requires that government or other non-profit agencies should finance research and invention. He follows Arrow's research which calls attention to three problem areas in the production of knowledge and invention: risk aversion, indivisibilities, and inappropriablility. Demsetz states that risk reduction is an economic good. Therefore, institutional arrangements should be made to reduce risk. Indivisibility of information presents the problem of the public good. Any information obtained should be available free of charge except for the cost of transmitting the data. However, there will be "free loaders" that benefit but do not pay. The inappropriateness of public data leads to private firms specializing in information gathering and dissemination. However, these firms must be able to benefit. Thus, patent laws concerning information should be provided to avoid theft and ensure protection because once any information is known and/or used, it loses value. He concludes by saying we should survey and research to identify the types of information needed by the public. Then, we should provide an institution to fund research, experimentation, and disperse data which is appropriate, available to all people free except for cost of transmission, and increase the penalties for patent law violation to ensure the data is not obtained illegally.

Farris identifies emerging influences on the future of agricultural marketing research. He states that past research was concerned with fair dealing and marketing activities, and that future research will focus on market competition and the adequacy of public information. He states that relevant information bearing on many important marketing problems has always been inadequate and difficult to obtain. This is due to private data being unavailable, and public data lacking important things. New research methods and computer technology allows the user to generate relevant data, but the methods are often hard to understand by the general public. He states that communication and information are becoming increasingly important to an efficient functioning of an ever more highly specialized and interrelated economic system. The general state of knowledge, including education and skills of the population, may be one of the more significant components of the U.S. infrastructure. New theoretical developments, problems, methods, and data availability is very important. No less important is the question of who should collect the data, the public or private sector.

Green states that in the presence of options markets, such as the cattle market, an improved information structure is almost surely beneficial. He states the economic literature devoted to the problem of inadequate information structure is fragmentary. He first reviews what is known about the effect of improving the quality of public information in models of general economic equilibrium. Then, he considers a partial equilibrium model to study the relationship between the ordering of information structure and the value to economic agents. He says the value of improving the information structure in a general equilibrium system depends on two principle factors: the timing of markets compared with the timing of the informational structure, and the presence or absence of a complete system of futures markets for trade. When information is being released before and after decisions, some producers will benefit and others will not. He found that some information was better than none at all. He also found that any improvement in the informational structure is beneficial if it reduces the variance of prices. Thus, if information is provided that reduces the variance of price forecasts it is beneficial. He says that the presence of options markets in place of unconditional futures markets at each of the two trading dates reduces the benefits of improving the informational structure. Thus, the presence of options markets in the cattle market allows producers to protect themselves at a cost which partially offsets the consequences of inadequate information. However, not all producers use options in the cattle market.

Antonovitz and Roe used a theoretical and empirical approach to identifying the value of information in risky markets. They used the theory of the competitive firm to develop a money metric of a producer's willingness to pay for additional information under risk. This concept was extended to the market by formulating measures of the value of a rational expectations fed cattle price forecast using a two equation econometric model. The money metric measure was derived from the firm's risk averse supply and factor demand functions. Their results showed that producers are risk averse, the bimonthly mean value of information to a typical producers varies from a deflated 12 cents per hundredweight to 41 cents per hundredweight over the period of 1970 to 1980, and the mean expected value of a rational expectations forecast to the market is about 21 cent per hundredweight. The empirical approach used supply and demand equations for the fed cattle market. The results were the same namely that producers were risk averse and a rational expectations forecast, which represents a more informed producer, reduces the variance of fed cattle price forecasts. However, they did not include the cost of acquiring and processing information, but indicated this would probably not be greater than the value of additional information.

Preckel, Loehman, and Kaylen followed Antonovitz and Roe to further analyze the value of public information to producers. They applied the money metric measure to sorghum yield. They state that better information is a need in many production decisions such as the amount of fertilizer that should be used in sorghum production. Using cost-benefit analysis, they showed that information is valuable if it leads to preferred decisions of producers and policy makers. They stated that production information should be considered a public good, and that it has a value of $0.08 to $1.72 per acre for sorghum. They conclude by stating that the value of producing and disseminating information to the U.S. is approximately $1.5 million.

As the literature has suggested, improving the timing, accuracy, adequacy, availability, and quality of public information is valuable to producers. With improved information, producers can make decisions which will improve market efficiency. Research into the costs versus the benefits of including more information in public data reports should be done. Research should also address the issue of whether public or private firms should collect the data. This research shows that more information should be included in the USDA seven state monthly *Cattle On Feed* report.

2.5 Contribution of this Research

Section 2.2 has shown that simple time series models are adequate for making short-run fed cattle price forecasts. Thus, this study uses a simple time series model to forecast monthly fed cattle prices. Time series methods will identify the usefulness of public information for montitoring feedlot inventories. Public data reports should allow producers to obtain information on market-ready inventories so they can reduce forecasting errors.

Section 2.3 evaluated the arguments concerning feedlot inventories. Some believe that cattle can be viewed as a storable commodity in the short-run, but others do not. Since market-ready inventories are correlated with fed cattle prices, this study follows the idea that fed cattle can be considered a storable commodity in the short-run (3 or 4 weeks). If market-ready inventories can be measured using public data, and if it explains fed cattle prices, we should view fed cattle as a storable commodity when performing further research.

Section 2.4 identified the consequences of inaccurate, untimely, or inadequate public information. It also showed that producers are willing to pay for additional information. Most importantly it discussed the improvement in market efficiency due to improved information. Since market-ready inventories cannot be measured accurately using public data, more information should be included in public data reports.

The results of this study can be used to compare alternative forecasting techniques, and to further examine the effect of market-ready inventories on fed cattle prices. Market inefficiencies due to inadequate, inaccurate, or untimely public data reports can be addressed as well as the rationality behind the decision of feedlots to hold inventory.

CHAPTER 3

THEORY AND PROCEDURES

3.1 Introduction

This chapter presents the theory used to develop the empirical models. The theory is based on fed cattle supply and the derived demand for fed cattle. In the long-run, many factors determine fed cattle supply and derived demand. Long-run equilibrium fed cattle price is determined by the balance of supply and demand. However, in the short-run fed cattle prices can be modeled by past fed cattle prices, season of the year, and short-run supply. Market-ready inventories can be used to represent short-run fed cattle supply (Bacon *et al.*). Past prices, season of the year, and market-ready inventories can be modeled using time series methods. Therefore, time series models will be used to explain and forecast fed cattle prices. The adequacy of public data in representing market-ready inventories can also be examined using transfer functions. Transfer functions are formed by directly adding measures of market-ready inventories to time series models. Section 3.2 discusses fed cattle supply and the derived demand for fed cattle. In section 3.3, reduced-form fed cattle price models are discussed. Three measures of market-ready inventories are introduced into the reduced form models. Section 3.4 discusses three measures of market-ready inventories. Section 3.5 discusses the procedures used. Section 3.6 summarizes.

3.2 Fed Cattle Supply and Demand

Profit-maximizing feedlots determine fed cattle supply based on expected fed cattle prices and relative input prices. Inputs include feeder cattle, feed, labor, management, facilities, and capital. Price expectations are formed from past prices. In the long-run, relative prices of inputs and expected fed cattle prices determine the profitability of cattle feeding and fed cattle supply. However, in the short-run many inputs do not vary or vary only slightly due to season of the year. Contracts for labor and management services do not vary monthly. Capital committed to cattle feeding cannot be changed rapidly. Likewise, physical resources are not established within a month. Thus, feeder cattle placements, feed cost, and expected prices are the main influences on short-run fed cattle supply. Feedlots can use hedging or contracting to limit the variability of feed costs. Furthermore, feeder cattle producers make many cattle supply and composition decisions through genetics and retained heifers. The cow-herd size, which is based on feeder-cattle-producer decisions, and feedlot capacity constrains feeder cattle placements and fed cattle supply. Typically, placements are highest in the early spring and late summer. So seasonality also affects fed cattle supply. Past prices and seasonal factors can be modeled using time series methods. Because, on a monthly basis many long-run input decisions are fixed, and because many decisions are made by agents other than cattle feeders, current fed cattle supplies can be modelled with time series methods.

The demand for fed cattle by profit-maximizing packing plants begins at the consumer level and ends at packing plants as derived demand for slaughter cattle. The derived demand for fed cattle depends on fed cattle prices, beef prices, other inputs, and other output prices. Other inputs include labor, utilities, management, facilities, physical supplies, and capital. Other outputs include cow hide and offal. In the long run, relative input and output prices and consumer preferences for beef determine the derived demand for fed cattle. However, in the short run many inputs do not vary. The number and capacity of packing plants does not vary monthly. Capital is committed to various fixed resources, so it does not vary monthly. Contracts for labor and management services are not written monthly. Other inputs, other output prices, and beef prices vary some monthly. The primary reason for buying fed cattle is to slaughter them for beef. Therefore, other output prices have such a small value that their price fluctuations matter little. Consumer preferences for beef cause beef prices to vary some due to seasonality. The demand for beef is higher in the summer than in the winter due to outdoor cooking. Likewise, physical supplies and utilities vary some due to season of the year. Because, on a monthly basis many inputs are fixed and other inputs and output prices vary only due to season of the year, the short-run derived demand for fed cattle can be modeled based on what happened last month and last year at this time. Therefore, time series methods can be used to model the derived demand for fed cattle.

