NCCC-134
APPLIED COMMODITY PRICE ANALYSIS, FORECASTING AND MARKET RISK MANAGEMENT

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Suggested citation format:

Dowty, T., C. Ward, S. Koontz, D. Peel, and J. Trapp. 1996. "The Impacts of Exclusive Marketing/Procurement Agreements on Fed Cattle Transaction Prices: An Experimental Simulation Approach." Proceedings of the NCR-134 Conference on Applied Commodity Price Analysis, Forecasting, and Market Risk Management. Chicago, IL. [http://www.farmdoc.uiuc.edu/nccc134].

The Impacts of Exclusive Marketing/Procurement Agreements On Fed Cattle Transaction Prices: An Experimental Simulation Approach

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The recent inclusion of exclusive marketing/procurement agreements between meatpacking and feedlot firms has created concern about how the level and variability of fed cattle transaction prices are affected. Existing agreements involve written or verbal contracts that allow the participating firms to market or purchase finished cattle at formula based prices for which the details are not made public. Exclusive marketing/procurement agreements were applied to an experimentally simulated fed cattle market. Two econometric models were developed from previous studies to evaluate price level and variability differences between active and non-active agreement periods. Price level and variability differences between the participating and non-participating firms of the agreements during the agreement and non-agreement periods were also evaluated. The effects of economically rewarding the subjects of experimental simulation studies on fed cattle transaction prices were evaluated. Results indicate that participants of exclusive marketing/procurement agreements realized significantly lower price means and variances than non-participating firms. However, the mean and variance of market prices were found to be higher during the agreement periods than during the non-agreement periods. Economic reward and non-reward periods were not found to have significantly different price levels.

Introduction

Problem

Price discovery is often described as the process of buyers and sellers gathering and interpreting information about the supply and demand of the product or products in question, formulating bid and asking prices, giving and taking during the negotiation of those prices, and adjusting the price formulations according to new market information as it becomes available across time (Purcell 1991). This process is completed several times each day in the fed cattle market as meatpacking and feedlot firms negotiate the sale or purchase of finished cattle. Due to both horizontal and vertical integration, price discovery issues within the fed cattle market have become a topic of focus over the last ten years. These issues range from the degree of concentration to the value of public information. However, the primary and secondary data

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required for the analysis of price discovery issues are difficult to acquire.

Among price discovery issues is the question of how different types of captive supplies impact fed cattle transaction prices. Over the last decade, meatpacking and feedlot firms have increased in size and some have entered into exclusive marketing/procurement agreements. These agreements involve a verbal or a written contract between one meatpacking firm and one or more feedlot firms. Many of the agreements are structured so that they allow the participating firms to engage in profit or loss sharing pricing strategies. Existing agreements have also been structured so that additional firms cannot be included and so that details of the agreement are not made public. Industry concerns range from the actual impact that these exclusive agreements have on the level and variability of transaction prices, to their effects on the availability of market information. However, collecting data from the relevant firms has become increasingly difficult as a direct result of the consolidation, concentration, and complex marketing/procurement agreements that have evolved within the industry. By simulating the fed cattle market in such a way that buyers and sellers behave in a manner parallel to today's fed cattle market, many data collection problems can be overcome. Furthermore, the impacts of exclusive marketing/procurement agreements on specific characteristics within the fed cattle market can be addressed through the application of experimental agreements to the simulated market.

Research Significance

Research is needed that will focus on the exclusive marketing/procurement agreements between meatpacking and feedlot firms that exist in today's fed cattle market. This research should provide the insight needed to assess how the exclusive marketing/procurement agreements will affect price variability, the supply of fed cattle, and changes in the financial stability of the individual participating firms.

