BARGAINING POWER AND CONTRACTING AGREEMENTS WITHIN THE FED CATTLE MARKET: AN EXPERIMENTAL SIMULATION APPROACH

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PREFACE

This thesis consists of two separate essays. The first essay is titled "Bargaining Power in the Beef Industry." This essay seeks to determine how bargaining power shifts between feedlots and processing plants under changing market conditions. A simulated fed cattle market was used to evaluate fed cattle transactions that took place under changing supply and demand conditions. Analysis of this information allowed for the creation of a bargaining power index and statistical modeling. This process identified which side (feedlots or processors) maintained the majority of bargaining power under continuously changing market conditions. Primary contributions of this essay are isolating the changing nature of bargaining power in the beef industry, which has not been completed to this extent in previous research. Also, the experimental design of this study potentially has benefits to further study in the areas of price discovery and price determination. The data analyzed in this essay were generated by students of the Agricultural Economics Course 3990 at Oklahoma State University. The experimental design included three one semester sets of transaction specific and supply and demand information.

The second essay, titled "Contracting in the Beef Industry" seeks to determine the effects of increasing levels of contracting between feedlot producers and beef packers on cash transaction prices. The primary focus of this essay is to identify trends in cash price

receipts that occur as levels of contracting increase. A second issue identifies volatility characteristics that are associated with high levels of contracting. Simulated fed cattle transaction information allowed for regression and statistical analysis which concluded this research. Data for this study were generated from a one semester controlled study in the Agricultural Economics Course 3990. Systematic levels of contracting were implemented in order to evaluate the effects on cash price. This information was then compared to three previous semesters in which mandatory contracting was not involved.

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ESSAY ONE

BARGAINING POWER IN THE BEEF INDUSTRY

BARGAINING POWER IN THE BEEF INDUSTRY

Abstract

This research deals with bargaining power, which is the ability of one entity involved in a transaction to receive more favorable terms than the other. Specifically, the bargaining power studied in this essay focuses on products that have a specified life span. In other words, the product must be sold within a certain window of time before it expires, spoils, or becomes outdated. The subject of study in this research is the transaction process that occurs between feedlots and meat processors in the beef industry. Animals involved in this process have a specified timeframe in which they can be most easily sold for a favorable price, after which they are sold at a considerable discount. This study examines the factors that influence bargaining power and then identifies which entity (packers or feeders) maintain the majority of bargaining power under changing supply and demand situations.

BARGAINING POWER IN THE BEEF INDUSTRY

Introduction

Bargaining takes place in every sector of the economy. For example, consumers bargain with auto dealers to obtain a reasonable price for automobiles. The same is true for the agricultural sector. Producers bargain for prices when selling goods and animals. Thus, bargaining is extremely important because it allows both parties to participate in establishing the terms of trade for a particular product or service.

Because bargaining is continuously used in business for creating trade agreements, it has important business and economic effects. However, studies in the area have typically focused on labor or business negotiations. These studies usually are not replicable and do not have controlled observations because they are typically done in case study format (Datt 1996; Monye 1996).

The focus in this study is on negotiation that takes place between the cattle feeding and meat packing segments of the beef industry. The negotiation and bargaining process is carried out between feedlots and packing companies. Producers seek to produce and market animals that will earn the highest possible amount of profit while processors seek to purchase cattle at low prices to earn strong profits. Thus, the producer/processor marketplace is continuously in negotiation. These negotiations are affected by overall supply and demand forces along with the characteristics of specific lots of cattle.

In this analysis, bargaining power will be studied through the use of experimental simulation. The objective of the study is to determine the different economic factors that affect bargaining power. The study will be conducted with the aid of the Fed Cattle Market Simulator (FCMS) developed at Oklahoma State University, which is a model used to simulate market dynamics in the meat packing industry. Representatives for both packers and feeders negotiate terms and prices in which animals will be sold. The importance of such an activity is that it gives an industry-like result through organized trade and bargaining. Players of the game have the responsibility of calculating the break even selling or buying price they must have in order to realize success in a trade agreement.

Conceptual Framework

Bargaining is the process of suppliers and processors working directly with one another to agree on a specific price for which a commodity will be traded. The bargaining process is important because through it the terms of trade for a product are established. Many factors affect bargaining power, including overall market demand and supply conditions as well as the quality of specific products. For example, if increased demand for a certain product occurs, it is common for producers to be able to negotiate higher prices and receive increased returns. Similarly, a sale lot of cattle or other products with superior or premium quality will typically receive higher prices than average quality. This bargaining power exists in the context of markets creating a supply and demand equilibrium.

In order to reach market equilibrium, processors and producers typically negotiate to buy and sell products in terms of price and quality. Throughout the course of bargaining, which typically involves buying, selling, haggling, negotiation, and compromise, suppliers and processors reach an agreement on terms in which products will be exchanged (Ladd 1964). In many cases there are factors that cause one party to receive a "better deal than the other." In other words, one side will receive more profit from the transaction. Therefore, it could be said that the side that received more profit has the greatest amount of bargaining power.

As an example of the practical effect of bargaining power, consider trade in the horticulture industry. Within the industry there are producers that plant, package, or germinate seeds, as well as processors that grow or prepare floral arrangements. It is the producers' task to identify how many seeds to prepare based on seasonal demand conditions. Similarly, since each processor generally will not buy one producer's entire production, producers also must be prepared to make purchase decisions based on consumer demand. They should also consider how many plants of each type to grow and prepare based on factors including size, color preference, and longevity of the plant.

In general, producers and retailers are faced with the task of negotiating what price to buy and sell the items. Producers want to sell the items at the highest possible price in order to realize maximum profit, while the processors want to pay the lowest price possible in order to ultimately realize their greatest potential profit. Both sides know the range of prices and terms for which they are willing to trade. Producers want to make at least enough from their sales to cover their costs of production. However,

processors do not want to pay more than what they will be able to sell the finished product for, after accounting for transportation, labor, and any other expenses.

The situation when both producers and processors make a profit is likely the typical situation because neither party could sustain losses indefinitely, but for short periods they may operate at a loss. Many times one side or the other is forced into selling their product at a loss. This is especially prevalent or possible when the products being sold are perishable or have a finite life-span. Many times sellers incur a loss in order to avoid further losses later in the life of the product. Such a situation develops in the fashion industry. For example, retailers optimally want to sell their apparel at the highest price the market will allow, as is common when a new design enters the market. However, as fashions change, so do preferences of the consumers and sales at discounted prices occur. Instead of keeping clothing until it is extremely hard (if not impossible) to sell, retailers will sell clothing for less than opportune prices in order to avoid a complete loss in the long-run.

Although generally not directly observable, bargaining can be measured in order to show which side involved in a transaction is most able to receive favorable terms of trade. In addition, in order to analyze bargaining power, it is necessary to decide what factors affect it. These factors can be expected to include market conditions, such as supply and demand, and transaction specific factors, which are specific to the product that is under question. Transaction specific factors describe the character of the good, such as quality, size, appearance, or age.

Considering that bargaining power can be influenced by overall market conditions and quality characteristics of specific lots of cattle, one reasonable way to conceptualize the relationship is in the following equation:

(1) $BP = f(X,Z)$

where. BP = bargaining power, X = supply and demand conditions and Z = transaction specific conditions.

The supply and demand variables (X) represent the amount desired and supplied of a certain type of product that is available for sale. The transaction specific variables (Z) represent the specific quality of cattle actually traded at a certain time. Both sets of variables together represent the key factors that affect bargaining power.

The focus of this study is the fed cattle market which consists of feedlots and packers. Feedlots, who are suppliers, want to sell cattle to packers at a high enough price to cover their costs and make a profit in the long-run. Packers transform the live animals into various cuts of meat and market that product to retailers and other customers. Packers also want to cover their costs and make a reasonable profit in the long-run.

In the cattle market to be studied, a number of factors affect bargaining power, as is similar to other industries. A key factor is the particular demand and supply condition (Trapp et al. 1994). In addition to supply and demand, feedlots and processors commonly reference overall market information about industry conditions (Anderson et al. 1998).

During the negotiation of sales, both feeders and packers pay special attention to items such as weight and showlist size, which is the number of animals projected to enter feedlots. As the number of cattle entering feedlots increases, supply increases. If supply

increases outweigh demand increases, a surplus develops. As such a surplus develops, prices paid for animals can be expected to decline. Therefore, packers would have strong bargaining power during this time period. However, during times of short supply, often when the showlist is small, a relative shortage can develop. When there is such an occurrence, packers usually are willing to pay higher prices in order to obtain the animals and cover at least some of their fixed costs. As the showlist or number of cattle available for sale increases, bargaining power for packers will increase and the price per pound can be expected to decrease.

Cattle placed in feedlots are sorted into feeding pens based on their weight. Feedlot managers monitor each pen of cattle's intake and growth on a regular basis. The cattle are targeted for sale at a weight where they will grade choice. However, once cattle exceed that weight they may receive quality grade discounts due to unfavorable weight characteristics that result from an extended feeding period.

It is hypothesized that cattle have a maximum value in the FCMS at the weight of 1150 pounds because marbling characteristics and muscle size matches those demanded by consumers once the meat has been converted into retail cuts (Trapp et al. 1994). The weight of slaughter animals is closely related to the price of boxed beef that is sold to retail grocers. Processors ideally want to buy animals at a certain weight in order to minimize the input that goes into preparing the meat for retail sale. Additional labor is required to trim excess fat or size from steaks when animals are too large in order to make the product pleasing to the consumer. The price will ultimately be higher at the retail end in order to cover the costs of the additional labor, which can cause a reduction in sales. Small animals, as well as larger ones, often cause losses to producers because

the meat suffers yield grade discounts in retail stores (Ward et al. 1999b). Processors therefore seek to purchase animals at ideal weights, which should theoretically give additional bargaining power strength to feedlots during such time periods. Thus, weight likely has the most dramatic affect on the value of animals as they leave the feed yard. Although the price-weight relationship is an extremely crucial function of the market, little study has been reported in the context of bargaining power.