3.3 Fed Cattle Price Equilibrium and Dynamics

Equilibrium fed cattle price is determined by the balance of supply and demand factors. In the long-run, supply and demand determines fed cattle prices, and fed cattle are a continuously produced nonstorable commodity (Tomek and Gray; Leuthold). However, feedlots hold cattle as market-ready inventories in the short-run (Bacon *et al.*; Trapp). Current market-ready inventories are determined by last month inventories, the number of cattle marketed from inventories this month, and the number of cattle held as market-ready inventories this month. Feedlots can base decisions concerning market-ready inventories on expected future prices, and current and past feedlot inventories. Therefore, market-ready inventories can be modelled using time series methods.

Past prices and season of the year are used to model short-run demand. Information on market-ready inventories provides one way to identify and forecast short-run fed cattle supply (Bacon *et al.*; Trapp). Reduced-form time series models have been used to represent short-run fed cattle supply and demand (Garcia *et al.*). Also, reduced-form time series models have been used to represent structural supply and demand models (Zellner and Palm). Thus, reduced-form time series models and market-ready inventories, past prices, and seasonality can be used to explain and forecast monthly fed cattle prices.

Since decisions on market-ready inventories are based on price expectations, a time series model using only past prices may capture the inventory effects of cattle numbers on price. However, cattle change quality in the feedlot. Also, changes in bargaining power between feedlots and packing plants may be captured by measures of market-ready inventories. Thus, directly substituting measures of market-ready inventories into a time series model may increase the explanatory power and forecasting ability of the model. This will also indicate whether or not public data can be used to monitor feedlot inventories.

First, a time series model is estimated based on past prices and errors. The model is

(3.1)

$$P_{FC,t} = \alpha + \sum_{i=1}^{p} \phi_i P_{FC,t-i} + \sum_{j=1}^{q} \theta_j \epsilon_{t-j} + \epsilon_{1t} .$$

The above equation is an autoregressive integrated moving average model (ARIMA). Past prices and errors are used to explain and forecast current prices ($P_{FC,t}$). The parameters α, ϕ_i, and θ_j will be estimated.

Second, transfer functions using past prices and measures of market-ready inventories are estimated. The transfer function incorporates market-ready inventories into the ARIMA model. The transfer function model is

(3.2)

$$P_{FC,t} = \alpha + \sum_{i=1}^{p} \phi_i P_{FC,t-i} + \sum_{j=1}^{q} \theta_j \epsilon_{t-i} + \sum_{n=1}^{k} \delta_n MRI_{t-n} + \epsilon_{2t} .$$

Past prices and past market-ready inventories (MRI_{t-n}) are used to forecast current prices. The parameters α, ϕ_i, θ_j, and δ_n will be estimated. The hypothesis that market-ready inventories explain fed cattle prices, and the hypothesis that market-ready inventories improve fed cattle price forecasts can both be tested. The adequacy of public data concerning feedlot inventories can also be evaluated. The next section explains how market-ready inventories are measured. There is one physical or direct measure (MRI_t) which is from a fed cattle marketings model. There are two price or indirect measures ($Y3Y4_t$ and CS_t) which are reported by the Livestock Marketing Information Center. All three measures are publicly available.

3.4 Measuring Market-Ready Inventories

Market-ready inventories are the number of cattle ready for market that have not been sold. Cattle are typically on feed four to six months depending on placement weight and growth rate (Trapp). Heavier weight feeder cattle placements will be marketed in less time than lighter weight placements. Past feeder cattle placements and season of the year can be used to model fed cattle marketings (Leuthold; Zapata and Garcia). The fed cattle marketings model is

(3.3)

$$MKT_t = \beta_0 + \sum_{h=4}^{8} \phi_h PL_{t-h} + \sum_{m=1}^{11} \delta_m S_{t-m} + \epsilon_{3t} .$$

The equation states that fed cattle placements four through eight months prior (PL_{t-h}) and seasonal factors (S_{t-m}) explain fed cattle marketings (MKT_t). The parameters β_0, ϕ_h, and δ_m will be estimated. If placements increase, marketings will increase. However, in the short-run, feedlots can hold cattle as market-ready inventories. Therefore, if predicted marketings from equation 3.3 do not equal actual marketings, market-ready inventories are present. This measure captures the monthly change in market-ready inventory. Monthly changes in market-ready inventory can be measured as the difference between the actual and predicted marketings, i.e. the error term in 3.3. Thus, this measure is the deviation from expected fed cattle marketings which is changes in market-ready inventories. If the error term is positive, feedlots are holding cattle as inventory. If the error term is negative, feedlots are marketing animals from market-ready inventory. If the error term is zero, there is no change in inventory. The measure is

(3.4)
$$MRI_t = \hat{MKT}_t - MKT_t = -(\epsilon_{3t}) \ .$$

MRI_t should have a negative effect on future fed cattle prices. If feedlots are holding animals, market-ready inventories are increasing, indicating that future supply will increase which causes future fed cattle prices to decrease. MRI_t should have a positive effect on current fed cattle prices. If feedlots hold animals, less animals are marketed and prices increase this month. Since there is sampling error that affects this measure, predicted MRI_t is also used to forecast prices. Figures 1 and 2 show these relationships. In January, February, and March market-ready inventories are increasing. This indicates that feedlots were holding cattle during January, February, and March. Animals were marketed from market-ready inventories in May, June, and July causing higher than expected supply and lower than expected prices.

Alternative measures of market-ready inventories are available through price discounts revealed by yield grade 3 and yield grade 4 price spreads, and choice and select price spreads. The yield grade 3 and yield grade 4, (Y3Y4), price spread is the difference between the average price of yield grade 3, ($P_{Y3,t}$), and average price of yield grade 4, ($P_{Y4,t}$), steers. The measure is

(3.5)
$$Y3Y4_t = P_{Y3,t} - P_{Y4,t} \ .$$

The Y3Y4 spread identifies the discount associated with an animal being overfinished. If an animal is held longer than needed to reach optimal weight, the carcass is overfinished and quality falls. Thus, the animal is graded yield grade 4. Yield grade 4 carcasses are discounted. If the Y3Y4 spread is wide, there are many yield grade 4 animals which indicates increasing market-ready inventories. Increasing market-ready inventories indicates increasing supply and decreasing prices. Therefore, the Y3Y4 spread should be negatively related to fed cattle prices. The relationship between the Y3Y4 spread and fed cattle price is seen by comparing Figure 3 to Figure 1. In March and April, the Y3Y4 spread is wide indicating increasing market-ready inventories which caused increased supplies and decreased prices in May and June.

The choice and select spread, (CS), indicates decreasing market-ready inventories. The average price of select animals ($P_{S,t}$) is subtracted from the average price of choice animals ($P_{S,t}$). The measure is

$$CS_t = P_{C,t} - P_{S,t} \quad (3.6)$$

When an animal is underfinished, it grades select. Select carcass prices are discounted. The CS spread is wide when feedlots are marketing animals before they reach optimal weight. Since feedlots are not holding animals, market-ready inventories are decreasing, fed cattle supply is decreasing, and fed cattle prices are increasing. Therefore, the CS spread should be positively related to fed cattle prices. The relationship between the CS spread and fed cattle price is seen by comparing Figure 4 to Figure 1. The CS spread is narrow in January, February, and March indicating feedlots are holding animals to finish them. This caused increased supplies and decreased prices in May and June.

Short-run fed cattle supplies can be captured by the three measures of changes in market-ready inventory. Therefore, models using these three measures are used to explain and forecast fed cattle prices.

3.5 Procedures

Two sets of transfer function models will be estimated. The first set uses current measures of changes in market-ready inventories to explain current fed cattle prices. An orthodox nonnested test is used to determine which measure provides unique information in explaining fed cattle prices. The second set of transfer function models uses past measures of changes in market-ready inventories to forecast current fed cattle prices. Ashley, Granger, and Schmalensee mean squared error test and turning point analysis as described by Leuthold are used to determine if information on market-ready inventory improves fed cattle price forecasts.

The hypothesis that information on market-ready inventories explain fed cattle prices is tested using pairwise orthodox nonnested tests (Green). The pairwise orthodox tests involve nesting two measures into the AR model and conducting F-tests. For example, MRI_t and $Y3Y4_t$ are nested into the AR model and an F-test on each is performed. The null hypothesis for the F-test on MRI_t is that the it is not significant in explaining fed cattle prices. So if the F-test on MRI_t fails to reject the null hypothesis, MRI_t does not provide unique information. If the F-test on $Y3Y4_t$ also fails to reject the null hypothesis, the conclusion is that both MRI_t and $Y3Y4_t$ contain the same or no unique information for explaining price. If both tests reject the null, then both variables provide unique information for explaining fed cattle prices. Pairwise tests will be done for combinations of all three variables to see which variable(s) provides unique information for explaining fed cattle prices.

Lagged and predicted measures of changes in market-ready inventory will be used to forecast prices. The current measures do not provide information in time for forecasting. Therefore, past measures will be used. If lagged measures do not improve forecasting and if the measures explain prices, the effects of changes in market-ready inventories may occur simultaneously within the current month perhaps on a weekly basis. Therefore, predicted MRI_t will be used to forecast fed cattle prices. The models containing lagged and predicted measures will be compared to the AR model to test the hypothesis that information on market-ready inventories improves fed cattle price forecasts using the Ashley, Granger, and Scmalensee (AGS) mean squared error procedure and turning point analysis.