Two research projects have estimated how captive supplies impact the fed cattle market (Schroeder et al.; Ward et al. 1996a). In general, these studies have evaluated the overall response of market prices to agreements and other forms of captive supplies using data that was collected from the industry. This study is different in that it uses a simulated fed cattle market to produce data which allows focusing on how prices behave during periods when agreements are being utilized versus market periods when no agreements exist. This study also evaluates how prices realized by the participants of marketing/procurement agreements differ from non-participant prices during both agreement and non-agreement periods. Therefore, this study will refute or strengthen previous research and focus on the specific details of exclusive marketing/procurement agreement impacts on the fed cattle market. One commonly cited reason for the need for this type of study is centered around the changes that have taken place in all of the U.S. meat markets leading towards value based marketing strategies. These strategies have been and can be further facilitated by extensions of exclusive marketing/procurement agreements.

Purpose and Objectives

The purpose of this research is to answer industry questions about the effects of exclusive marketing/procurement agreements on specific characteristics of the fed cattle market. The

general objective of the research is to determine how exclusive marketing/procurement agreements between meatpacking and feedlot firms affect transaction prices in the fed cattle market. Specific objectives are: (1) to determine the effects of exclusive marketing/procurement agreements on the level of fed cattle transaction prices, (2) to determine the effects of exclusive marketing/procurement agreements on the variability of fed cattle transaction prices, (3) to determine how economically rewarding or not rewarding participants of a simulated market affects the level of transaction prices, and (4) to determine how economically rewarding or not rewarding participants of a simulated market affects the variability of transaction prices.

Data

Data for this research project was generated by students in Agricultural Economics 3990 during the 1995 spring semester at Oklahoma State University. The project began by allowing the students to trade without experimentation while being instructed on how the Fed Cattle Market Simulator operates. The Fed Cattle Market Simulator (FCMS) is a simulated fed cattle market developed by Dr.'s Stephen Koontz, Derrell Peel, Jim Trapp, and Clement Ward of the Agricultural Economics Department at Oklahoma State University. It includes eight simulated feedlot firms and four simulated meatpacking firms. The FCMS is an experiential learning tool that has been used by its developers to instruct interested groups of people on the decision making processes of feedlot marketing and meatpacking procurement managers in the fed cattle market. Most of these participating groups have been high school and university students, employees of various agribusiness firms, and agricultural producers. The range of knowledge levels in these groups is from the high school level to that of corporate executives. Fundamental components of the FCMS and details on how the simulator operates are reported in Ward et al. 1996b.

The nature of the data collected for this study primarily consists of transaction prices with associated transaction level and variability information. Data were collected for two experimental periods, each of which included a 16-week experimental period. The total period covered 75 weeks of trading between the simulated firms or 2,770 pens of fed cattle. This translates to approximately 277,000 head of fed cattle weighing between 1100 and 1200 pounds. The cattle are bought or sold in pens of 100 head each and are marketed by the feedlot firms at one of five weight classes which are 1100, 1125, 1150, 1175, and 1200 pounds. The number of cattle supplied throughout the marketing period follows a realistic supply pattern. The experiment was developed to determine the impacts of exclusive marketing/procurement agreements under both abundant and tight cattle supply conditions.

Each data record consisted of one transaction which is the sale/purchase of one simulated pen of 100 steers between one feedlot firm and one meat packing firm. Data for each transaction included: week traded, meatpacker purchasing the cattle, feedlot selling the cattle, weight of cattle traded, the agreed upon transaction price, and type of transaction (cash, forward contract, or marketing agreement). Other data recorded for each week of trading within the simulated fed cattle market consisted of: the break-even price for 1150 pound cattle for each feedlot and the largest meatpacker, the boxed beef price for which the meat can be sold that week, the closing

nearby futures market price for the preceding week, the number of fed cattle marketings from the previous week, and the number of pens of cattle on the show list at the beginning of each trading week.

Procedure

Methods

Two econometric models were estimated. The first model focuses on determining the effects of both the exclusive marketing/procurement agreements and the economic reward periods on the level of fed cattle transaction prices. The second model focuses on determining the effects of both the exclusive marketing/procurement agreements and the economic reward periods on the variability of fed cattle transaction prices. These models were estimated for the entire simulated market trading period to consider the price level and price variability changes that are related to exclusive marketing/procurement agreements, economically rewarding the subjects, and other variables which have been found to explain fed cattle transaction prices.