Empirical Model

In order to study the effect of various factors on bargaining power, it is necessary to develop an empirical counterpart to the bargaining power concept described in Equation 1 above. Empirically studying bargaining power in a large scale study with controlled observations *per se* is a relatively new area; however there are several related research efforts on which to draw. These efforts include price discovery (Ward et al. 1996) and hedonic price analysis (Bowman and Ethridge1992; Epple 1987; Rosen 1974; Lyford et al. 1997).

In order to operationalize the bargaining power concept, a specific measure of bargaining power needs to be developed. Such an index needs to take into account and measure market changes that are caused by a change in conditions. An index previously used by Trapp et al. was formed from the average slaughter price for a particular period. This price was then used to determine a percentage of profits captured by feedlots. Accordingly, the percentage was then multiplied by 100 to form an index (Trapp et al.

1994). This index provides an adequate representation for bargaining power, and could be used in this study. Therefore, one choice for the bargaining power index (BPI) is:

(2) $$BPI = P / [(BE_p + BE_f)/2],$$

where

BPI = bargaining power index,
P = price paid per animal,
BE_p = break even price for packers,
BE_f = break even price for feedlots.

A second choice is to form an index that measures the amount of potential profit available, rather than forming a ratio of potential profit. The second choice for a bargaining power index is:

(3) $$BPI = P - [(BE_p + BE_f) / 2],$$

where

P = price received per trade,
BE_p = breakeven price for packers,
BE_f = breakeven price for feedlots.

After further study of the two index structures, it was determined that either form is suitable for the calculations of the index. However, the second form is more easily explained because it is simply a difference between price paid and breakeven for packers and feedlots. Ultimately, it was chosen because it lends itself to more understandable interpretations.

For the beef industry, market conditions are hypothesized to impact or explain bargaining power. In order to test the effects of each variable, a statistical model has been developed to show how market conditions affect bargaining power. The model is:

(4) $$BPI_{it} = \alpha_{it} + (\beta_1 \ldots \beta_2)X_{it} + \epsilon_{it},$$

where BPI_{it} = bargaining power index, α_{it} = intercept, β = parameters to be estimated, X_{it} = vector of market variables, and ϵ_{it} = error term. Additionally, it was originally hypothesized that boxed beef price as well as total pens sold would have a significant affect on bargaining power. However, further study described below revealed other suggestions.

Supply and demand is a dominating feature that affects bargaining power. Supply and demand possibly has more of a deterministic role in the beef packing segment of the cattle market than in other industries. This is attributed to the fact that processors are generally quick in adjusting to changing conditions while feedlots often experience production lags attributed to the time it takes to make an animal available for sale. Ward et al. (1996) identifies several supply and demand variables that have previously been used to predict market conditions. Among these variables are futures price, yield grade, number of head sold, boxed beef cutout value, and forward contracting volume. Although some variables are not applicable to this research, certain ones described below are.

The noted supply and demand agents that influence bargaining power are showlist size, boxed beef price and total pens sold. Each variable affects the supply and demand situation, which in turn directly affects bargaining power. Showlist size is a good measure of overall supply because it is the variable that describes the number of animals available for sale in a given week. Consequently, this has a major impact on the ability of animals within a given weight class to be sold. Boxed beef price is hypothesized to be a necessary component because it yields detailed information needed to establish the price retail cuts of meat are sold for by processors. This can act as a bargaining tool by

feedlots. Feedlots often feel that they should realize above average profits from processors when the price of boxed beef is high. Equally important is the number of pens that are being sold in a given period. Under conditions when unusually high numbers of animals are being sold to processors, feedlots realize that demand conditions are high. Thus, there is commonly a possibility for increased feedlot profit. Feedlots commonly monitor situations such as this to determine when they can bargain their cattle most successfully.

After study of the subject, it was realized that not all of the variables previously described could function fluently in the same model. Specifically, the impacts of boxed beef were captured through the use of the index described above because boxed beef price is used in the calculation of packer breakeven prices. Therefore, boxed beef price was not deemed necessary for the bargaining power equation. Additionally, the total number of pens sold was found to be highly correlated to the showlist variable described above. Therefore, it was not necessary to use a total pens sold variable because the showlist size quite adequately explains more of the overall supply/demand dynamics of the market.

The showlist variable was proven to be vital to the estimation of bargaining power and therefore chosen to represent supply characteristics. The flexible nature of the variable, as well as its broad explanatory power, led to this choice. Within the dynamics of the FCMS, earlier research has shown that as showlist size changes, so does the price of the animals being sold. Cattle prices are typically high when the showlist is low; likewise, as showlist increases the price received for animals declines. Accordingly, it is logical to deduce that showlist and price are inversely related. Therefore, it is

hypothesized that bargaining power is greater for feedlots when showlists are low and lower when showlists are high.

The use of a showlist squared term confirmed the strength possessed by the showlist variable. The showlist squared variable shows that as showlist gets larger there is a diminishing marginal impact on the bargaining power retained by feedlots. As the number of animals available for sale increases, bargaining power is reduced at a decreasing rate for feedlots. Theoretically, each additional animal does not reduce bargaining power as much as the one before it.

Quality characteristics have a major contribution to bargaining power as indicated by the conceptual model. Perhaps the most influential quality characteristic (at least in this structure) is weight because it encompasses all other quality characteristics such as yield grade, quality grade, and dressing percentage. As animals increase in weight from 1125 pounds, it is hypothesized that they gain bargaining power for feedlots to a certain extent, under normal market conditions. However, if the animals become too heavy, it is also likely that those animals will begin to lose bargaining power under the same conditions until a certain point when the cattle do not meet the specifications of the market and are forced to be sold at a discount. This occurs in the FCMS when animals reach weights above 1200 pounds. At this time they are sold at a considerable loss within the computer simulator. It is hypothesized that an animal's bargaining power increases until it reaches a weight around 1150 pounds and then declines significantly thereafter. In addition, it is theorized that animals have more bargaining power before they reach 1150 pounds, but they typically sell for more at that weight. The hypothesized impact of each variable is presented in Table 1. In compliance with the hypothesis that bargaining

power declines significantly after the weight of 1150 pounds, it was recognized that the price per pound of beef declines as the animal exceeds 1150 pounds. Therefore, it is hypothesized that under normal conditions an animal weighing 1150 pounds will be more easily sold and with better bargaining power to the seller than an animal weighing 1200 pounds.

As previously described, it is believed that the showlist size plays an important role in the determination of bargaining power. Therefore, there is a need to isolate the outcome of bargaining power as showlist changes at each weight level. Through doing this, changes in bargaining power can be monitored as supply conditions vary between heavy and light. In order to accomplish this, an interaction term between showlist and weight will be created. It is further hypothesized that feedlots control even greater bargaining power at all weights when relatively few cattle are available for trade. Alternatively, it is also believed that feedlots have little bargaining power at all weights when the market is saturated with animals to be traded.

Data were derived from three separate years of the FCMS. Each year consists of individual traits that are specific to the particular semester in which each data set was recorded. In order to maintain quality test results, it is necessary to include a variable that is representative of those specific years of transactions. This variable will identify individual years as well as test for consistency in both the transaction specific and supply and demand relationships in each data set.

In summary, the model can be described by the empirical equation to be tested:

$$BPI_{it} = \alpha + X_{it} + Z_{it} + Shwl + Shwl^2 + Y_{it} + \epsilon_{it} \quad (5)$$

where BPI = bargaining power index, α = intercept value for 1150 pound cattle, X = a vector of the variable indicating weight of the cattle, Z = a vector of showlist and weight interaction conditions, Shwl = showlist, Y = the year in which the trade occurred, and the subscripts *i* and *t* refer to specific lots and time periods in which a transaction occurred, respectively.

Experimental Economics

Experimental economics is a form of modeling designed to simulate the actual functions of economic activity. Edward Chamberlin, who designed a market simulation to explain cost structure and contract pricing, first reported experimental economics in 1948 (Davis and Holt 1993). Davis and Holt also note that experimental economics was later broadened to game experiments in the 1950's and 1960's. The purpose of the studies was to monitor participant reasoning, decision making, and negotiation in a controlled environment.

Since the introduction of experimental economics, criteria and standards have evolved for using valid testing approaches. Among these factors are replicability, motivation and an unbiased environment. These criteria are important to testing in order to authenticate the results obtained. The studies must be able to be replicated in order to ensure validity of the results. In addition, participants must be motivated in some way so as to fulfill their task as well as possible; this ensures market-like results. Participants should react to the events within the experimental environment as if they were happening in the market place. Further, individual participants should not benefit from insider

information gained from the administrators of the experiment unless this is explicitly part of the research design. The goal is to create and study real world market dynamics in a controlled setting.

Experimental economics and experimental simulation (another form of experimental study), although closely related, can be distinguished. Experimental economics evolves when the researcher actively controls specific variables within the system, in order to monitor and record the effects of the control on economic behavior and performance. Experimental simulation designs function more freely than experimental economics by allowing participants to make virtually all decisions themselves with no restraints. Experimental simulation is designed to capture the relationships that exist between economic variables of a specific market when major components of that market are affected by realistic market changes (Ward et al. 1996). Thus, since few variables are controlled, the result is a market simulation that functions much like a real-world market. Accordingly, the FCMS adheres to the experimental simulation guidelines.

The FCMS is a form of experimental simulation that is designed to represent the market activities that take place between feedlots and packers. Through observation of cattle transactions it is possible to recognize and study market characteristics, negotiation patterns, and ultimately, bargaining power.

The FCMS was developed to focus on the trades that occur between feedlots and packers. Therefore, participants can experience the diversity and dynamics that are involved with numerous repetitions of market trading periods.

Experimental elements within the FCMS parallel both experimental simulation and experimental economics (Dowty 1996). The simulator exhibits a structure that parallels components of a microeconomic system specified by Smith (1982) for experimental economics. This is accomplished through the use of a specified market structure and subjects or participants that make decisions that affect performance of both their own firm and the entire market.

Friedman and Sunder (1994) note that research designs in experimental economics should control specific variables that allow researchers to focus on a specific amount of behavioral or performance variables. In the FCMS control is accomplished through relatively few variables, thus allowing dynamic interaction among numerous economic variables as occurs naturally in real-world markets. This follows the structure of experimental simulation (Ward et al. 1996).