The AGS procedures test for significant reduction in mean squared errors between two forecasting models. First, the forecast error observations of two models ($e_{1,t}$ and $e_{2,t}$) are summed ($SUME_t$) and differenced ($DIFFE_t$). Second, the mean of the summed errors is subtracted from the summed errors. The equations are

(3.7)
$$e_{1,t} + e_{2,t} = SUME_t \ ,$$

(3.8)
$$e_{1,t} - e_{2,t} = DIFFE_t \ ,$$

(3.9)
$$SUME_t - \overline{SUME_t} = SUMDIFF_t \ .$$

Third, a regression is used to compare mean squared forecast errors. The regression equation is

(3.10)
$$DIFFE_t = \alpha + \beta SUMDIFF_t + u_t \ .$$

The equation states that the difference of the forecast errors ($DIFFE_t$) is explained by the difference in the sum of the errors ($SUMDIFF_t$) and an error term (u_t). The intercept (α) and the slope (β) parameters measure which model has a smaller mean squared forecast error. A joint F-test on the slope and intercept indicates whether or not the difference in mean squared errors is significant. If the sign on the slope and intercept is positive and significant, the second model has a smaller mean squared error. If either parameter is negative and significant, the first model has a smaller mean squared error. The joint F-test indicates whether or not the second model forecasts significantly better or worse than the first model. If neither coefficient is significant, the null hypothesis that the forecast mean squared errors are equal cannot be rejected. Thus, both models forecast equally well. The level of significance for the F-test is taken as half of the probability.

Turning point analysis indicates how well the model forecasts changes in direction. A model may have a small mean squared error, but if it cannot predict when prices will rise or fall, it may not be useful to producers. Four categories of price movements are defined. The categories are peak, trough, upward, and downward. A peak occurs when the current price is greater than last and next months price. A trough is the opposite of a peak. When three consecutive months have rising or falling prices, upward or downward movements occur. Two percentages are calculated. The percent of correct directional forecasts indicates how many times the model correctly predicted a price movement. The percent of worst case directional forecasts indicates how often the model predicted the exact opposite of the actual price movement. For example, the model predicted a trough when a peak actually occured, or the model predicted a downward move when the move was upward.

3.6 Summary

In summary, price expectations and market-ready inventories affect short-run fed cattle prices. Other factors affecting short-run fed cattle supply and derived demand are slow to adjust or have a predictable seasonal pattern. Feedlots and packing plants can form price expectations based on past prices. Price expectations and current inventory levels affect feedlot decisions concerning market-ready inventories. Since fed cattle prices and market-ready inventories both have a time dimension, time series methods are used. Changes in market-ready inventories may or may not be captured by past prices. So two time series models are used. One is an ARIMA model. Current prices are modelled as a function of past prices and errors only. The second is a transfer function. Since cattle change quality in the feedlot, market-ready inventories this month are not exactly equal to marketings from inventories minus cattle held plus last month inventories. Also, changes in bargaining power between feedlots and packing plants may be captured by measures of changes in market-ready inventories. The transfer function allows measures of changes in market-ready inventories to be incorporated in the ARIMA model. The transfer functions may or may not improve the expanatory power or forecasting ability of the ARIMA model. Transfer functions also identify the adequacy of public information on feedlot inventories. Changes in market-ready inventories are measured directly from a marketings model. This measure is represented by MRI_t. Indirectly, the Y3Y4 and CS price spreads can be used to measure market-ready inventories. These two measures are represented by $Y3Y4_t$ and CS_t respectively. All three measures are publicly available. MRI_t and $Y3Y4_t$ should be negatively related to fed cattle prices. $Y3Y4_t$ indicates increasing fed cattle supplies. CS_t should be positively related to fed cattle prices. CS_t indicates decreasing fed cattle supplies.

Two sets of models are estimated. The first set uses current measures of changes in market-ready inventories to explain current fed cattle prices. The hypothesis that information on market-ready inventories can be used to explain fed cattle prices is tested using an orthodox nonnested test. The second set of models uses past measures of changes in market-ready inventories to forecast current fed cattle prices. The out-of-sample forecasts are compared to the AR model using the Ashley, Granger, and Schmalensee mean squared error test and turning point analysis. This tests the hypothesis that information on market-ready inventories can be used to improve fed cattle price forecasts.

Figure 1. Monthly Choice 11-13 Hundredweight Steer Prices
Source: Western Livestock Information Center

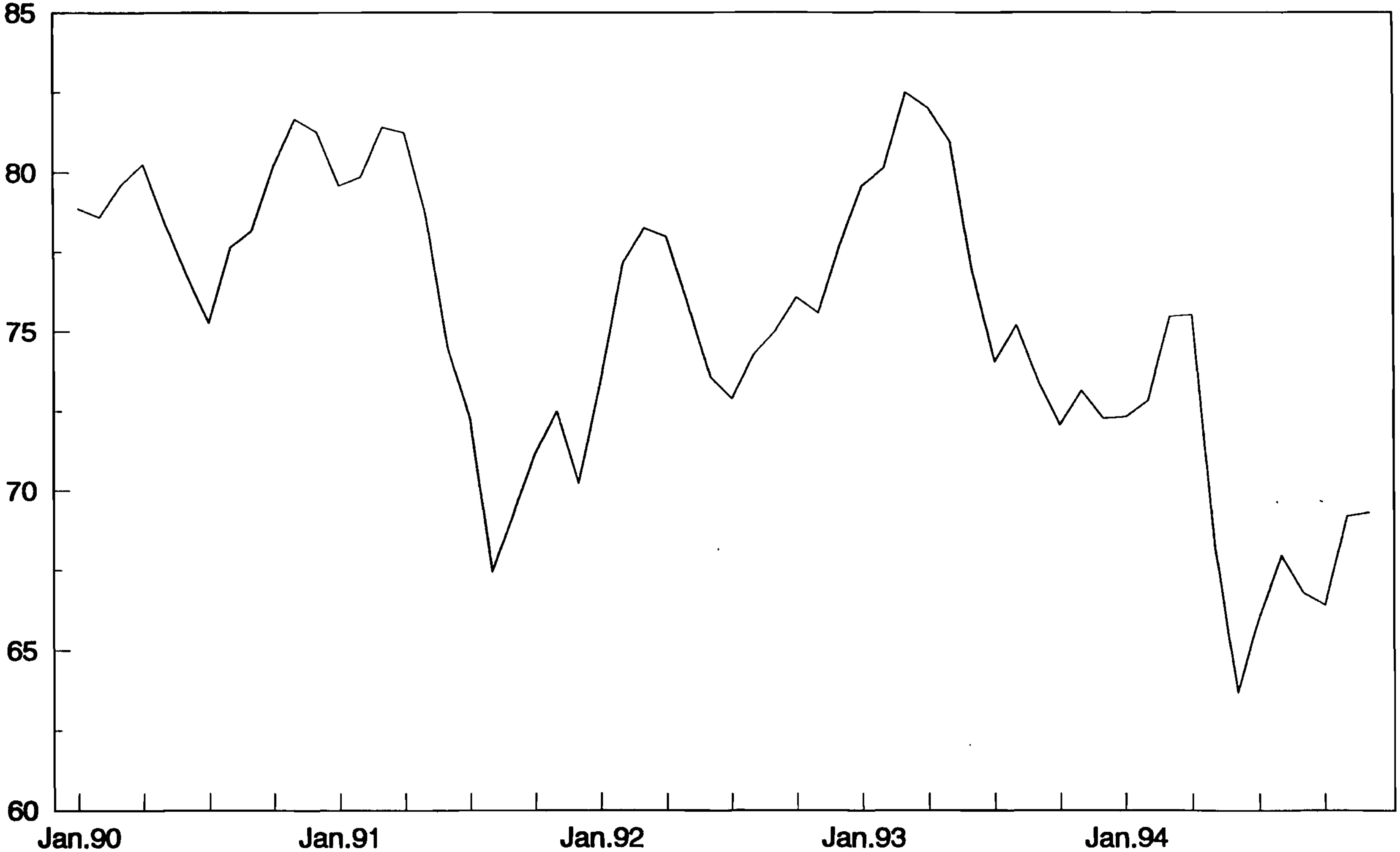


Figure 2. Changes in Market-Ready Inventory from Marketings Model
Source: Western Livestock Information Center