Experimental Design

The exact design for collecting the relevant data for this research project was completed as follows. The students began trading in week 21. The first rotation occurred after week 24 and the second occurred after week 28. Rotations gave students an opportunity to participate on both sides of the market, as buyers and sellers. Final teams for the research project were established prior to week 33. At week 40, the FCMS computer began recording team profits, price discovery data, and financial performance data. This process is documented in previous research (Ward et al. 1996b). All data recorded was stored in order to be evaluated on a later date. The students then continued trading for 36 weeks before switching teams on week 76. The students traded for another 36-week experimental period. Therefore, the data collection period began on week 40 and ended on week 114. This period will be referred to as the entire marketing period for the experiment.

Within the two periods discussed above (i.e., weeks 40-75 and weeks 76-112) there were two subperiods each being 16 weeks in duration. One experiment consisted of imposing an exclusive marketing/procurement agreement between the largest meatpacker (#4) in the FCMS and two large feedlots (#2 and #5). Under this agreement, feedlot #2 and #5 marketed all of their cattle when they reached 1150 pounds to packer #4. The 1150 pound weight class has been illustrated as the optimal weight for medium framed cattle within the FCMS. Within the agreement, each participating firm negotiated a profit-sharing price based on the difference between the packer's and the feedlots' break-even price for 1150 lb. steers. It is important to note that packer #4 dealt with feedlots #2 and #5 on an individual basis. Accordingly, feedlots #2 and #5 did not market finished cattle to packer #4 as a collective group. All transactions produced by the agreements were recorded as a unique type of contract by the FCMS system.

The second experiment involved rotating periods of rewarding the students based on their

profit performance in randomly-selected four-to-seven week periods which were interspersed by randomly-selected four-to-seven week periods of not rewarding the students. Total periods of reward versus non reward were equal. The students in the class shared $900 or approximately $80 per simulated firm. Each individual was given a beginning balance of $10. After the initial balance, each team's profit/head was monitored and as it increased or decreased by $1, payment also increased or decreased by a proportional amount, approximately $.02/dollar of profit/head marketed. Additionally, each team's profit/head figures were accounted for each week throughout both of the above mentioned experimental periods. However, payment was not awarded until the final week of the experiment.

Transaction Price Model

The transaction price level model is specified and was estimated as follows:

$$[1] \quad TPFC_{it} = \alpha_0 + \alpha_1 BBP_{t-1} + \alpha_2 LCFMP_{t-1} + \alpha_3 TM_{t-1} + \alpha_4 TSL_{t-1} + \alpha_5 PPL_t + \sum_{j=1}^{8} \alpha_{6j} DFDLT_{ijt} + \sum_{j=1}^{4} \alpha_{7j} DPKR_{ijt} + \sum_{j=1}^{2} \alpha_{8j} DMPA_{ijt} + \sum_{j=1}^{2} \alpha_{9j} DRNR_{ijt} + \sum_{j=1}^{2} \alpha_{10j} DMA_{it} + \sum_{j=1}^{2} \alpha_{11j} DNM_{it} + v_{it},$$

where, $v_{it} = e_{it} + u_t$, $E[u_t] = 0$, $Var[u_t] = \sigma_u^2$, $Cov[e_{it}, u_t] = 0$, $Var[e_{it} + u_t] = \sigma_e^2 + \sigma_u^2 = \sigma^2$, and $Corr[e_{it} + u_t, e_{is} + u_s] = \rho = \sigma_u^2/\sigma^2$. The subscript notation is defined as follows: t = time in simulated weeks = 40, 42, 43, ..., 114; i = observations within a week = 1, 2, 3, ..., N; it = each transaction = 1, 2, 3, ..., 2770. The model is specified as a Weighted Random Effects Model (WREM) and was estimated for unbalanced panel data. The model yielded Estimated Generalized Least Squares estimates for the relevant economic variables using LIMDEP 6.0 software (Greene). Definitions of the variables and their expected signs are presented in table 1.