The FCMS is designed to be played in specific trading periods called weeks. Each week lasts between six and eight minutes. Throughout the trading period, market information is provided on two different display bars. One display bar scrolls cash market information (trading volume and high-low prices) which is analogous to current market information available to fed cattle buyers and sellers from the USDA/Agricultural Marketing Service (USDA/AMS). The other display bar scrolls futures market information (trading volume and current prices for three futures market contracts) which is analogous to information available from the Chicago Mercantile Exchange (Ward et al. 1996).

The three –to-five minute period following trading is an information-processing period or "weekend" during which each team updates its showlist, calculates breakeven

prices, and formulates marketing strategies. For each period, the FCMS software provides an individual income statement for each team, as well as summary market information for the preceding period. "This summary information also resembles that available from USDA/AMS in the real-world fed cattle market" (Anderson et al. 1998). Data generated from past sessions have been used to study marketing agreements (Ward et al. 1999a), price discovery (Ward et al. 1996), and information impacts on price discovery (Anderson et al. 1998). Each study has been conducted in a similar format. Experimental simulation guidelines were employed to provide real-world market dynamics.

Data

Data for this research were generated from three separate semesters of the Agricultural Economics Course 3990, the Fed Cattle Market Simulator. The class meets in 90 minute sessions in the spring semesters at Oklahoma State University. Students are generally upper-level agriculture majors from various fields.

The data collected for this study were transaction specific for each trade that occurred throughout the time of the simulation. Data were collected from approximately 65-70 weeks of trading or 2,000-2,600 pens of cattle. Cattle are bought and sold in pens of 100 head and are marketed by one of the eight feedlots to one of the four packers (Dowty 1996). Cattle are available for trade at one of five different weight classes ranging from 1100 to 1200 pounds. Cattle weights increase by 25 pounds after each week of trading. However, due to low profit potential, animals are rarely traded at the 1100 pound level and any such trades were omitted for analysis purposes. Once the

animals exceed 1200 pounds they are no longer available for trade, and are sold at a significant loss within the computer program.

An overall summary description of the data used in this research can be found in Table 2 and a summary of statistics is included in Table 3. Each data observation consisted of one transaction that represented the trade of 100 head of cattle between one feedlot and one meatpacking firm. Transaction specific data included: week traded, bargaining power index, sale weight, total number of pens sold in that particular week, showlist size, and boxed beef price. A sample of transaction specific variables can be found in Appendix A.

Students experience the simulation from both the packer and feedlot perspective. Throughout the simulation, participants are periodically rotated from one position to another. Students do not stay with any particular feedlot or packer for an extended period of time.

Results

The purpose of the model used in this research is to identify the effect of various market conditions on bargaining power. Throughout the analysis of bargaining power, all results were reported from the feedlot perspective. Therefore, a negative sign associated with any of the test variables indicates that feedlot bargaining power was negatively affected by that variable; likewise the opposite is true for a positive sign. Thus, switching the signs will change the interpretations to the packer's point of view. The bargaining

power model illustrated the effects of such market conditions as weight, showlist size, and weight and showlist interactions.

As shown in Table 4, the model confirmed several preliminary hypotheses, while providing several other interesting findings that were somewhat unexpected. The R^2 of the model is 0.12. While this is a somewhat low r-squared value, many other factors affect bargaining power such as exceptional bargainers and other conditions that contain substantial statistical "noise" that varies between trading periods and transactions. However, those conditions would generally not be correlated with the included independent variables. Due to the real-world nature of the data, all variables were necessarily not isolated as feedlots and packers constantly negotiate and seek better terms of trade.

The Breusch-Pagan, Glejser, and Harvey tests for heteroskedasticity were used on the three years of data and resulted in a rejection of the null hypothesis of homoskedasticity. In order to alleviate the problem, the iterative program for the correction of heteroskedasticity, as specified by Greene (1997), was employed. The procedure uses an iterative process to estimate coefficients given multipicative heteroskedaticity, consequently heteroskedaticity was corrected during the seventh iteration of the process.

Results confirmed that showlist has an influential affect on bargaining power with a coefficient of –0.17. The negative coefficient flows with real-world dynamics in that showlist and bargaining power are inversely related. Additionally, weight characteristics, as originally hypothesized, have a crucial affect on bargaining power. However, early hypotheses proved to be different than the results yielded from testing. Originally,

bargaining power was hypothesized to be positive for feedlots from 1125 pounds through 1150 pounds, peaking after 1125 pounds and then becoming increasingly negative thereafter. However, an important result was found that revealed showlist and weight, when interacted, have substantial effects on bargaining power. The weight/showlist interaction isolates the effects of weight under different showlist levels. Under light showlists feedlots maintain all bargaining power, whereas under normal and heavy showlists feedlots maintain virtually no bargaining power. This is illustrated in Figure 1 through a three series representation of light, average, and heavy showlists for the weight classes.

The first series shows that bargaining power under a light showlist maintains a positive nature for feedlots throughout the entire weight range. Bargaining power decreases slightly from 1125 to 1150 pounds (but stays positive), and then increases from 1150 pounds through 1200 pounds. The second series of results showed how bargaining power was affected by weight when an average showlist was present. Bargaining power was never positive for feedlots under the average showlist conditions. Increases were noticed from the weight of 1125 through 1175 pounds, where it peaked but was not largely negative. Thereafter, bargaining power decreased until the cattle reached 1200 pounds and were either sold at a loss, or bought by the computer. The third series involves a large showlist. In this series, bargaining power was never in the favor of feedlots. Bargaining power was negative from 1125 to 1200 pounds. Bargaining power peaked at a weight of 1150 pounds during this time period, but abruptly decreased thereafter.

It is evident that showlist size has a substantial impact in determining who possesses the most bargaining power. When showlist numbers are low, such as 90 pens of cattle, it is difficult for processors to meet their demand quotas. Therefore, the processors are willing to pay higher prices for animals. Consequently, feedlots have the opportunity to sell animals at a premium. This accounts for the booms in feedlot profits that are commonly encountered in both real life and in the classroom. When showlists are around an average size, such as 122 pens of cattle, we think of the market as "being balanced." However, balanced does not adequately represent the bargaining power received by feedlots. During this time period feedlots have less bargaining power than processors. They can simply strive to market their animals at a moderate weight before bargaining power shifts increasingly to the processors. Much the same is true when the showlist is big, such as 170 pens of cattle. The difference here in that situation is that feedlots never have significant bargaining power. In other words, it is extremely difficult (if not impossible) for feedlots to make a profit in this situation.

Implications for Marketing Systems

The information presented here should be of value to the fed cattle segment of the beef industry. Answers to bargaining power questions based on market dynamics are shown within the framework of this research. These are: 1) feedlots maintain the majority of bargaining power under light showlist situations, 2) feedlots maintain little bargaining power under normal and heavy showlist situations, and 3) analysis of incoming cattle supplies can be a useful tool in predicting the future status of who

controls bargaining power. Although the information provided does not reveal any secrets to gaining higher prices for cattle across the board, it does show how a competent manager could seek to maximize bargaining power and returns under different market conditions.

Insight has been given as to when to sell animals in order to avoid a large loss as well as when to maintain ownership of animals for extended periods of time in order to achieve larger profits. Not surprisingly, this analysis has shown that feedlot managers should not base their selling decisions exclusively on the weight of animals, but just as importantly should consider the supply of animals in feedlots. Feedlots should seek to maintain ownership of fed cattle as long as possible when the supply available to processors is limited. This technique will generally result in the realization of overall higher profits. Similarly, it is in the feedlots best interest to sell their cattle at moderate weights to processors when the supply available is large. This will ensure that feedlots receive the best price available, even if it means suffering a loss. Finally, when the supply of feedlot animals is average it is in the best interest of feedlots to monitor sales price trends as well as the incoming supply level in order to successfully obtain fair prices. Average supply characteristics are statistically proven to be slightly in favor of processors, but any significant change in market conditions is capable of skewing bargaining power toward one side or the other. Therefore, it is extremely important to monitor market conditions on a daily basis in this type of situation.

Conclusions

Through the use of a newly employed experimental simulation model, the estimation of bargaining power control in the beef industry was accomplished. Potential beneficiaries of this study include feedlots and processors, as well as other entities involved in the production and sales of perishable products. A statistical model has been designed to identify market variables that affect bargaining power. From this model, it was possible to illustrate how bargaining power shifts between feedlots and processors under varying market conditions (primarily weight and supply). The importance of monitoring such a shift is that the side controlling more bargaining power has a greater profit potential.

It is essential to understand that weight, although not as dominating as previously suspected, has a substantial affect on bargaining power. Additionally, showlist size plays a determining role in bargaining power. It would be improper to state that one factor is dominant over the other, rather it is necessary for the two variables to be used in association with one another to derive a true illustration of bargaining power.

Further study could be focused on feedlot and processor dynamics. This type of study would monitor whether or not the entity in control of bargaining power is utilizing it in such a way as to achieve the highest possible profit. This information would be particularly useful to feedlots due to the fact that the majority of the time they have less bargaining power. An observation is that feedlots sell animals too cheap in the FCMS even when they control bargaining power. It is hypothesized that this also occurs in industry. This can be attributed to the belief that they are content with making a

moderate profit, when in actuality they could make a tremendous profit. A major drawback, however, is obtaining pertinent information from the industry for testing purposes. However, proven results in this area could potentially improve long-run feedlot profits.

Additional exploration resulting from this study could be in the area of price discovery and price determination. Previous research in agricultural economics has not clearly differentiated between the two (Ward 1997). However, factors such as supply and demand that affect bargaining power also affect price. This is represented through the creation of the showlist and weight interaction variables used in this research whose results parallel the dynamics of price discovery. Further research could clearly illustrate the characteristics defined by price discovery and those defined by price determination. The outcome should be a clear differentiation between the two.

One major limitation to the study was the inability to isolate embedded factors that affect bargaining power. Further detailed study could be employed to test for other significant factors that affect it. This type of analysis could include tracking individual participants under all market conditions to study whether one person bargains more effectively than another. It is clear that extended planning and precise experimental structure is needed for this to be accomplished, largely due to the effort required to keep records on each participant for the duration of the simulation.