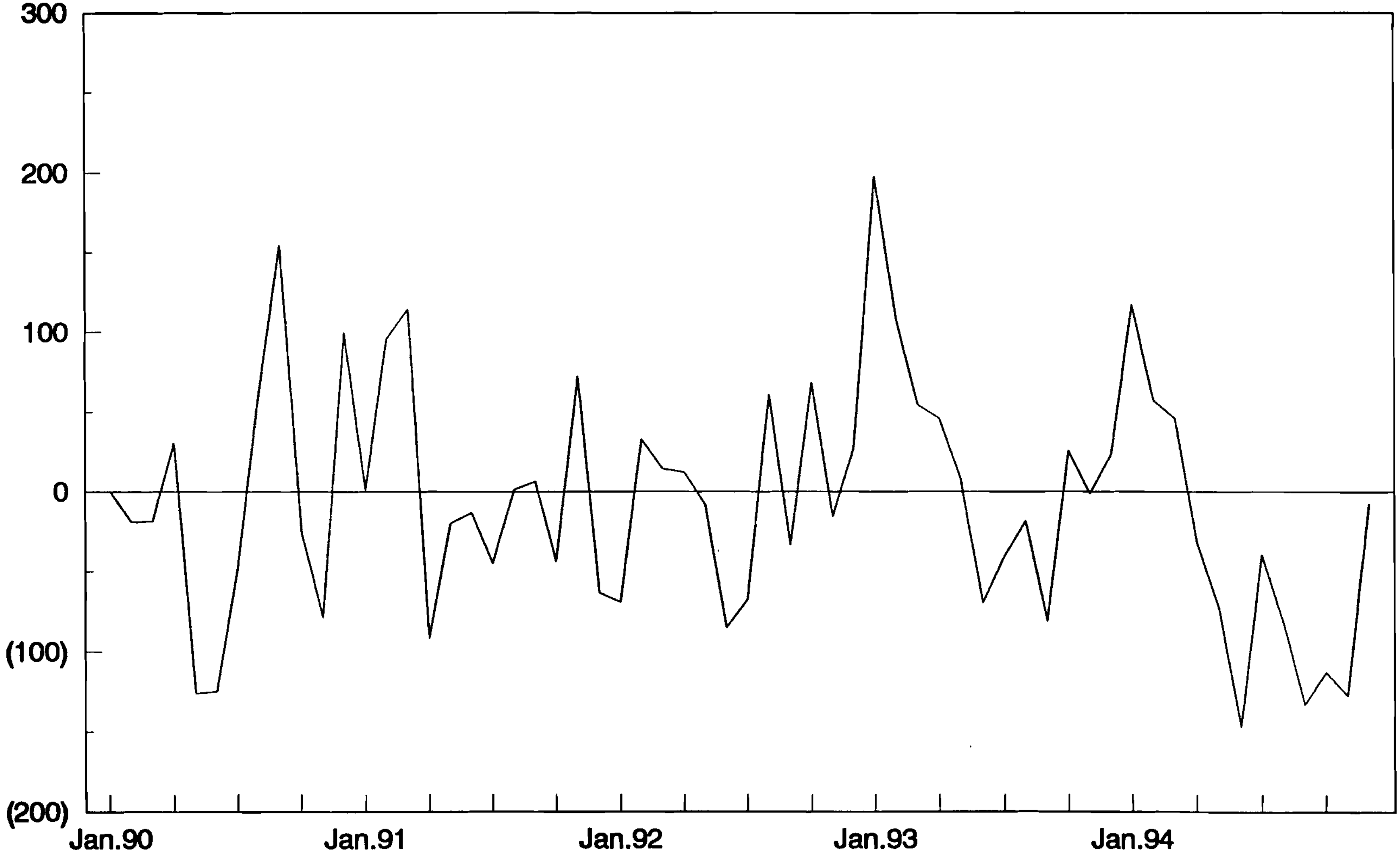


Figure 3. Changes in Market-Ready Inventory from Y3Y4 Price Spread
Source: Western Livestock Information Center

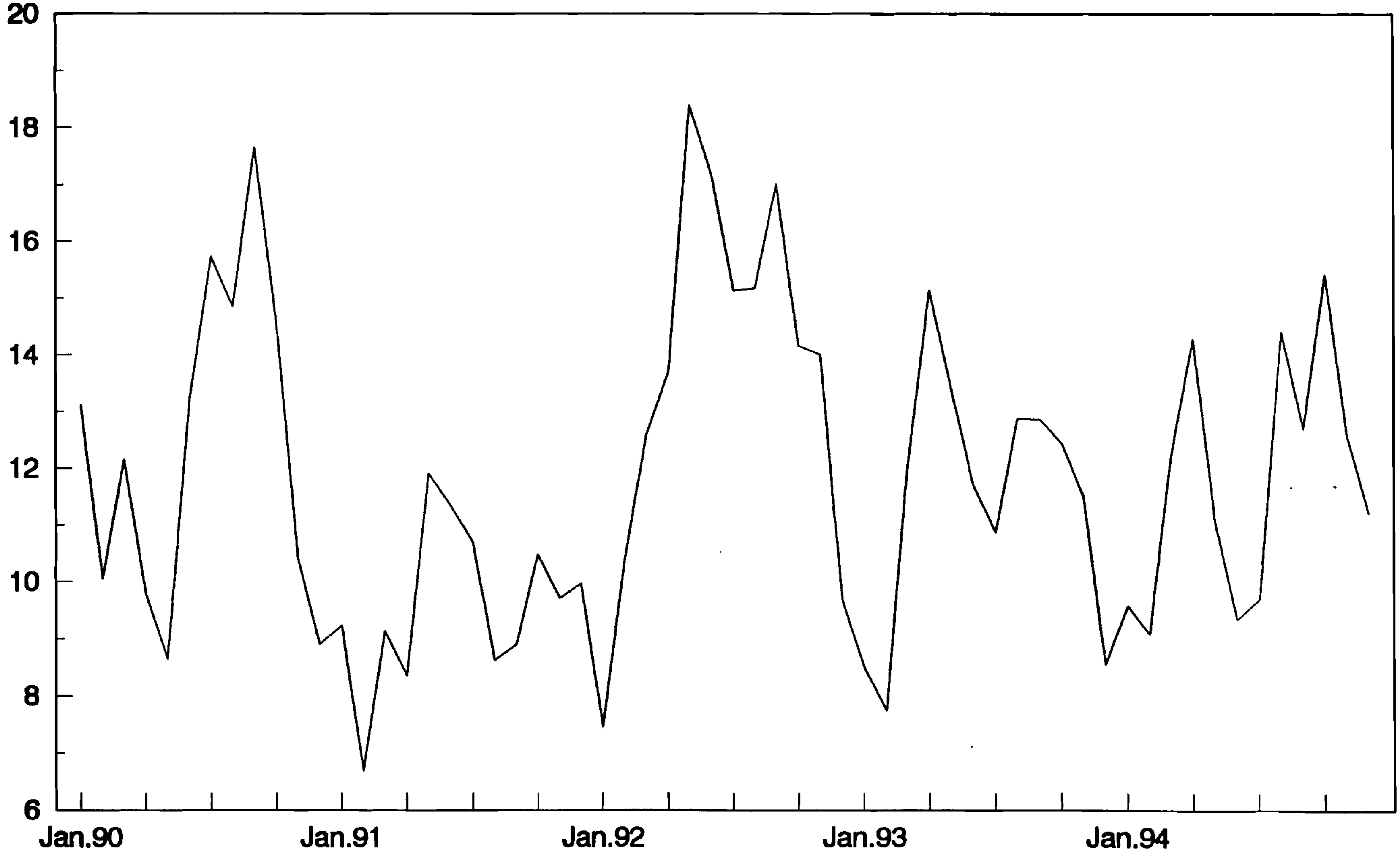
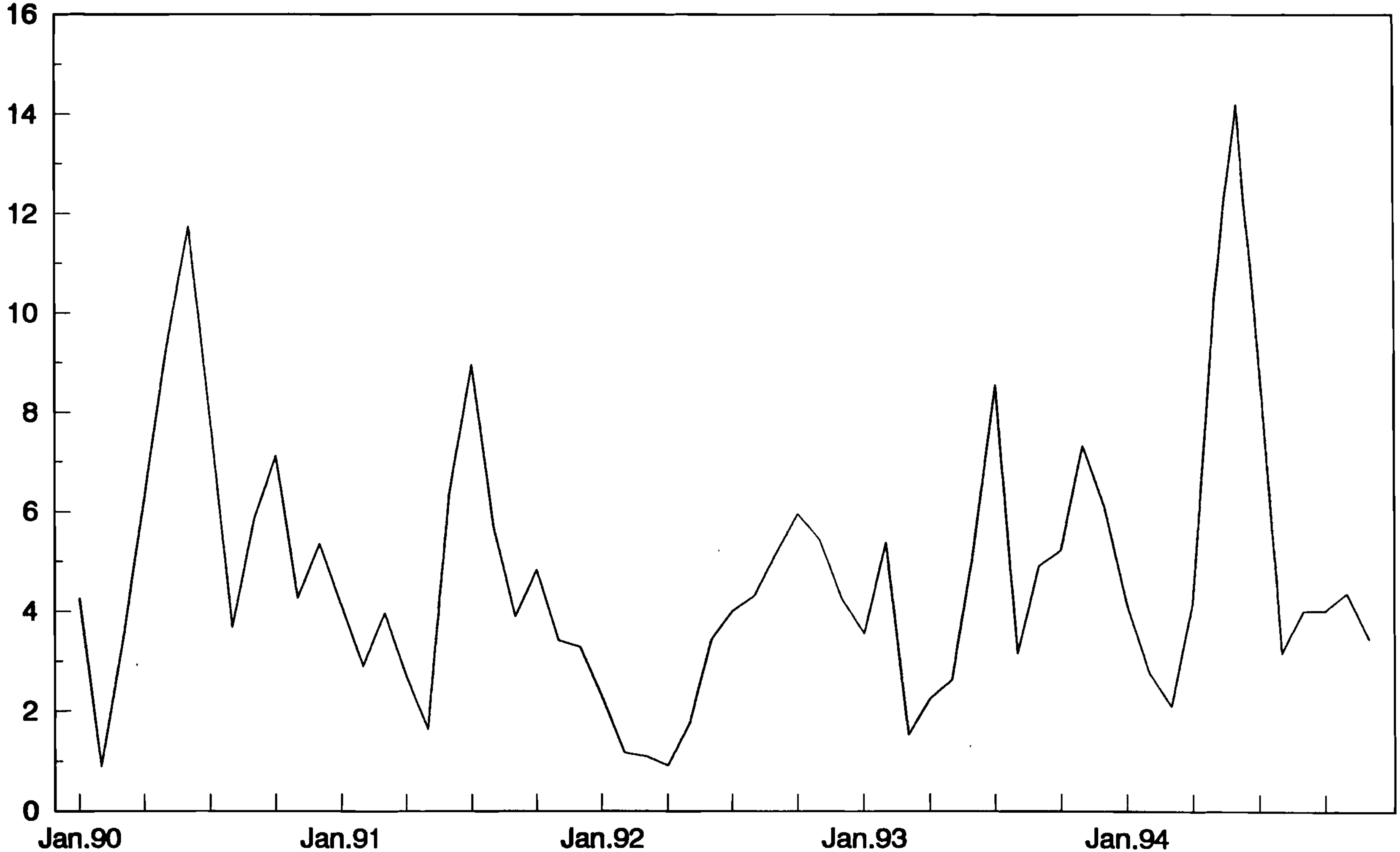