Ward et al. 1996b notes that many of the traditional economic variables of transaction price models found in previous research are accounted for or held constant by the FCMS. These variables generally include cattle quality characteristics such as age, weight, sex, quality grades, yield grades, etc. Reasons for the inclusion of these types of variables in transaction price models that explain fed cattle prices are thoroughly developed in prior research (Jones et al.; Schroeder et al.; Ward et al. 1996a, 1996b; Ward 1981, 1982, 1992). As a result, variable explanations at this juncture will focus on those variables that are specific to this study.

The price of boxed beef (*BBP*) was lagged one week (t-1) because the meatpacking firms (buying agents) base their procurement decisions on the market information that has been reported most recently. The price of boxed beef is reported at the conclusion of each simulated week and represents the price for which boxed beef is sold in that week. Therefore, the buying agents within the FCMS utilize boxed beef prices for fed cattle that were purchased in the previous week (i.e., buying agents purchase cattle in one week and sale beef produced by those cattle the following week). The rationale for including the previous week's closing futures market price for the nearby live cattle futures market contract ($LCFMP_{t-1}$) is much the same as the reason for using lagged boxed beef prices (BBP_{t-1}).

Two different independent variables were used to represent the supply of fed cattle. The total number of fed cattle on the show list (TSL) for the previous week (t-1) is known by all firms within the FCMS. The number of cattle on the show list represents cattle that can be marketed in the current week (i.e., fed cattle that weigh between 1100 lbs. and 1200 lbs.). Previous research has indicated that this number is important in forecasting prices in the fed cattle market (Ward et al. 1996a, 1996b; Bacon, Trapp, and Koontz). The total number of pens marketed in the previous week (TM_{t-1}) is another supply variable that has also been found to significantly affect prices paid for fed cattle (Schroeder et al.). These two variables were not found to be highly correlated with one another. An explanation for this is that the buying agents purchase fed cattle within a narrow range around their known low cost or optimal plant capacity during each week of trading. This causes total marketings (TM_{t-1}) to remain relatively constant compared with the amount of cattle supplied to the market or on the total show list (TSL_{t-1}) from week to week.

When the buying and selling agents of the FCMS approach one another to agree upon a bid or ask price, they negotiate or bargain until a final transaction price is reached. The amount for which they negotiate revolves around how to split or share the available profits or losses in the market at the time of the trade. In order to do this, the participants of the FCMS must estimate the feedlot and meatpacker break-even prices for fed cattle in each trading period. The difference between the largest meatpacker's break-even price for the 1150 lb. weight class and the feedlots' break-even price for the same weight class represents the profits or losses (PPL_t) that are available to the market in week t. This amount can be shared by the simulated firms in each trading period. The available profits or losses (PPL_t) in this study were used as a measure of the bargaining range or the distribution of profits or losses between the buying and selling agents of the FCMS.

Separate variables were included in the model to explain how each feedlot firm and each meatpacking firm within the FCMS affects transaction prices. Hence, there are eight variables which represent the feedlot firms ($DFDLT_{ijt}$) and four variables that represent the meatpacking firms ($DPKR_{ijt}$). Each of these are binary dummy variables which coincide with one another to represent the simulated firms involved in each transaction. These variables provide an indication of the overall effects that each firm has on fed cattle prices.

Previous research has evaluated the impacts of captive supplies on market transaction prices (Schroeder et al.; Ward et al. 1996a). However, little research has been conducted to contrast the response of market transaction prices during agreement and non-agreement periods. An additional set of variables was included in the model to represent the effects of exclusive marketing/procurement agreements on the transaction prices paid for fed cattle. The first of which indicates how market transaction prices differ during periods where agreements are active ($DMPA_{ijt}$) versus those periods where there were no agreements. The second agreement variable in the model represents the prices experienced by the participating firms of the exclusive marketing/procurement agreements during agreement periods (DMA_{ijt}) compared to the prices experienced by the non-participating firms during the same market periods (i.e., market periods where agreements were being utilized). A third agreement variable was included in the model which represents the prices experienced by participating firms of the exclusive marketing/procurement agreements during periods where there were no agreements (DNM_{ijt})

compared to the prices experienced by the non-participating firms for the same periods (i.e. market periods where there were no agreements being utilized).