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TABLE 1

HYPOTHESIZED EFFECT OF WEIGHT ON BARGAINING POWER FOR FEEDLOTS

Weight lbs	Hypothesized Effect On Bargaining Power (pos/neg)	Hypothesized Explanation
1125	pos	Feedlots have greatest bargaining power but less overall profit because of lower price per pound
1150	neutral	Maximum shared profits result (base situation)
1175	neg	Bargaining power shifts to packers because feedlots seek to sell cattle before they are docked for the animals being too heavy
1200	neg	Feedlots lose majority of bargaining power; Last weight to sell without severe penalties
1225	-----	Cattle are bought by the computer system at a severe penalty; feedlots have virtually no chance to make a profit

TABLE 2

DATA COLLECTION

Year	Trading Begin (Week)	Data Collection Begin (Week)	Data Collection End (Week)	Trading End (Week)	Number of Observations
1994	21	30	103	103	2644
1995	22	30	101	115	2665
1996	21	37	96	97	1940

TABLE 3
SUMMARY STATISTICS

VARIABLE	MEAN	STANDARD DEVIATION	MINIMUM	MAXIMUM
BPI	-0.15	1.95	-11.45	10.19
1125 lb cattle	0.11	0.31	0	1
1175 lb cattle	0.27	0.45	0	1
1200 lb cattle	0.13	0.34	0	1
Showlist*1125 lb (pens*)	11.98	35.04	0	152
Showlist*1175 lb (pens)	35.00	57.89	0	173
Showlist*1200 lb (pens)	18.71	47.53	0	173
Showlist Size (pens)	121.68	19.16	86	173
Showlist Squared (pens)	1.52×10^4	4.83×10^3	7396	29,929

TOTAL NUMBER OF ANIMAL PENS SOLD	**7249**
AVERAGE WEIGHT (Lbs)	**1161**
AVERAGE SHOWLIST SIZE (pens)	**122**

* Refers to 100 animals of uniform grade, weight, and structure characteristics

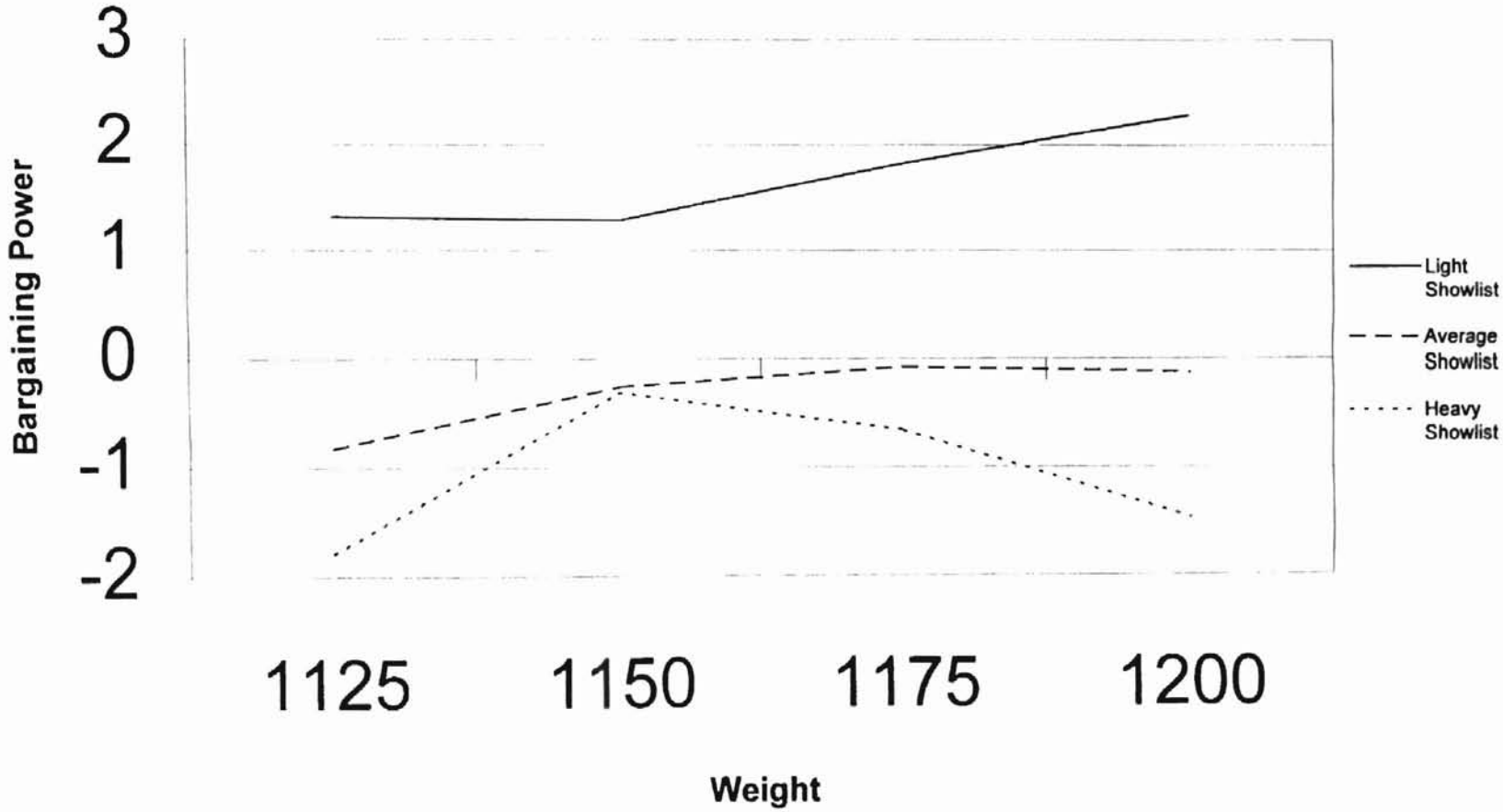
TABLE 4

STATISTICAL RESULTS

VARIABLE	PARAMETER ESTIMATE
Constant	12.03* (12.07)[a]
1125 lb cattle	1.75* (4.75)
1175 lb cattle	1.54* (4.88)
1200 lb cattle	3.43* (6.55)
Showlist*1125 lb	-0.02* (-5.78)
Showlist*1175 lb	-0.01* (-4.39)
Showlist*1200 lb	-0.03* (-6.91)
Showlist Size	-0.17* (-10.29)
Showlist Squared	5.8×10^{-4}* (8.46)
Year 1 (1995)	-0.24* (-3.75)
Year 2 (1996)	0.28* (3.88)
R^2	0.12
Number of Observations	7249

[a] Represents t-statistics, * denotes significance at the 10% level.

Figure 1
Bargaining Power in Association with Weight and Showlist



APPENDIX A

EXAMPLE OF TRANSACTION SPECIFIC VARIABLES ACCORDING TO YEAR

WEEK	BPI	1125	1150	1175	1200	Shwl * 1125	Shwl*1150	Shwl * 1175	Shwl * 1200	Showlist	Showlist^2	1994	1995	1996
30	-3.025	1	0	0	0	123	0	0	0	123	15129	1	0	0
71	-0.205	1	0	0	0	123	0	0	0	123	15129	1	0	0
80	-0.270	0	1	0	0	0	109	0	0	109	11881	1	0	0
30	2.020	0	1	0	0	0	111	0	0	111	12321	0	1	0
56	-1.265	0	0	1	0	0	0	125	0	125	15625	0	1	0
91	-0.650	0	1	0	0	0	108	0	0	108	11664	0	1	0
37	1.435	0	0	0	1	0	0	0	144	144	20736	0	0	1
73	4.810	0	0	0	1	0	0	0	118	118	13924	0	0	1
92	1.370	0	1	0	0	0	104	0	0	104	10816	0	0	1

ESSAY TWO

CONTRACTING IN THE BEEF INDUSTRY

CONTRACTING IN THE BEEF INDUSTRY

Abstract

Recent developments within the fed cattle segment of the beef industry have led to structural changes in the market. Among these changes is an increase in the use of contractual agreements between feedlots and meat processors. Contractual arrangements can benefit both feedlots and processors by considerably reducing price and production risks. However, the effect of these arrangements on overall price and returns to major segments in the industry has been a source of substantial controversy. As contracting levels increase within a market, a portion of the total available supply is delegated to those agreements. This portion of the supply is referred to as "captive supply." As captive supply increases, the portion of the supply available for sale in the cash market decreases. This phenomena is known as a "thin market." A common contention is that cash price is driven below normal levels and experiences increased volatility as captive supply levels increase. Therefore, this essay examines the effects contracting has on cash market prices.

CONTRACTING IN THE BEEF INDUSTRY

Introduction

A strong trend of contracting has overtaken many areas of production agriculture. Since 1960, contracting has been a growing part of agriculture and in 1993 accounted for about $47 billion (32 percent) of U.S. agricultural production (USDA 1996). Contractual agreements are common place in many industries such as broilers, turkeys, eggs, milk, fruit, and vegetables.

Cattle marketing has similarly seen increased levels of contracting, vertical integration, and strategic alliances. These arrangements develop forms of "captive supply" for packers and, as they increase in the industry as a common vertical exchange relationship, they increasingly lead to what is commonly called a "thin" cash market. There have been strong ongoing concerns about the impact of this change on pricing dynamics (Hayenga 1979). Some have argued that these changes will result in lower prices and returns to farmers (Elam 1992). Another common theoretical expectation is that the price will become increasingly volatile as a market becomes increasingly thin (Williamson 1979). These changes and potential effects are a source of substantial controversy (Hayenga 1979; Elam 1992; Williamson 1979).

A key need is for research to study the effect of contracting on markets. Study of the impact of contracting presents substantial difficulties. The markets in question are slowly changing in structure by implementing non-price procurement methods such as contracting. This is a new phenomenon and there is a lack of data for a large-scale time

series study. However, a research design where contracting levels can be controlled to study the effects at different levels can be developed using experimental economics. In this type of approach, varying levels of contracting can be studied to identify their impact on market price levels and price volatility due to thin markets.

This study will focus on the effects contracting has on the cash market price received for beef cattle. Controlled changes in contracting levels will be used to examine the effect of contracting levels on cash prices. Special interest is devoted to examining whether cash price is forced below or above average in periods of high contracting. Additionally, volatility issues will be addressed to identify whether increased levels of contracting cause increased amounts of rapid price adjustments in the cash market.