Figure 4. Changes in Market-Ready Inventory from CS Price Spread
Source: Western Livestock Information Center



CHAPTER 4

RESULTS AND IMPLICATIONS

4.1 Introduction

This chapter presents the results of the models. There are two sets of models. The first set explains current fed cattle prices based on past prices and current measure of changes in market-ready inventories. The hypothesis that information on market-ready inventories can be used to explain fed cattle prices is tested. The second set of models uses past prices and past measures of changes in market-ready inventories to forecast current fed cattle prices. The hypothesis that information on market-ready inventories can be used to improve fed cattle price forecasts is tested. Section 4.2 describes the fed cattle marketings model used to measure market-ready inventories. Section 4.3 describes the models used to explain fed cattle prices. Orthodox nonnested test results are presented. Section 4.4 describes the models used to forecast fed cattle prices. Mean squared error and turning point analysis results are presented. Section 4.5 briefly summarizes the results and implications.

4.2 Fed Cattle Marketings Model

Fed cattle marketings are modeled as a function of feeder cattle placements and season of the year. Fed cattle marketings and placements are reported in the USDA monthly seven-state *Cattle On Feed* report. Table 1 reports summary statistics for fed cattle marketings and placements. Table 2 reports the parameter estimates, standard errors, and summary statistics for the model. This model was estimated using ordinary least squares. A polynomial distributed lag with endpoint restrictions was used with placement variables to reduce collinearity. The degree of polynomial and lag length was selected based on Akaike's Information Criterion (AIC).

The model explains 64.41% of fed cattle marketings. A strong seasonal pattern in marketings is found. On average, marketings are highest in the late summer and fall months and lowest in the late winter and spring months. Autocorrelation was found, but was not corrected. Since market-ready inventories depend on past inventories, autocorrelation is expected in this model.[1]

4.3 Explaining Fed Cattle Prices

Table 3 gives the parameter estimates, standard errors, and summary statistics for the models used to explain fed cattle prices. Monthly average prices of 11-13 hundredweight steers from direct trade in Western Kansas are used. These prices were obtained from the Livestock Marketing Information Center. Table 1 reports summary statistics for the prices. All models were estimated using least squares. None of the models had problematic collinearity according to the variance inflation criterion (Judge *et al.*). The Chi-square statistic in Table 3 is a test for autoregressive conditional heteroskedasticity. Homoskedasticity is not rejected. An autoregressive model was estimated. It is compared to the transfer functions. The transfer functions incorporate measures of changes in market-ready inventories into the AR model.

The autoregressive (AR) price model was estimated using a Box-Jenkins approach. Prices were first differenced to produce stationarity. An augmented Dickey-Fuller test indicated that first differencing was necessary. Autocorrelations and partial autocorrelations were examined to determine the lags of prices and errors. A model using prices one, two, and eleven months prior was estimated. Prices the last two months indicate current market conditions. If prices increased last month, they will increase this month. If prices increased two months ago, they will decrease this

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[1] Measuring market-ready inventories from a fed cattle marketings model that was corrected for autocorrelation did not improve fed cattle price forecasts.

month. The eleven month lag removes seasonality. If prices were increasing last year at this time, they will increase this month. The Q-statistic in Table 3 indicates the residuals are white noise. The AR model is the base-line model. Therefore, it is reported in each later table containing models. The model R-squared states that 30.33% of the month-to-month change in price this month is explained by price changes one, two, and eleven months prior. Correlations between the actual and forecasted price levels were calculated using the forecasted price change. Squaring the correlation is comparable to the R-squared of a price level model. The squared correlation coefficient between price levels is 95.145%.

Models 2, 3, and 4 in Table 3 use measures of changes in market-ready inventories in month t to explain price changes in month t. MRI_t is measured from the marketings equation. It represents the monthly average deviation from expected marketings, i.e. the change in market-ready inventory. $Y3Y4_t$ and CS_t are for average monthly prices in Omaha-Central U.S. markets and are reported by the Livestock Marketing Information Center. Table 1 reports summary statistics for these three variables. MRI_t is positive indicating that increasing market-ready inventory causes price increases because feedlots are not marketing as many animals. The signs on the Y3Y4 and CS price spreads are unexpected, but they can be explained. When fed cattle prices increase, feedlots hold animals longer to finish them. This causes market-ready inventories to increase resulting in more yield grade 4 and choice cattle. The, the Y3Y4 price spread widens and the CS price spread narrows. The F-statistics for each regression are greater than the critical value of 2.47. The MRI_t variable is significant at the 18.6% level in Model 2, $Y3Y4_t$ is significant at the 14.1% in Model 3, and CS_t is significant at the 0.3% level in Model 4. The three measures are used jointly in an AR model and orthodox nonnested tests are conducted.

Model 5 in Table 3 indicates that 38.91% of the month-to-month change in fed cattle prices can be explained by price changes one, two, and eleven months prior, and current measures of changes in market-ready inventories. The three measures explain 8.58% of the month-to-month change in prices. However, the three measures only explain 0.423% of the variation in price levels. MRI_t is significant at the 52.6% level, $Y3Y4_t$ is significant at the 4.5% level, and CS_t is significant at the 0.2% level. T-tests indicate that MRI_t is insignificant. However, the insignificance may be due to correlation with the other variables. Therefore, pairwise orthodox nonnested tests are used to identify which variables contribute unique information.

Table 4 reports the results of the pairwise orthodox nonnested tests. First, MRI_t and $Y3Y4_t$ were nested in the AR model. The F-test on MRI_t indicates that it is significant at the 13.5% level. The F-test on $Y3Y4_t$ indicates that it is also significant at the 13.5% level. Both of these tests fail to reject the null hypothesis. The conclusion is that $Y3Y4_t$ and MRI_t contain the same information. Therefore, either $Y3Y4_t$ or MRI_t or both should not be in the model. Second, MRI_t was paired with CS_t in the model. The F-tests indicate that CS_t provides unique information in explaining price. However, MRI_t does not. Third, $Y3Y4_t$ and CS_t were nested in the same model. The pairwise test on $Y3Y4_t$ and CS_t indicates that both contain unique and useful information. The orthodox test results suggest that both the Y3Y4 and CS price spreads should be used to explain monthly fed cattle price changes.

Model 6 in Table 3 indicates that 38.67% of the month-to-month change in fed cattle prices can be explained by past prices, and current Y3Y4 and CS spreads. All the variables are significant at the 5% level. The F-statistic indicates the model is also significant. The R-square indicates that 8.34% of the month-to-month change in prices is explained by Y3Y4 and CS spreads. The squared correlation coefficient for price level is 95.626%.

The hypothesis that market-ready inventories are significant in explaining fed cattle prices is accepted. When market-ready inventory variables are used in the time series model, the coefficients are significant, but unexpected. The causality indicated by the results of the empiririical models indicates that increasing market-ready inventories cause price increases. This can be explained by acknowledging the fact that if feedlots are holding more animals, they are marketing less animals. Thus, current supply decreases and prices increase. However, this is contrary to the theory that market-ready inventories indicate short-run fed cattle supply. The pairwise orthodox test indicates that the indirect measures of market-ready inventories, Y3Y4 and CS price spreads, are the best measures. The next section tests the hypothesis that information on market-ready inventories can be used to forecast fed cattle prices.

4.4 Forecasting Fed Cattle Prices

The set of forecasting models contains two subsets. In one subset, lagged measures of changes in market-ready inventories are used to forecast current fed cattle prices. In the second subset, predicted current MRI_t is used to forecast current fed cattle prices. The models are estimated using data from January 1980 through December 1990. Out-of-sample forecasts are compared using data from January 1991 through December 1994. Out-of-sample forecasts are tested using Ashley, Granger, and Scmalensee (AGS) mean squared error test and are evaluated using turning point analysis as described by Leuthold.

4.4.1 Forecasting Prices using Lagged Market-Ready Inventories

Table 5 reports the models using lagged measures of changes in market-ready inventories to forecast prices. These models are similar to the models in Table 3 except that the measures are lagged one month. Models with additional lagged terms were also estimated and forecasts performed. The three measures were lagged one-to-four months cumulatively. However, price forecasts were not improved so only the models using one month lags are reported. The first model in Table 5 is the baseline AR model.

Models 2, 3, and 4 each use one measure in the model. Lagged MRI is significant at the 31.12% in Model 2, the lagged Y3Y4 spread is significant at the 33.6% level in Model 3, and the lagged CS spread is significant at the 5.5% level in Model 4. Only MRI_{t-1} has the expected sign. Increased market-ready inventories in previous months, will lead to increased marketings and lower prices this month. This negative relationship is indicated by MRI, but not the Y3Y4 spread. The sign on the CS spread should be positive. Wide CS spreads in the past should indicate decreasing market-ready inventories. Decreasing market-ready inventories should lead to decreased marketings and higher prices this month. However, the CS_{t-1} coefficient is negative and significant. All three measures are used in Model 5. The results of Model 5 indicate that 35.74% of the month-to-month change in fed cattle prices is due to past measures of changes in market-ready inventories. Lagged MRI is significant at the 10.6%, and the sign is negative as expected. The coefficients on the lagged Y3Y4 and CS spreads are opposite of a priori expectations. $Y3Y4_{t-1}$ is significant at the 14.4% level and CS_{t-1} is significant at the 1.3% level.