This study also evaluates the effects on transaction prices for fed cattle within the FCMS from rewarding market participants. Rewarding the participants of experimental markets has been used as a tool which provides the control of subject preferences (Smith 1976, 1982; Plott). In this study, significant changes in subject preferences are hypothesized to be reflected in the market prices that are produced by participants of the FCMS. Under the salience condition set out by Friedman and Sunder, the reward medium should prevent the subjects from becoming bored which is noted as an important reason for using cash rewards over other types of reward mediums. Transaction price differences are evaluated in this study during randomized periods of rewarding the subjects ($DRNR_{ijt}$) versus market periods where the subjects are not being rewarded. A significant reward variable in this study could mean that the students did experience preference changes during market periods where rewards were being offered.

Transaction Price Variability Model

There have been previous studies detailing the overall impacts of captive supplies on fed cattle transaction prices but none have considered the impacts that exclusive marketing/procurement agreements have on the variability of fed cattle transaction prices. The second econometric model, model [2] is a transaction price variability model that was used to explain how exclusive marketing/procurement agreements affect the variance of transaction prices. The base transaction price variability model is specified and was estimated as follows:

$$\textbf{[2]} \quad VTPFC_{it} = \gamma_0 + \gamma_1 BBP_{t-1} + \gamma_2 LCFMP_{t-1} + \gamma_3 TM_{t-1} + \gamma_4 TSL_{t-1} + \gamma_5 PPL_t + \sum_{j=1}^{8} \gamma_{6j} DFDLT_{ijt} + \sum_{j=1}^{4} \gamma_{7j} DPKR_{ijt} + \sum_{j=1}^{2} \gamma_{8j} DMPA_{ijt} + \sum_{j=1}^{2} \gamma_{9j} DRNR_{ijt} + \sum_{j=1}^{2} \gamma_{10j} DMA_{it} + \sum_{j=1}^{2} \gamma_{11j} DNM_{it} + e_{it}.$$

This model utilizes the same independent variables and subscript notations that appear in model [1]. The dependent variable ($VTPFC_{it}$) of model [2] is represented by the natural log of the squared residuals from model [1] which serve as estimates of the variance about the conditional mean of the dependent variable or the level of transaction prices (Judge et al.). A more precise definition of $VTPFC_{it}$ can be found in table 1. This model was estimated using Ordinary Least Squares for unbalanced panel data with the traditional assumptions for the Classical Linear Regression Model (CLRM). The model yielded OLS estimates for the specified economic variables using LIMDEP 6.0 econometric software (Greene).

The rationale for including the variables of the transaction price level model in the residual variance model are similar to the rationale for each that has been discussed above and defined in table 1. The definition of each remains the same but their hypothesized impacts on the variability of transaction prices may be different. The main reason for using the traditional transaction price variables found in model [1] in this study is that the variables which explain the level of

transaction prices are assumed to also explain the variability in transaction prices. Hence, discussion here is limited to the impacts of exclusive marketing/procurement agreement impacts on the variability of transaction prices.

Empirical Results and Discussion

The transaction price level model (model [1]) explained over 80 percent of the variation in fed cattle transaction prices (table 2). Model [1] was found to be highly significant with an F-statistic of 773.19 and it yielded estimates of the relevant economic variables that had been corrected for multiplicative heteroskedasticity within each week and serial correlation throughout the weeks considered by the experimental trading periods. The random effects of model [1] were found to be highly significant and reduced the significance of the independent variables that remained constant within each week of the experimental trading period. The transaction price variability model (model [2]) exhibited an expectedly low explanation (7.23 percent) for the variation in the variance estimates (table 2). However, the model was found to be significant with an F-statistic of 11.91. The estimated results for each coefficient in models [1] and [2] are presented in table 2.