Literature Review

This study addresses the effects of captive supply and thin markets (caused from contracting) on cash market prices. Several areas of study have focused on these effects, but previous research has not been able to isolate the effects of increasingly thin markets from other changes in supply and demand. Early cash price studies addressed price changes from a market structure standpoint and were then used as a building block for later studies. The information covered here begins with early studies of market structure and then moves into later research that is specific to captive supply and thin markets. Reviewing previous research on captive supply and price discovery will link this research to earlier work as well as utilize knowledge in the areas of price discovery, the effects of contracting, and price volatility.

Price Discovery

Price discovery within the fed cattle industry is based upon market dynamics. In recent history price discovery has commonly been studied from an industrial organization theory approach. This is the belief that buyers and sellers directly affect price formation through "shocking" or changing the market conditions. In the beef industry, two specific forms of price discovery were studied using this theoretical approach, both of which were based upon a shock to the marketing system. This theory is relevant to the current work because it has been the building block upon which all subsequent research has developed.

The first investigation examines the effects on price when a major buyer exits the market through slaughter plant closings (Love and Shuffett 1965; Ward 1983; Hayenga, Dieter, and Montoya 1986). Prices declined in two of the three studies (Love and Shuffett 1965; Ward 1983), while the third study revealed no immediate price decline in relation to comparison markets (Hayenga, Dieter, and Montoya 1986).

The second set of studies focuses on the effects of price when buyers enter the market through a change in marketing method (Ward 1984; Rhodus, Baldwin, and Henderson 1989; Bailey and Peterson 1991) or plant opening (Hayenga, Dieter, and Montoya 1986). In all four cases price increased as a result of more buyers. Ward et al. (1999) notes that all price effects in the previous studies are due to sudden shifts in market conditions and structural behavior changes.

Effects of Contracting

A new trend for managing vertical exchange relationships, which may have price impacts, has become increasingly common. This mechanism involves non-cash procurement which results in a certain amount of the product supply being under contract or other managed relationships. The supply that is involved in this process is typically known as "captive" supply. This results in the beef industry when a feedlot enters into a contract with a packer. Captive supply is traditionally created through the use of one of three procurement methods: 1) Exclusive Marketing Agreements, 2) Packer Feeding, or 3) Forward Contracting. In each case cattle are purchased several weeks prior to slaughter and before animals are sold in the cash market (Ward et al. 1999). Once such an agreement has been formed, supply contracts are established in which the cattle feeder agrees to market a specified number of cattle in a specific period to a given buyer (Ward et al. 1998). Prior research in this area has focused on cash market price effects due to captive supply.

A significant portion of contract utilization can be attributed to the need for more uniform goods. In open market settings, goods often vary drastically in size, shape, appearance, weight, quantity, timeliness, and quality. Further, it can become expensive to get specific quality attributes for certain products. However, with the use of contracting, a more exact product specification can be achieved. In other words, members of a contract agreement can agree on the characteristics above, as well as a delivery date and price. This is a key factor that has increased the use of contracting within the poultry and swine industries. Both industries are similarly related in that

production takes place in an extremely controlled, as well as confined environment. The result is that entrepreneurs of each industry produce a uniform product that is later sold (under contract) to a major wholesaler or other contractual buyers.

An increase in the use of contracting can also be attributed to the dependability of income that is received from performing a service or producing a commodity. Contracts can be established to cover extended periods of time such as months or years. This type of agreement benefits many producers because it ensures a stable income into an area that is typically not well diversified (USDA 1996). The result is a reduction of income risk on behalf of producers and a secure purchase price for processors.

Contracting has also become an important part of business due to a need for tighter vertical coordination. One means of improving vertical coordination is for a central or coordinating body to establish contracts with various entities that produce all or part of a product. The contracts typically specify that a certain amount of goods will be produced and available (at a pre-determined date) for the coordinating body. Consequently, the producing bodies receive compensation for their activities as long as all contract specifications are met.

Anderson et al. (1998b) notes that firms understand the importance of vertical coordination and further acknowledges that studies have expanded to include non-price coordination methods while focusing on vertical coordination. For example, Frank and Henderson note that "asset specificity" is often a strong incentive for vertical coordination. Asset specificity describes goods or components that are generally unmarketable or difficult to market once purchased or created, however play a major role in the creation of a specific product. Williamson further breaks the nature of an asset's

specificity into three categories: nonspecific, mixed, and idiosyncratic. Nonspecific assets, or investments as described by Anderson et al. (1998b) and Williamson, can be used in many different ways, whereas idiosyncratic investments have a specific use. As expected, mixed asset situations exist between the previous two extremes mentioned above. Williamson believes that contracting exists primarily between parties when the asset involved is of a mixed nature, whereas vertical integration (complete ownership) becomes more prevalent when assets are idiosyncratic. Thus, vertical coordination has become prevalent in the beef industry and led to an increase in contractual agreements which have boosted the amount of captive supply.

Research measuring the effects of captive supply has studied the effects of price in relation to different levels of captive supply. Elam found that increasing levels of captive supply drove cattle transaction prices down in Kansas, Nebraska, Colorado, and Texas over the period of October 1988 to May 1991. Hayenga and O'Brien compared weekly average feeder prices for the same states with other reported market prices from October 1988 to December 1989. Overall research found that the impact of captive supply on price was mixed. Some research found cash price to be higher and others found it to be lower, but mostly insignificant. A third study also found a negative relationship between fed cattle captive supply shipments and cash market transaction prices between May and November 1990 in Kansas (Schroeder 1993). Finally, Ward, Koontz, and Schroeder (1998) estimated impacts from captive supply on cash transaction prices across the United States. In general, increased levels of captive supply yielded lower cash transaction prices in this study.

Current records show that in 1997 16% of the fed cattle traded were sold under contract and the trend likely shows a significant increase in the future (USDA 1999). Anderson et al. (1998a), in a study citing the need for public information in relation to contracting, predicts that forward contracting in the fed cattle industry will continue to grow in the future. Ward (1998) agrees by noting that the beef industry faces larger biological differences and longer production delays than the pork and poultry industries in addition to cattle requiring vast amounts of space which makes production land-intensive.

Price Volatility

Price volatility is a concern associated with high levels of contracting. Through monitoring the effects of contracting, it is possible to note any fluctuations or volatile characteristics in cash prices that may occur due to captive supply situations brought on by contracting. Previous research leads to the assumption that as the cash market supply becomes thin, the cash price is capable of being drastically affected (Hayenga 1978). As market conditions change, the cash price seeks to restore market equilibrium. Thus, price frequently fluctuates in an attempt to restore the equilibrium (Ward 1997).

Previous research dealing with pricing issues in this area have largely been in relation to general captive supply and thin market situations. The emphasis of such research has been to conceptualize the effects of thinning supplies on price. Both captive supplies and thin markets cause changes in market structure. A major change occurs in the method of price discovery. Because these conditions lead to markets in which buyer-seller negotiations occur for only a small portion of the total volume traded, it is plausible

to experience more variability in price (Jesse 1980). Further, research has also revealed that cash values may not be representative of aggregate supply and demand conditions due to the effects of thinly traded markets (Raikes 1978; Williamson 1979).

Price volatility is an issue that has lacked extensive study, particularly in relation to contractual agreements. A large factor contributing to the lack of study is an inability to obtain industry pricing literature. Extended pricing data is not available because of the cost associated with collecting such information. Further, information that could potentially be beneficial is often internalized within large agribusiness firms and is not available for public use.

Summary

The research presented here has focused on three areas. First, early studies conceptualized the factors that cause changes in market dynamics. These studies were largely based on industrial organization theory. Information from these research areas were then used as a stepping stone in a trend toward examining the effects of changing market conditions. Common areas of study have been captive supply and thin markets where captive supplies were often found to impact cash prices negatively. The third research area deals with the causes and effects of price volatility. This research indicated that increasingly "thin" markets should lead to increased price volatility and non-supply/demand representative prices. It is also important to note that previous research has largely been hampered through unavailable and incomplete data.

Experimental Economics

Experimental economics is a form of modeling that is designed to represent the conditions that exist in real world markets. Several criteria govern the formation of an experimental research study. These factors include the ability of the study to be replicated, an inherent motivation force that stimulates participants' interest in the activity at hand, and the ability for choices to be made without bias.

A particular form of experimental economics is commonly known as experimental simulation. Experimental simulation maintains many of the qualities possessed by experimental economics, yet in a refined manner. Experimental simulation is similar to experimental economics in the three factors described above. However, it is common for experimental simulation to be free from most inhibitors. In other words, restraints are not placed on the majority of the variables for the purpose of testing, while experimental economics may have restraints placed on multiple variables (Friedman and Sunder 1994). Thus, the distinguishing factor is that experimental simulation allows for the creation of a more life-like market.

The nature of the Fed Cattle Market Simulator (FCMS) employed at Oklahoma State University resembles a design governed by experimental simulation characteristics. This allows for a free flow of trading activity that would naturally occur in an open market. Accordingly, the simulator is also capable of controlling specific aspects of the simulated market in order to complete related market studies. Therefore, it was used to create the data for this study.

The Fed Cattle Market Simulator was used to create an atmosphere analogous to that which exists between feedlots and packing companies. The FCMS allows players to act out the part of both packers and feeders through trading pens of cattle. The cattle are produced by feedlots and then sold to packers. It is the job of both the feedlots and the packers to mathematically calculate the breakeven prices that must be received in order to achieve profits or avoid losses that could occur through trading. Each side seeks to optimize the profit they are capable of receiving from cattle sales.

The FCMS is played in specific trading periods that last between seven and eight minutes. Each trading period is termed a week. At the end of each trading week, there is a five to ten minute information session in which participants monitor prices and analyze supply and demand conditions that are analogous to that available from the USDA/AMS (Anderson et al. 1998a).

Once play begins, feedlots are given a certain amount of cattle in which they have to market to the packers. Animals within the game may be sold through the use of an open cash market, marketing agreement, or forward contract. It is the responsibility of the feedlots and processors to bargain with one another in such a way as to arrive at a reasonable sales price for both parties.

In past studies, researchers have analyzed the effects of public information (Anderson, et al., 1998a), price discovery (Ward, et al., 1996a), as well as non-price vertical coordination in the fed cattle market (Anderson, et al., 1998b). Since this evaluation will involve analysis of cash price and volatility, the objective of this study is to estimate the extent to which increasing levels of contracting affect cash market prices.