Since the orthodox tests performed on the explanatory model indicated that the Y3Y4 and CS price spreads should be included in the model, Model 6 was estimated. $Y3Y4_{t-1}$ in Model 6 is significant at the 17.5% and CS_{t-1} is significant at the 3.1% level. The R-square indicates that 3.73% of the variation in price is due to lagged CS and Y3Y4 spreads. The squared correlation coefficient is 95.326%.

Table 6 reports the out-of-sample forecast statistics for the models. The mean error indicates on average how the model forecasts. For instance, the mean error of Model 1 is -0.2907. Thus, on average forecasts from this model are $0.2907 too high. The mean error measures the actual minus the predicted forecast error. The root mean squared error from Model 1 is $1.9057 per hundredweight. One month ahead forecasts are within $2.00 per hundredweight of the actual price change two thirds of the time. One month ahead forecasts are within $4.00 per hundredweight of the actual price change 95% of the time. Model 1 forecasts a correct market direction 34.04% of the time and forecasts the opposite move 12.77% of the time.

Models 2, 4, and 6 perform slightly better as compared by the percent of correct directional forecasts. However, the percent of worst case forecasts is higher for these models. Thus, there is little improvement in forecasting according to this criterion. Models 3 and 5 perform worse than the AR model. The mean squared errors for all models are larger than the AR model mean squared error. However, the significance should be tested using the AGS test.

Table 7 reports the intercept, slope, F-statistic, and p-values for the AGS regression of Models 2 through 6. Each model is compared to the AR model. All models have a negative coefficient on either the slope or intercept term. However, the coefficients are not significant. Therefore, the null hypothesis that the mean squared errors are equal cannot be rejected.

The results indicate that lagged measures of changes in market-ready inventories do not improve fed cattle price forecasts. The reason that forecasting is not improved may be due to three things. One, past prices are capturing the information contained in the measures. The difference between current prices and prices one and two months prior is due to changes in short-run supply. Changes in short-run supply is caused by feedlots holding more cattle or marketing animals from market-ready inventories. Two, the simultaneous nature of changes in market-ready inventories and price changes occurs only in the current month since current measures are significant in explaining prices. Prices may only be effected by changes in market-ready inventories within the month, i.e. weekly. Three, the data used to measure changes in market-ready inventories is inadequate. The measures used here were not reported in the *Cattle On Feed* report, but rather estimated from a marketings model. The data included in the report may not be sufficient for measuring changes in market-ready inventories. The simultaneous nature of price changes and changes in market-ready inventories is addressed in the next section.

4.4.2 Forecasting Prices using Predicted Market-Ready Inventories

Table 8 reports two models that predict MRI_t. The first model predicts MRI_t using an AR model. This model explains 24.84% of MRI_t with MRI four and twelve months prior. The second model uses past MRI and lagged Y3Y4 and lagged CS price spreads to predict MRI_t. $Y3Y4_{t-1}$ is positive indicating that large Y3Y4 spreads last month are correlated with large inventories this month. It is significant at the 15% level. CS_{t-1} is only significant at the 49.3% level and positive. The R-square indicates that lagged CS and Y3Y4 spreads explain 1.98% of the variation in market-ready inventories. Distributed lags on the CS and Y3Y4 spreads were also used to predict MRI_t. However, additional lags were not significant.

Table 9 reports the models using predicted MRI_t to forecast fed cattle prices. Model 1 is the base-line AR model. Models 2 and 3 use predicted MRI_t from Model 2 and 3 of Table 7 to predict price changes. Models 2 and 3 improve the AR model R-square by only 0.69% and 0.63% respectively. The predicted MRI_t variables are the correct sign but are not significant. Since MRI_t is predicted by past MRI and past Y3Y4 and CS spreads, predicted MRI_t can be used to forecast prices.

Table 10 reports the out of sample forecast statistics. Models 2 and 3 do not forecast better according to turning point analysis. However, Models 2 and 3 do have a smaller mean squared error.

Table 11 reports the intercept, slope, F-statistic, and p-values of the AGS regression. Models 2 and 3 have negative signs on the intercept, but the intercept is not significant. The sign on the slope is positive, but it is not significant. Therefore, the null hypothesis that the two mean squared errors are equal can not be rejected.

The results indicate that predicted MRI_t does not improve fed cattle price forecasts. The hypothesis that information on market-ready inventories do not improve fed cattle price forecasts cannot be rejected based on these results.

4.5 Discussion of the Results

Results indicate that public data reports provide information on market-ready inventories that explain fed cattle prices. However, public information on market-ready inventories does not improve fed cattle price forecasts. One conclusion is that the *Cattle On Feed* report should contain a weight breakdown of animals in the feedlot. This would allow all producers to monitor feedlot inventories. Then, the implications of market-ready inventories on market efficiency could be examined. A second conclusion is that feedlots need to recognize the effect of market-ready inventories on prices and make rational decisions. Weekly data on market-ready inventories instead of monthly data may be needed to improve short-run price forecasts. Comparing these results to private data results would indicate whether or not private data can be used to monitor feedlot inventories.

Table 1. Summary Statistics for Variables Used in this Study over the Estimation Period of January 1980 through December 1990.

Variable	Mean	Standard Deviation	Minimum	Maximum
Marketings	1558.8	115.25	1295.0	1824.0
Placements	1664.4	366.93	1073.0	2779.0
Price	69.337	6.802	53.810	82.510
MRI_t	-2.848	68.342	-157.930	197.540
$Y3Y4_t$	11.309	2.749	6.040	19.800
CS_t	4.438	2.494	0.900	14.190

Table 2. Parameter Estimates, Standard Errors, and Summary Statistics of the Regression Used to Model Monthly Fed Cattle Marketings over the Period January 1980 through December 1990.

Variables	Marketings[a]
Intercept	705.421 (102.5)
$Placements_{t-4}$	0.0877 (0.0238)
$Placements_{t-5}$	0.1261 (0.0234)
$Placements_{t-6}$	0.1258 (0.017)
$Placements_{t-7}$	0.0975 (0.0225)
$Placements_{t-8}$	0.052 (0.0231)
January	182.64 (36.15)
February	-85.113 (56.15)
March	-86.852 (51.66)
April	-117.04 (43.09)
May	-8.7917 (44.56)
June	103.28 (39.5)
July	159.75 (31.97)
August	219.28 (33.76)
September	102.27 (35.12)
October	118.06 (32.88)
November	-12.969 (31.34)
F-value	14.2276
R-Square	64.41%

[a] Standard errors are in parenthesis.

Table 3. **Parameter Estimates, Standard Errors, and Summary Statistics of the Regressions Used to Explain Monthly Fed Cattle Price Changes over the Period January 1980 through December 1990.**

Variables	Price (1)[a]	Price (2)	Price (3)	Price (4)	Price (5)	Price (6)
Intercept	0.1146 (0.2080)	0.1586 (0.2098)	-1.1327 (0.8667)	1.2412 (0.4186)	-0.3305 (0.8646)	-0.3057 (0.8612)
$Price_{t-1}$	0.2805 (0.0864)	0.2586 (0.0876)	0.2780 (0.0859)	0.2479 (0.0837)	0.2328 (0.0839)	0.2414 (0.0825)
$Price_{t-2}$	-0.1964 (0.0856)	-0.1682 (0.0879)	-0.1766 (0.0862)	-0.1619 (0.0831)	-0.1208 (0.0853)	-0.1321 (0.0832)
$Price_{t-11}$	0.4154 (0.0718)	0.411 (0.078)	0.3995 (0.0785)	0.3668 (0.0769)	0.3413 (0.077)	0.3407 (0.0768)
MRI_t		0.0045 (0.0034)			0.0021 (0.0033)	
$Y3Y4_t$			0.11074 (0.0747)		0.1463 (0.0722)	0.1474 (0.072)
CS_t				-0.2482 (0.081)	-0.2605 (0.0833)	-0.273 (0.0807)
F-statistic	15.094	11.848	11.999	14.579	10.723	12.862
Q-statistic[b]	1.52					
Chi-square[c]	0.104	0.069	0.206	0.535	0.55	0.618
Price Change R-Square	30.33%	31.51%	31.79%	36.15%	38.91%	38.67%
Price Level Correlation	95.145%	94.879%	95.280%	95.435%	95.568%	95.626%

[a] Standard errors are in parenthesis.
[b] Test for white noise in AR model.
[c] Test for ARCH effects.

Table 4. F-Statistics, Probabilities, and Conclusions of the Regressions Used for the Pairwise Orthodox Nonnested Tests.

Ho: β=0	F-statistic[a]	Probability	Conclusion
MRI_t	1.851	0.135	MRI or Y3Y4 or Both
$Y3Y4_t$	2.271	0.135	Should Not Be in Model
MRI_t	0.451	0.504	MRI Should Not Be in Model
CS_t	7.895	0.006	and CS Should Be in Model
CS_t	4.186	0.043	CS and Y3Y4 Should
$Y3Y4_t$	11.443	0.001	Be in Model

[a] The F-critical value used for comparison at the 5% level is 3.95.