Data

Data for this research, as stated, were generated from the FCMS. The class meets in the spring semester and generally consists of upper-level agricultural majors. The data set was generated from a one semester controlled study of contracting levels in the spring of 1999 and then compared with pricing results of three previous years (1994, 1995, and 1996).

Students were allowed to freely trade animals for the first simulated thirteen weeks of the study in order to become familiar with the interaction process required to be successful. At the end of this introduction session, students were informed by the administrators of the study that selected levels of contracting were going to gradually be implemented into the simulation. Before each trading period, feedlots were instructed how many cattle were to be contracted to predetermined processors. (Additionally, teams were also allowed to contract on their own as long as the mandatory contracting levels were fulfilled).

The research plan consisted of six discrete contracting levels: 1) 0%, 2) 25%, 3) 50%, 4) 62%, 5) 75%, and 6) 87%. Each level of contracting was used once for eight weeks before rotating upward to the next consecutive level. Table 1 indicates weeks for each contracting level and Table 2 contains a summary of statistics of the data.

Contract prices were determined from the previous week's cash price. Modifications were made to the contract price if either the packer or feeder involved in a contractual agreement lost money the week before. In order to make appropriate adjustments, both packers and feeders were required to indicate if they lost or made money. If both entities were making or losing money, then no adjustment was made.

However, if one entity was making money and the other losing money, then a $0.50 price adjustment was made for the packer or feeder that was losing money. Further, in all cases, packers and feeders were not allowed to share profit and loss statements. Finally, in the event of disputes over the truthfulness of prices from previous weeks, the administrators of the experiment had the right to penalize the offending party up to $2.00 at their discretion.

The testing period consisted of 58 simulated weeks in which contracting was monitored. All contracts were selected at random in order to bypass favoritism between participants. Additionally, students involved were frequently rotated so that all players had the opportunity to experience trade as both feedlot and processing managers.

Conceptual Framework

Understanding market structure is essential in order to conceptualize the effects of changing characteristics within a market. Markets typically evolve over time. Within the evolution, structural behavioral changes occur. In this case the change is an increased use of contracting. Therefore, through a common understanding of structural dynamics, such as price determination, the effects of contracting can be isolated.

Price is determined through the dynamic interaction of supply and demand. Product supply within a given market is used to fill consumer demand. Consequently, buyers and sellers agree to terms in which the product will be sold. Therefore, during the sales negotiation of a product a transaction price is agreed upon. Over the course of multiple transactions, buyers will generally seek to find suppliers that are willing to sell

their products at the lowest price possible. Likewise, suppliers will generally seek out buyers who will purchase their products at the highest price. Throughout repetition of this process, an equilibrium (or common) market price evolves. However, when imposing characteristics such as contracting are integrated into the market, thin market characteristics evolve. These characteristics may impact cash price levels and volatility. This can largely be attributed to the effect of captive supply which allows for only a small amount of bargaining to exist within the cash market. Therefore, the market often suffers from under-represented cash prices because of a lack of buyers and sellers needed to establish a pertinent price. Further, this can lead to the possibility of delayed price effects in the cash market. Delayed effects occur when the cash price maintains high (low) levels for extended periods of time when it should be adjusting to current market conditions. This potentially leads to abrupt shifts in the cash price in an effort to reestablish the equilibrium price.

In the beef industry, feedlots and processors bargain and negotiate in order to establish transaction prices. Previous transaction specific research dealing with the impacts of captive supplies on fed cattle prices have established both supply and demand variables as well as transaction specific information (Ward et al. 1998). Previous research can be conceptualized by the following general model:

(1) Price = f(Supply/Demand, Transaction Specific Characteristics).

However, this study focuses on week-to-week market changes so the use of transaction specific information is not applicable.

Supply and demand in this case can be represented by showlist size (the number of animals available for sale) and boxed beef price (the price in which wholesale cuts of

meat are sold), respectively. These characteristics parallel those used by Anderson et al. (1998a) and Ward et al. (1998, 1999). The relationship can be expressed by:

(2) $$P = f(BBP, SHWL),$$

where BBP is boxed beef price and SHWL is showlist.

The effects of contracting can be captured through adding an additional variable that is representative of the contracting level that is utilized during the applicable week of study. The use of contracting causes a form of captive supply as well as leads to a thin cash market. The contracting variable is important because it indicates the amount of the market which is contracted and hence is not negotiated.

The effects of contracting on cash price will be tested through the use of the controlled data produced from one semester of the FCMS. The data yields prices realized in the cash market as contracting levels are varied in a controlled manner. These prices will then be compared to three previous years of data that yield cash market prices when contracting was either non-existent or done voluntarily only. The comparisons will be used to identify the effects on cash price returns and serve as an agent to monitor price volatility. Cash prices received under contract will be tested against cash prices received under no contract in order to determine if there is a significant difference between the two.

Through the graphical depiction (Figure 1), which represents the pricing data used, it is apparent that different prices are present under contractual conditions than under non-contractual conditions. At the 0% contracting level, prices are very similar indicating that similar underlying pricing dynamics exist for all four years. However, at the 25% contracting level, 1999 cash prices begin to consistently deviate from the other

years, sometimes dramatically. Further, as contracting levels increase, the cash price begins to deviate in a greater amount.

The fact that pricing dynamics change is not surprising. However, it is surprising to see that cash prices associated with contracts (1999) rose above previous years' prices (1994, 1995, and 1996) in certain situations. This seems to refute a common conventional argument that increasing levels of contracting lead to lower cash market prices.

The effects of contracting will be evaluated by testing three hypotheses. Each hypothesis will utilize different approaches to study thin market effects. The hypotheses are: 1) Increased levels of contracting cause lower average cash prices, 2) Increased levels of contracting cause an "enhanced supply effect", and 3) Increased levels of contracting cause cash prices to become increasingly volatile.

Hypothesis 1

It is hypothesized that the cash market price for fed cattle is reduced by increased levels of contracting. A common argument in many studies is that as captive supply increases, the cash market price declines (Elam 1992; Schroeder et al. 1993). In this examination the contention that increasing levels of contracting cause low cash prices will be tested.

Captive supply may have notable effects on general supply and demand conditions because it causes a thin cash market. In this situation captive supply reduces the number of available (non-purchased or non-committed) fed cattle in short-term

supply. This occurs because animals are already contracted to specific individuals, therefore reducing the number of animals available for sale in the cash market. Additionally, packers will purchase fewer animals from the open market because their demands have been partially met through captive supply cattle deliveries. As a result, the short-term demand curve shifts to the left and a new supply/demand equilibrium is established.

In order to evaluate the effects of contracting on cash market price it is necessary to include the factors that have an affect on overall price formation as well as contracting levels. As discussed earlier, the variables that are effective at describing supply and demand conditions are showlist size and boxed beef price. With the addition of a contracting variable this results in the following regression model:

$$P_t = \alpha_t + BBP_t + SHWL_t + PerCont_t + \epsilon_t, \quad (3)$$

where P_t = price, α_t = intercept value for zero percent contracting, BBP_t = Boxed Beef Price, $SHWL_t$ = Showlist Size, $PerCont_t$ = percent contracting, and the subscript *t* refers to the trading week. The contracting percentage is used as a test variable in order to analyze whether it has a significant affect on price determination as contracting levels increase.

The results of the model are presented in Table 3. First order auto-correlation was discovered and corrected for using the Cochrane-Orcutt procedure for correction of auto-correlation as employed by the Statistical Analysis System (SAS). Additionally, multiplicative heteroskedasticity was found using the Breusch-Pagan, Glejser, and Harvey tests for heteroskedasticity, but was not believed to skew the results and therefore not corrected for. The model proved to have strong explanatory power and revealed an

R^2 of 0.90. Each of the parameter estimates is highly significant. Most interestingly, the contracting coefficient is negative which is consistent with the common argument that high levels of contracting lead to low cash prices. This result may be consistent with earlier research, but the graphical illustration of cash market prices (Figure 1) suggests that the previous regression results may not fully reflect the underlying price dynamics. As shown from the graph, cash price actually exceeds normal levels in many situations. This certainly seems to contradict the evidence above.

The analysis of the graphical illustration of price behavior was further strengthened through the use of a t-test (presented in Table 4) to determine if any of the pricing data deviated significantly between the years. This confirmed that mean prices for data comprising 1994, 1995, and 1996 were not statistically significantly different, whereas the mean prices for 1999 were statistically different in four of the six trading periods. Further, three of the four occurred during the highest levels of contracting.

Prices representing 1999 became significantly different once contracting was implemented. The only deviation from this pattern occurred at the 50% contracting level where the price crossed the prices associated with the other years. Most importantly, price was *not only significantly lower than previous cash prices, but also significantly higher than the norm.*

Thus, this result seems to suggest that high prices are higher than the norm with small supply levels and low prices are lower than the norm with large supply levels. Under increased contracting levels this would indicate that supply has a more dramatic affect on cash market prices. This indicates that the cash market overreacts when the

market as a whole experiences extreme supplies (either high or low) along with high levels of contracting.

The results from the regression analysis supported conventional theory in that increasing levels of contracting lead to lower cash prices. However, the qualitative results yielded from the graphical depiction of cash prices as well as the statistical test results suggest that contracting has mixed effects on cash price.

Hypothesis 2

The previous results showed that contracting seemed to have varied or inconsistent effects on the cash price. This suggests that under certain conditions, contracting can cause cash prices to rise above normal, while at other times it can cause cash prices to dip below normal. Similarly, it might also be reasonable to expect an enhanced supply effect on cash price as contracting levels increase. As contracting increases, the number of buyers and sellers bargaining in the cash market declines. Therefore, the competition for available supply is decreased in the cash market and cash price declines. Further, as both contracting levels and overall supply levels increase, the cash market suffers even more. Controversly, if high levels of contracting are associated with low overall supply conditions, the competition for products in the cash market will be great, resulting in higher cash prices. Therefore, it is logical to determine that as contracting levels increase, the marginal impact of supply increases.

This suggests that there may be different relationships between supply and price than when contracting is not present. An increase in supply would result in a lowering of

the cash price. However, with increased amounts of contracting, the cash price is not only lowered because of supply, but it also suffers the effects of buyers fulfilling all or part of their demand requirements through contractual obligations. Therefore, cash price is driven down further because of the effects of contracting. This suggests the effect is negative. However, the same principle can hold for periods of low supply in that prices are pushed higher. This could be termed the "enhanced supply effect" where essentially highs get higher and lows get lower in the cash market.

This hypothesis can be tested through modifying Equation 3 to include a variable that represents the interaction of contracting and showlist. This theory can be tested through the empirical equation:

(4) $$P_t = \alpha_t + BBP_t + SHWL_t + PerCont_t + ShwlCon_t + \epsilon_t,$$

where P_t, α_t, BBP_t, $SHWL_t$, $PerCont_t$, and t are unchanged, and $ShwlCon_t = SHWL_t * PerCon_t$.

The statistical results of this regression are shown in Table 5. The parameter sign of boxed beef remains unchanged, however the parameter sign for contracting became positive but was not substantially significantly different from zero, indicating that it did not have either a positive or negative affect on cash price. Further, the showlist variable became insignificant while the showlist-contracting interaction variable is significant, indicating that it has an affect on cash price.

The R^2 of this regression analysis is 0.91, which indicates slightly broader explanatory power than Equation 3. First order auto-correlation was detected and corrected for using the Cochrane-Orcutt procedure in SAS. Multiplicative Heteroskedasticity was also found using the Breusch-Pagan, Glejser, and Harvey tests for

heteroskedasticity but not corrected for because it is not believed to affect the regression results.

The results of this experimental model suggest that the showlist-contracting interaction variable yields results that have previously not been found. This variable indicates that contracting is capable of enhancing the effect of supply on cash price and further shows that cash price can be both negatively and positively affected depending on the supply situation.

Consistency with earlier studies has been exemplified through observations from industries with high levels of contracting. One example is the national pork industry which has been marked by high levels of contracting over the past few years. The pork industry has experienced the lowest sustained prices in recent history with high oversupply, which would be consistent with the "enhanced supply effect" found in this experiment.

Hypothesis 3

Effects observed from increased contracting levels imply that cash prices could become more volatile as suggested by theory (Raikes 1978). Volatility issues studied in this context refer to abrupt and sudden changes in cash prices due to extensive contracting which leads to an increasingly thin market. Through observing the effects of the controlled levels of contracting used in this research, it is possible to study price volatility on a week to week basis as well as to see whether the cash market is subject to large overall price adjustments. The goal of this study is to make an initial observation

about the mechanics of price volatility, rather than create in depth research. The information gained from this study should be used to identify the initial effects of contracting on volatility and create a basis in which further research can be accomplished. Therefore, the third hypothesis is that cash price begins to incorporate volatile characteristics as contracting levels increase.

Cash price volatility can be monitored through the graphical illustration presented in Figure 2. It is important to note the strong resemblance in price change characteristics between 1994, 1995, and 1996. The change in the 1999 cash price closely follows the changes of the other three years (1994, 1995, and 1996) during periods of no contracting. However, with the advent of contracting, the cash price begins to experience periods of vary calm price changes followed by periods of rapid and drastic adjustments. Price changes that occur between weeks 43 and 50 are mild, whereas price changes between weeks 70 and 76 are extremely erratic. Another interesting pattern appears between weeks 51 and 60. It appears that the cash price experiences changes that are inconsistent with the other three years. In fact, the changes in price appear to be greater and then smaller than the other years.

These patterns can be studied further through the examination of Table 6. Between weeks 35 and 42, the changes in 1999 cash price are not significantly different than those for 1994, 1995, and 1996. However, between weeks 43 and 75 the price change is significantly different than the previous years. Even more interesting is the fact that between the weeks of 43-50 and 59-66 the cash price for 1999 had less price change than the other years. Moreover, the statistical results in Table 6 are consistent with the results presented in Figure 2.

It can be noted from the statistical and graphical results presented above that cash price volatility is affected by increasing contract levels. Cash price changes for 1999 were found to be significantly different from the changes for 1994, 1995, and 1996. Interestingly, the changes for 1999 were not only different in higher volatility, but also in lower volatility. Further, as the contracting levels increased, variability in cash price changes seemed to increase, but not in a linear fashion.

Market Implications

The results of this study may be of interest to all parties involved in cattle trade and negotiations. Firms within the fed cattle segment of the beef industry that rely heavily on non-cash procurement methods for cattle should be especially interested in this research. Results of this study identified three major characteristics associated with contracting. They are: 1) Cash market prices are affected both positively and negatively by increasing levels of contracting, 2) Increasing levels of contracting cause an "enhanced supply effect" on cash market prices, and 3) Increasing levels of contracting lead to the potential for sudden large swings within cash market prices.

Some previous research found that cash market prices maintained an inverse relationship with increasing levels of contracting. However, through the use of regression analysis, statistical testing, graphical illustration, and replicable data sets, it has been shown that increasing levels of contracting can push cash prices above normal levels.

Producers and processors may also find useful information in test results that reveal cash market price is drastically affected by a combination of contracting level and supply (showlist). Research revealed that in periods of high (low) supply and high levels of contracting, the cash market price is dramatically lower (higher) than in average conditions. These situations should be monitored on a continual basis. Through doing this, producers and processors will have both an idea of expected contract agreements (monetary and quantity) as well as what price levels to expect in the cash market.

Finally, it is also useful to know that increased levels of contracting have the potential to cause variability in cash price. Systematic monitoring of contracting levels can reduce some price risk associated with filling demand quotas through the cash market. For example, if a general increase in overall contract levels is noted within the industry, it could be in a processor's best interest to implement more contracting agreements in order to eliminate the possibility of making large purchases in a volatile cash market.

The information presented here can be used to analyze potential effects in the marketplace. Producers and processors can utilize this material to heighten their awareness of price risks associated with substantial contracting levels, thus allowing them to plan appropriately.

Conclusion

This study has provided important insights into the effects of captive supply with a focus on contracting. The central issue has been to estimate the effects of contracting

on cash market prices. Results obtained from this research indicate that contracting has mixed impacts on cash prices, depending on supply situations. These results were different from earlier research and were only made possible through the use of experimental economics. The specific nature and length of data on contracting is unique to this study.

It has been identified from this study that price can be above or below average when increased levels of contracting are present, depending on supply levels. It has also been shown that cash market prices observed during high levels of contracting experience an "enhanced supply effect." This causes cash prices to experience "higher highs" and "lower lows." Additionally, cash price variability seemed to increase as contracting increased, but not in a linear fashion.

Further research in this area might be achieved through the use of the "Bubble Theory" to test dynamic adjustments and the probability of adjustments to underlying market dynamics (Behzad 1989; Topol 1991). This can be justified by the premise that price continuously increases (decreases) until it reaches a certain point and then decreases (increases) dramatically in an effort to adjust. As a result, the outcome is typically a significant over-adjustment. Thus, it is logical to deduce that contracting may affect efficient price discovery.

Research interests might also focus on volatility issues. Information presented here suggests that, in the presence of contracting, cash prices experience extremely volatile periods followed by calm periods. This information could potentially be beneficial for new, effective risk management approaches when contracting has a major influence on market dynamics.

Related research can also be achieved through the study of price behavior within the FCMS. Through graphical illustration, it became apparent that pricing characteristics are extremely closely related between the three years (1994, 1995, and 1996) of non-mandatory contracting. Study in this area could focus on price patterns and the illustration of price as it occurred in all semesters since the implementation of the FCMS.

A further research area would be to compare the results of this research with those gained from research in another industry. This would allow for the comparison of consistency within test results. Additionally, this research could identify differences and similarities in the effects of contracting on cash price behavior that are experienced between unrelated markets.

This research could further be improved through the use of another semester of mandatory contracting. Further results could therefore be compared for consistency with those gained in this paper. Similarly, it could potentially be beneficial to compare profit summaries between highly contracted feedlots and processors and lightly contracted feedlots and processors. This can be done for a given period of time in the same semester. The outcome should reveal whether one group benefits more than the other from contracting.

This research has analyzed the effects of contracting on cash prices. The use of experimental simulation allowed for the creation of data that were used to estimate characteristics of contracting that were previously unknown. The results obtained suggest that future research in this area could be beneficial because of the growing use of contracting in many production enterprises.

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TABLE 1

Contracting Levels According to Week

WEEK	CONTRACTING LEVEL
21 - 33[1]	0%
34 - 41	0%
42 - 49	25%
50 - 58	50%
59 - 66	62%
67 - 74	75%
75 - 82	87%

[1]Controlled contracting began in week 34. Prior transactions represented a training period for simulation participants.

TABLE 2

Summary Statistics (1994, 1995, 1996, and 1999)

VARIABLE	N	STANDARD DEVIATION	Minimum	Maximum
Average Price ($)	58	6.43	67.77	88.75
Boxed Beef Price ($)	58	6.77	113.07	137.21
Showlist (pens)	58	20.07	89.0	154.0
Contracting %	58	33.15	0.0	87.0
Contracting*Showlist (%*pens)	58	3.78×10^3	0.0	1.27×10^4

TABLE 3

Cash Price Regression Analysis with Contracting Percentage

Variable	Coefficient
Constant	-15.98* (-1.52)[a]
Boxed Beef Price (BBP)	0.84* (10.65)
Showlist (SHWL)	-0.08* (-3.21)
Contracting Percent (PerCont)	-0.06* (-3.46)
R^2	0.90
No. of Observations	58

[a] Represents t-statistics, * denotes significance at the 10% level.

TABLE 4

Mean Price and Test for Significant Differences for 1994, 1995, 1996, and 1999 with 1999 Contract Level

	CONTRACTING WEEK					
YEAR	35-42	43-50	51-58	59-66	67-74	75-82
1994	73.0	75.2	79.6	82.1	78.6	78.0
1995	72.8	74.7	79.6	81.8	81.3	77.9
1996	73.6	74.0	78.5	81.1	81.1	78.5
Contracting Percent	0%	25%	50%	62%	75%	87%
1999	74.3	70.3*	78.4	85.0*	86.1*	69.4*
Showlist[1]		High	Low	Low	Average	Average
Showlist[2]	138	128	100	91	116	116

* Denotes a significant difference from all others at the 10% level.