Table 5. Parameter Estimates, Standard Errors, and Summary Statistics of the Regressions Used to Forecast Monthly Fed Cattle Price Changes Using Lagged Measures of Changes in Market-Ready Inventories.

Variables	Price (1)[a]	Price (2)	Price (3)	Price (4)	Price (5)	Price (6)
Intercept	0.1146 (0.208)	0.0763 (0.2113)	-0.7067 (0.8749)	0.8832 (0.4425)	-0.1635 (0.8856)	-0.1780 (0.8927)
$Price_{t-1}$	0.2805 (0.0864)	0.2963 (0.0877)	0.2638 (0.0881)	0.2176 (0.0910)	0.1968 (0.0931)	0.1859 (0.0936)
$Price_{t-2}$	-0.1964 (0.0856)	-0.1910 (0.0858)	-0.1907 (0.0859)	-0.1985 (0.0845)	-0.1817 (0.0838)	-0.1907 (0.0843)
$Price_{t-11}$	0.4154 (0.0718)	0.4123 (0.0782)	0.4109 (0.0783)	0.4173 (0.0771)	0.406 (0.0764)	0.4111 (0.0770)
MRI_{t-1}		-0.0034 (0.0034)			-0.0055 (0.0034)	
$Y3Y4_{t-1}$			0.0729 (0.0755)		0.1104 (0.0749)	0.1031 (0.0754)
CS_{t-1}				-0.1688 (0.0861)	-0.2254 (0.089)	-0.1906 (0.0872)
F-statistic	15.094	11.582	11.547	12.590	9.363	10.531
Q-statistic[b]	1.52					
Chi-square[c]	0.104	0.024	0.108	0.145	0.001	0.02
Price Change R-Square	30.33%	31.02%	30.96%	32.84%	35.74%	34.05%
Price Level Correlation	95.145%	95.210%	95.211%	95.229%	95.448%	95.326%

[a] Standard errors are in parenthesis.
[b] Test for white noise residuals.
[c] Test for ARCH effects.

Table 6. Out-of-Sample Forecast Statistics Used to Compare Models Using Lagged Measures of Changes in Market-Ready Inventories to Forecast Monthly Fed Cattle Price Changes.

Variables	Price (1)	Price (2)	Price (3)	Price (4)	Price (5)	Price (6)
Mean Error	-0.2907	-0.2631	-0.3190	-0.3202	-0.3284	-0.3640
Mean Square Error	3.6316	3.6692	3.8205	3.7898	4.4419	4.1866
Root Mean Square Error	1.9057	1.9155	1.9546	1.9467	2.1067	2.0461
Percent of Correct Direction Forecasts	34.04%	36.17%	31.11%	36.17%	31.91%	36.17%
Percent of Worst Case Direction Forecasts	12.77%	14.89%	13.33%	14.89%	14.89%	19.15%

Table 7. Parameter Estimates and F-Statistics for the Regressions Used to Test the Hypothesis that Lagged Measures of Changes in Market-Ready Inventories Improve Monthly Fed Cattle Price Forecasts Using the AGS Mean Squared Error Test.

Variables	Intercept[a]	Slope	F-statistic	Probability
Model 2	-0.0276 (-0.7907)	-0.0037 (-0.4009)	0.3930	0.6773
Model 3	0.0283 (0.9371)	-0.0118 (-1.196)	1.5578	0.2215
Model 4	0.0295 (0.5423)	-0.0098 (-0.6802)	0.3784	0.6871
Model 5	0.0376 (0.3427)	-0.0519 (-1.84)	1.7510	0.1850
Model 6	0.0732 (0.8976)	-0.0341 (-1.611)	1.7000	0.1940

[a] The t-statistic is in parenthesis.

Table 8. Parameter Estimates, Standard Errors, and Summary Statistics of the Regressions Used to Predict MRI_t.

Variables	MRI_t[a]	MRI_t
Intercept	-11.686 (5.405)	27.377 (24.05)
MRI_{t-4}	-0.2730 (0.0854)	-0.2973 (0.0878)
MRI_{t-12}	0.4315 (0.0829)	0.4010 (0.0899)
$Y3Y4_{t-1}$		2.8505 (1.9670)
CS_{t-1}		-1.5751 (2.2890)
F-statistic	17.35	9.44
Q-statistic[b]	2.03	
R-Square	24.84%	26.82%

[a] Standard errors are in parenthesis.
[b] Test for white noise residuals.

Table 9. Parameter Estimates, Standard Errors, and Summary Statistics of the Regressions Used to Forecast Monthly Fed Cattle Price Changes Using Predicted MRI_t.

Variables	Price[a] (1)	Price (2)	Price (3)
Intercept	0.1146 (0.2080)	0.1739 (0.2180)	0.1653 (0.2175)
$Price_{t-1}$	0.2805 (0.0864)	0.2674 (0.0876)	0.2699 (0.0875)
$Price_{t-2}$	-0.1964 (0.0856)	-0.1862 (0.0864)	-0.1898 (0.0861)
$Price_{t-11}$	0.4154 (0.0718)	0.4253 (0.0790)	0.4243 (0.0781)
Predicted MRI_t		0.0062 (0.0067)	0.0052 (0.0064)
F-statistic	15.094	11.512	11.448
Chi-square[b]	0.104	0.169	0.164
Price Change R-Square	30.33%	30.89%	30.78%
Price Level Correlation	95.145%	95.176%	95.160%

[a] Standard errors are in parenthesis.
[b] Test for ARCH effects.

Table 10. Out-of-Sample Forecast Statistics Used to Compare Models Using Predicted *MRI*$_t$ to Forecast Monthly Fed Cattle Price Changes.

Variables	Price (1)	Price (2)	Price (3)
Mean Error	-0.2907	-0.2764	-0.2726
Mean Square Error	3.6316	3.4561	3.4492
Root Mean Square Error	1.9057	1.8590	1.8572
Percent of Correct Direction Forecasts	34.04%	31.91%	31.91%
Percent of Worst Case Direction Forecasts	12.77%	14.89%	14.89%

Table 11. Parameter Estimates and F-Statistics for the Regressions Used to Test the Hypothesis that Predicted MRI_t Improve Fed Cattle Price Forecasts Using the AGS Mean Squared Error Test.

Variables	Intercept[a]	Slope	F-statistic	Probability
Model 2	-0.0143 (-0.4280)	0.0121 (1.3450)	0.9958	0.3773
Model 3	-0.0181 (-0.6130)	0.0125 (1.5700)	1.4211	0.2519

[a] The t-statistic is in parenthesis.

CHAPTER 5

SUMMARY AND CONCLUSIONS

5.1 Introduction

This chapter summarizes this research and draws conclusions from the results. Section 5.2 will briefly summarize this study. Section 5.3 will discuss conclusions that can be drawn from the results.

5.2 Summary

The cattle industry is an important part of the agricultural sector of the U.S. economy. Inefficiency in the cattle industry hurts producers and consumers. Therefore, inefficiencies in the cattle industry should be addressed. Feedlots cause inefficiency by holding large market-ready inventories. If it is unknown that many feedlots are holding cattle, large unexpected price decreases are likely to occur. Three measures of market-ready inventories are used to explain and forecast fed cattle prices. Public data is used to measure changes in market-ready inventories so that all producers can benefit from the results. Also, arguments for including more information in the USDA seven state *Cattle On Feed* report can be made.

One measure of changes in market-ready inventories is the residual from a fed cattle marketings equation called MRI. Fed cattle marketings are predicted by placements four through eight months prior and seasonal factors. Data from the USDA seven state monthly *Cattle On Feed* report was used for marketings and placements. The *Cattle On Feed* report is widely used in the cattle industry. Theoretically, if MRI is increasing, fed cattle supply is increasing and fed cattle prices are decreasing.

The second measure of market-ready inventories is the yield grade 3 and yield grade 4 (Y3Y4) price spread. This measure captures when market-ready inventories are increasing. When this spread is wide, there are many overfinished cattle marketed due to increasing market-ready inventories. Increasing inventories, cause the size and number of fed cattle marketed to increase, which cause prices to decrease. However, results indicate the opposite. The results can be interpreted as follows. Increasing prices cause feedlots to hold more animals to finish them. By holding more animals, inventories increase and more yield grade 4 cattle are present which causes the Y3Y4 spread to widen. The Y3Y4 spread is reported by the Livestock Marketing Information Center.

The third measure of changes in market-ready inventories is the choice and select (CS) price spread. This measure captures when market-ready inventories are decreasing. The CS spread is wide when many underfinished cattle are marketed due to decreasing inventories. When inventories are decreasing, the number and size of marketings decrease, which cause prices to increase. The results indicate the opposite. The are interpreted as follows. Increasing prices cause feedlots to hold more animals to finish them. By holding more animals, inventories increae causing more choice cattle to be marketed and CS spreads to narrow. The CS spread is also reported by the Livestock Marketing Information Center. The three measures are incorporated into an autoregressive model to form a transfer function.

Two sets of transfer function models are estimated. One set is used to test the hypothesis that information on market-ready inventories explains fed cattle prices. The second set is used to test the hypothesis that information on market-ready inventories improves fed cattle price forecasts.

Information on market-ready inventories was significant in explaining fed cattle prices. This hypothesis was tested by placing MRI, Y3Y4, and CS for the current month into an AR model and conducting orthodox nonnested tests. The tests revealed that the CS and Y3Y4 spreads provide unique information in explaining fed cattle prices.

Information on market-ready inventories did not improve fed cattle price forecasts. This hypothesis was tested using two sets of forecasting models. One set used past prices and past MRI, Y3Y4, and CS to forecast monthly fed cattle prices. The second set used past prices and predicted MRI_t to forecast monthly fed cattle prices. Out-of-sample forecasts from the models were compared to an AR model forecasts. The Ashley, Granger, and Schmalensee mean squared error test and turning point analysis as described by Leuthold were used to determine which model forecasted better. The AR model forecasted as well as or better than models including information on market-ready inventories.

5.3 Conclusions

Market-ready inventories are an important concept. Large unexpected price decreases and market inefficiencies may be due to feedlots holding large market-ready inventories. Bacon *et al.* showed that market-ready inventories are correlated with fed cattle prices using public data, private data, and data from an experimental fed cattle market. Trapp showed that feedlot inventory levels were important for forecasting short-run fed cattle supplies. This study showed that information on market-ready inventories explains fed cattle prices. Market-ready inventories are also discussed in the cattle industry. However, public data does not include information that allows the industry to identify large feedlot inventories.

This study measured changes in market-ready inventories directly from a fed cattle marketings models. Changes in market-ready inventories were measured indirectly by yield grade 3 and yield grade 4 price spreads and by choice and select price spreads. All three measures are publicly available. The indirect measures significantly explain fed cattle prices. However, the measures did not improve fed cattle price forecasts. Furthermore, the two indirect measures forecasted as well as the direct measure. This indicates that the data used are inadequate in representing market-ready inventories and should be improved.

Two conclusions can be drawn from this study. The first conclusion is that the seven state *Cattle On Feed* report should contain a weight breakdown of cattle in the feedlot. Currently, only placements, numbers on feed, marketings, and other disappearance categories are used. If the numbers on feed were broken down according to weight, the number and size of future fed cattle marketings would be available to all producers. This argument is parallel to Trapp. Trapp argued that sex, placement weight, and growth rate variables should be included in public data reports so producers can track feedlot inventories. Irwin has shown that public situation and outlook reports are useful to producers. He also stated that any information is useful if it reduces the variance in forecasts. Public information on market-ready inventories that reduces producer forecast errors should be provided. Weight breakdowns should provide this information.

The second conclusion is that feedlots should recognize the effect of holding large market-ready inventories on market efficiency. If feedlots hold large market-ready inventories, future supplies increase causing future prices to decrease. If a feedlot holds cattle to buffer prices, it may not cause inefficiency in the fed cattle market. However, if feedlots hold cattle to force packing plants to bid higher, it may cause inefficiency in the fed cattle market. If other feedlots are holding animals at the same time, large unexpected price decreases will occur. If other feedlots are selling cattle at the current bids, packing plants will buy from other feedlots, and the feedlot holding cattle will have many overfinished animals, low prices, and big price discounts. Both scenarios provide false price signals to all producers and cause inefficiency in the cattle industry.

Improving public information will allow the cattle industry to reduce forecast errors, make more informed decisions, improve market efficiency, and realize the problems associated with holding large market-ready inventories. The options market allows producers to partially offset their losses due to inadequate information (Green). However, many producers do not have the knowledge, resources, or ability to use the options market. Cost-benefit analysis and producer surveys should be done to ensure that any additional information is affordable, useful, and necessary. Finally, any research that assumes perfect information in the cattle industry may lead to ineffective or unnecessary policies that may decrease market efficiency.

BIBLIOGRAPHY

Antonovitz, Frances, and Terry Roe. "A Theoretical and Empirical Approach to the Value of Information in Risky Markets." *Review of Economics and Statistics* 68(February 1986):105-114.

Ashley, R., C.W.J. Granger, and R. Schmalensee. "Advertising and Aggregate Consumption: An Analysis of Causality." *Econometrica* 48(July 1980):1148-1167.

Bacon, Kevin, James N. Trapp, Steve Meyer, and Kevin Smith. "The Importance of Inventory in Short-Run Beef Market Analysis." Paper presented at the 1993 NCR-134 Conference on Applied Commodity Price Analysis, Forecasting, and Market Risk Management. Chicago, IL, 1993.

Bessler, David A., and Jon A. Brandt. "Forecasting Livestock Prices with Individual and Composite Methods." *Applied Economics* 13(December 1981):513-522.

Demsetz, Harold. "Information and Efficiency: Another Viewpoint." *Journal of Law and Economics* 12(April 1969):1-22.

Farris, Paul L. "Agricultural Marketing Research in Perspective." *Future Frontiers in Agricultural Marketing Research.* Ames, Iowa: Iowa State University Press, 1983.

Garcia, Philip, Raymond M. Leuthold, T. Randall Fortenbery, and Gboroton F. Sarassoro. "Pricing Efficiency in the Live Cattle Futures Market: Further Interpretation and Measurement." *American Journal of Agricultural Economics* 70(February 1988):162-169.

Granger, C.W.J., and Paul Newbold. *Forecasting Economic Time Series.* Orlando, Florida: Academic Press Incorporated, 1986.

Green, Jerry. "Value of Information with Sequential Futures Markets." *Econometrica* 49(March 1981):335-358.

Green, William H. *Econometric Analysis.* New York: Macmillan, 1993.

Harris, Kim S., and Raymond M. Leuthold. "A Comparison of Alternative Forecasting Techniques for Livestock Prices: A Case Study." *North Central Journal of Agricultural Economics* 7(January 1985):40-50.

Hayek, F.A. "The Use of Knowledge in Society." *American Economic Review* 35(September 1945):519-530.

Irwin, Scott. "The Economic Value of Situation and Outlook Programs: A Review of Theory and Empirical Evidence." Paper presented at the Symmposium on Re-Engineering Marketing Policies for Food and Agriculture. Washington, D.C. January 13-15, 1994.

Judge, George C., R. Carter Hill, William E. Griffiths, Helmut Lutkepohl, and Tsoung-Chao Lee. *Introduction to the Theory and Practice of Econometrics.* New York: John Wiley & Sons, 1988.

Leuthold, Raymond M. "The Price Performance on the Futures Market of a Nonstorable Commodity: Live Beef Cattle." *American Journal of Agricultural Economics* 56(May 1974):271-279.

Livestock Marketing Information Center. *Western Livestock Roundup* Denver, Colorado: January 1994 through January 1995.

Naik, Gopal, and Raymond M. Leuthold. "A Note on Qualitative Forecast Evaluation." *American Journal of Agricultural Economics* 68(August 1986):721-726.

Preckel, Paul V., Edna T. Loehman, and Michael S. Kaylen. "The Value of Public Information for Microeconomic Production Decisions." *Western Journal of Agricultural Economics* 12(December 1987):193-197.

Stiegert, Kyle W., Azzeddine Azzam, and B. Wade Brorsen. "Markdown Pricing and Cattle Supply in the Beef Packing Industry." *American Journal of Agricultural Economics* 75(August 1993):549-558.

Stigler, George J. "The Economics of Information." *The Journal of Political Economy* 69(June 1961):213-225.

Tomek, William G., and Roger W. Gray. "Temporal Relationships among Prices on Commodity Futures Markets: Their Allocative and Stabilizing Roles." *American Journal of Agricultural Economics* 52(August 1970):372-380.

Trapp, James N. "Forecasting Short-Run Fed Beef Supplies with Estimated Data." *American Journal of Agricultural Economics* 63(August 1981):457-465.

U.S. Department of Agriculture. *Cattle On Feed* Washington, D.C.: National Agricultural Statistics, January 1980 through December 1994.

U.S. Department of Agriculture. *Livestock, Meat, and Wool Market News* Washington, D.C.: Agricultural Marketing Service, January 1980 through December 1994.

U.S. Department of Agriculture. *Livestock and Poultry: Situation and Outlook* Washington, D.C.: U.S. Government Printing Office, January 1980 through December 1994.

U.S. Bureau of the Census. *Statistical Abstract of the United States: 1994* 114th Edition, Washington, D.C., 1994.

Zapata, Hector O., and Philip Garcia. "Price Forecasting with Time Series Methods and Nonstationary Data: An Application to Monthly U.S. Cattle Prices." *Western Journal of Agricultural Economics* 15(July 1990):123-132.

Zellner, Arnold, and Franz Palm. "Time Series Analysis and Simultaneous Equation Econometric Models." *Journal of Econometrics* 2(May, 1974):17-54.

VITA

Kendall Lee McDaniel

Candidate for the Degree of

Master of Science

Thesis: IMPROVING MONTHLY FED CATTLE PRICE FORECASTS WITH INFORMATION ON MARKET-READY INVENTORIES

Major Field: Agricultural Economics

Biographical:

Personal Data: Born in Springdale, Arkansas, On December 12, 1970, the son of Don and Jan McDaniel. Married to Roni Michelle McDaniel, On August 14, 1993.

Education: Graduated from Minco High School, Minco, Oklahoma in May 1989; received Bachelor of Science degree in Agricultural Economics and Computer Science from Oklahoma State University Stillwater, Oklahoma in December 1993. Completed the requirements for the Master of Science degree with a Major in Agricultural Economics at Oklahoma State University in July 1995.

Experience: Student Assistant, Department of Agronomy, Oklahoma State University Fall 1992; Computer Programmer, Department of Agricultural Economics, Oklahoma State University, January 1993 to December 1993; Summer Help, ENOGEX, Incorporated, Summers 1990 to 1992; Graduate Research Assistant, Department of Agricultural Economics, Oklahoma State University, January 1994 to July 1994.