[1] Showlist size as compared to average showlist of 115-122.

[2] Average showlist size for each contracting percentage.

TABLE 5

Cash Price Regression Analysis with Contracting Interaction

Variable	Coefficient
Constant	-25.38* (-2.40)[a]
Boxed Beef Price (BBP)	0.87* (11.94)
Showlist (SHWL)	-0.03 (-0.72)
Contracting Percent (PerCont)	0.08 (0.97)
Showlist*Contracting Percentage (ShwlCon)	-1.18×10^{-3}* (-1.69)
R^2	0.91
No. of Observations	58

[a] Represents t-statistics, * denotes significance at the 10% level.

TABLE 6

Mean Week-to-Week Price Change and Test for Significant Differences for 1994, 1995, 1996, and 1999 with 1999 Contract Level

	CONTRACTING WEEK					
YEAR	35-42	43-50	51-58	59-66	67-74	75-82
1994	0.27	0.96	0.61	0.90	0.88	0.73
1995	0.50	1.70	0.81	0.77	1.07	0.99
1996	0.57	1.35	0.79	0.83	0.59	0.95
Contracting Percent	0%	25%	50%	62%	75%	87%
1999	0.59	0.40*	1.58*	0.49*	3.19*	1.74

* Denotes a significant difference from all others at the 10% level.

FIGURE 1
Prices for Years Studied and 1999 Contracting Percent

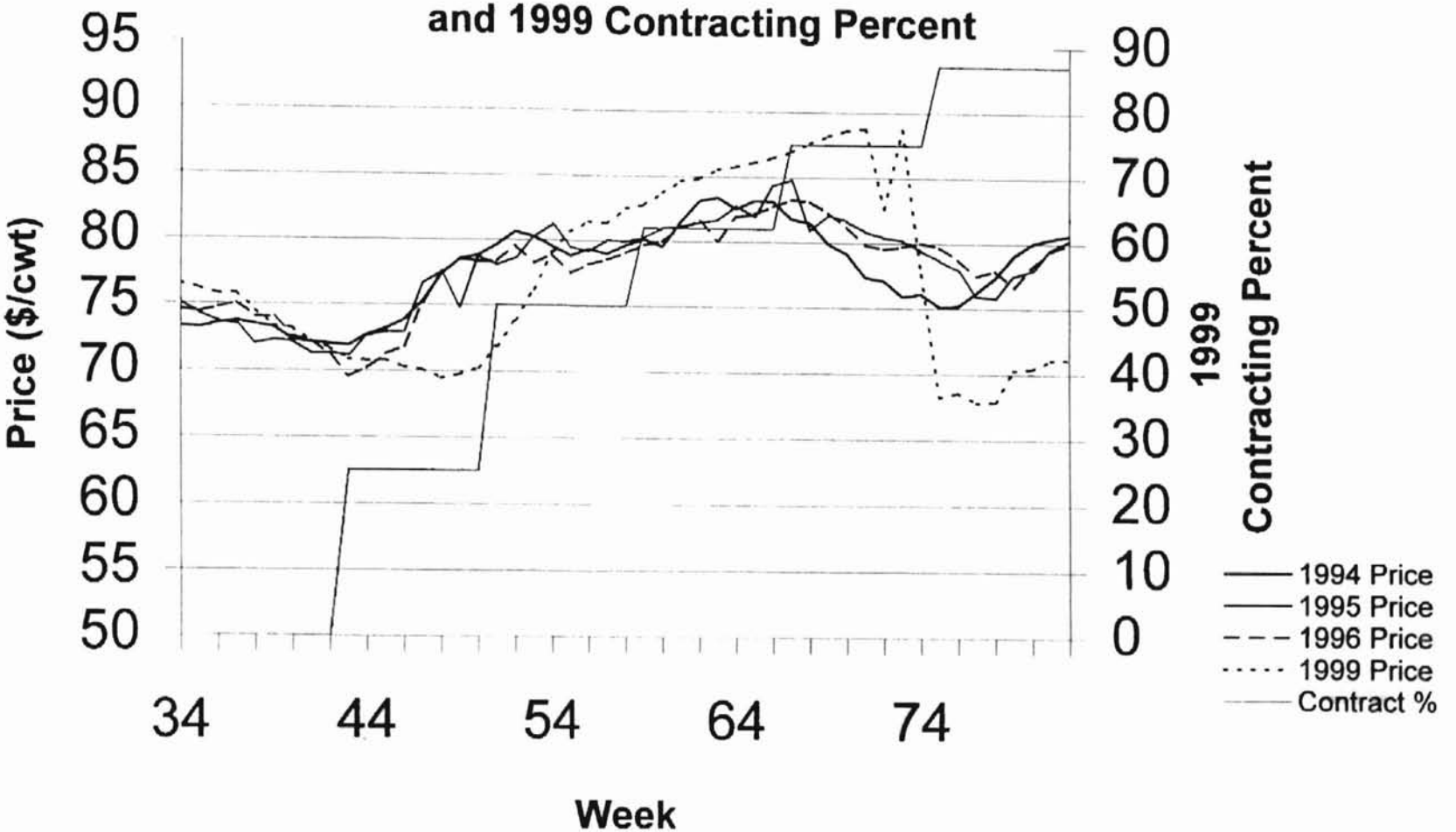
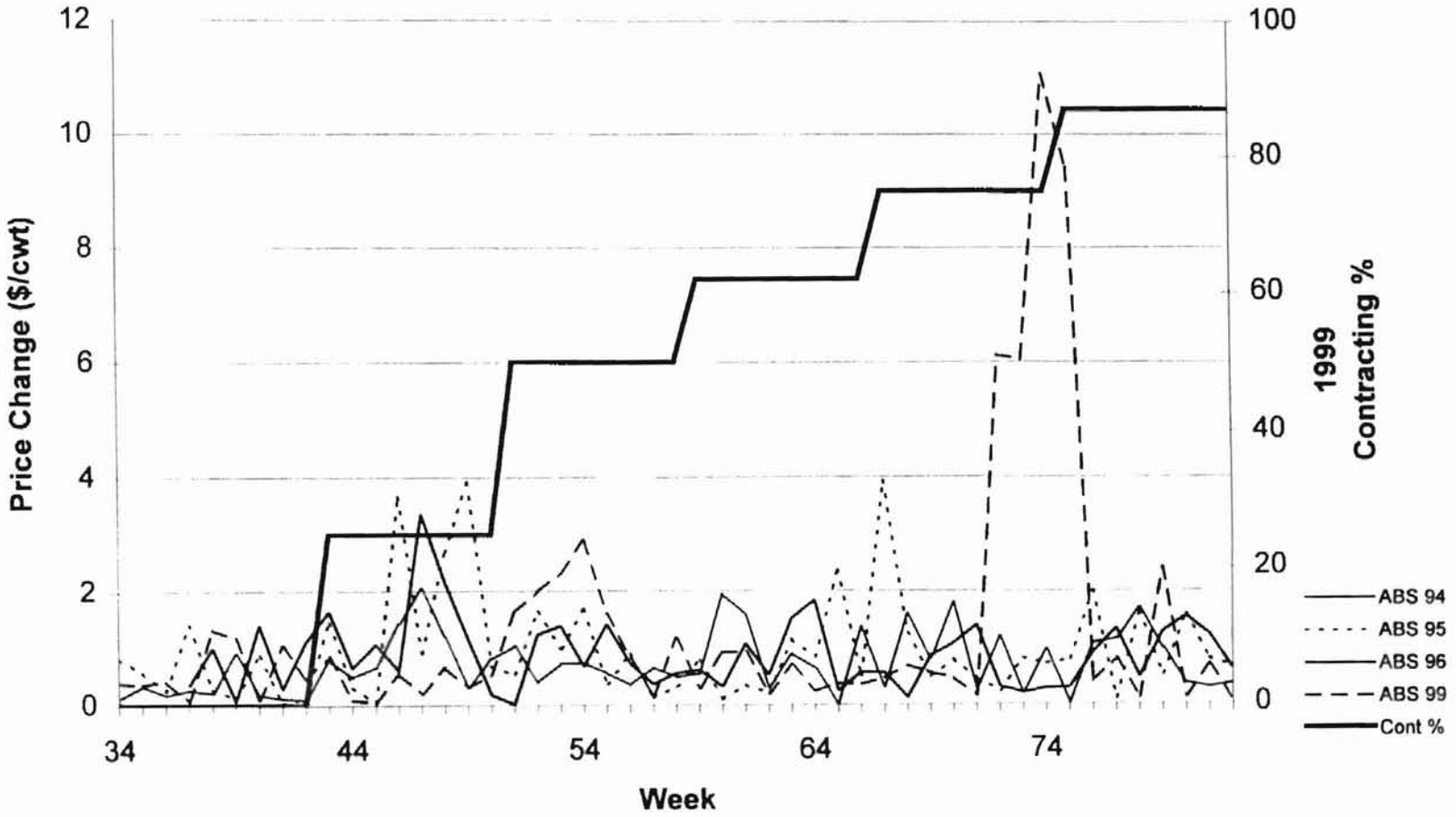


FIGURE 2
Week-to-Week Price Change
for Years Studied and 1999 Contracting Level



OKLAHOMA STATE UNIVERSITY
INSTITUTIONAL REVIEW BOARD

Date: August 3, 1999 IRB #: AG-00036

Proposal Title: "CONTRACTING IN THE BEEF INDUSTRY"

Principal Investigator(s): Conrad Lyford
Robert Hicks

Reviewed and Processed as: Exempt

Approval Status Recommended by Reviewer(s): Approved

Signature:

Carol Olson, Director of University Research Compliance

August 3, 1999
Date

Approvals are valid for one calendar year, after which time a request for continuation must be submitted. Any modification to the research project approved by the IRB must be submitted for approval. Approved projects are subject to monitoring by the IRB. Expedited and exempt projects may be reviewed by the full Institutional Review Board.

VITA

Robert Todd Hicks

Candidate for the Degree of

Master of Science

Thesis: BARGAINING POWER AND CONTRACTING AGREEMENTS WITHIN THE FED CATTLE MARKET: AN EXPERIMENTAL SIMULATION APPROACH

Major Field: Agricultural Economics

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