Traditional Price Discovery Model

The lagged boxed beef price (BBP_{t-1}) has been found to be significantly related to fed cattle transaction prices in previous research. In this study, the coefficient for BBP_{t-1} was found to be significant and positive in its relationship to simulated fed cattle transaction prices. Specifically, fed cattle transaction prices were found to increase by \$0.33/cwt. with a \$1/cwt. increase in the lagged boxed beef price (BBP_{t-1}). This finding is consistent with relevant economic theory concerning derived demand and is parallel to findings in previous research (Schroeder et al.; Ward et al. 1996b; Ward 1992). Lagged live cattle futures market prices ($LCFMP_{t-1}$) have also been found to have significant positive impacts on fed cattle transaction prices in previous research (Schroeder et al.; Ward 1981, 1982). Lagged live cattle futures market prices in this study were also found to be significant. Fed cattle transaction prices were found to increase by \$0.27/cwt. for every \$1/cwt. increase in the lagged live cattle futures market price.

The relationships between the two cattle supply related variables used in this study and fed cattle transaction prices are consistent with one another and with economic theory about how changes in the quantity supplied impacts prices within a given market. The total supply of cattle in the market window or the number of cattle available for purchase within a given week is known as the number of cattle on the show list. This type of information is not publicly reported in the real-world market. However, private organizations often attempt to collect show list data from the members of those organizations (Ward et al. 1996b). The total number of pens of cattle (100 hd./pen) on the show list for the previous week (TSL_{t-1}) has been found in previous studies to have a negative and significant relationship with fed cattle transaction prices (Ward et al. 1996b; Bacon, Trapp, and Koontz). Here, the coefficient for TSL_{t-1} was also negative and significant in its relation to simulated fed cattle transaction prices. Specifically, simulated fed cattle transaction

prices were found to decrease by $0.05/cwt. with an additional pen of cattle on the previo week's show list.

The number of cattle marketed by feedlots or slaughtered by meatpackers has be considered in two previous studies. Schroeder et al. found that the number of cattle marketed slaughtered significantly affected fed cattle transaction prices. However, Ward et al. 1996b c not find that the total number of cattle marketed in each simulated week significantly impacted f cattle transaction prices. In the FCMS setting, this number is reported at the end of each wee As a result, the subjects are allowed to use the total number of marketings from the previo week (TM_{t-1}) to formulate and arrive at bid or ask prices for pens of finished cattle. In this stuc TM_{t-1} was found to have a negative and significant relationship to fed cattle transaction pric which is similar to the impact of TSL_{t-1}. The coefficient indicates that simulated fed cat transaction prices decreased by $0.06/cwt. with a one pen increase in the number of pe marketed for the previous week.

Ward et al. 1996b notes that a specific type of firm behavior is commonly observed in t FCMS setting that is related to the manner in which meatpacking firms and feedlot firms sha available profits. The authors suggest that feedlot firms are more often willing to be satisfied wi a targeted profit margin that can be realized by feeding and marketing finished cattle. The authc also suggest that meatpacking firms more often attempt to gain the highest possible profit that produced by purchasing finished cattle and selling the beef produced by those cattle. As a resu when there are known profits to be shared in the fed cattle market, meatpacking firms commor attempt to capture the largest portion of the amount to be negotiated. Much like in the re world, the subjects of the FCMS are able to calculate the meatpacker and feedlot break-even pri for 1150 lb. cattle from week to week. The difference in the largest meatpacking firm's brea even price for 1150 lb. cattle and the feedlot firms' break-even price for 1150 lb. cattle is a pro: in this study for the amount of profits to be shared in a particular week or the bargaining rang This amount will be referred to as the potential profit/loss for each week (PPL_t). Previo research results have indicated that there is a negative and significant relationship between *PP* and fed cattle transaction prices (Ward 1996b; Ward 1981). Results found in this study we consistent with previous findings in that a $1/cwt. increase in the potential profit/loss for ea week was associated with a $0.15/cwt. decrease in fed cattle transaction prices.

Differences in managerial and negotiation skills exist between individuals within the firr that participate in most markets. These differences become collective for each firm as t individuals work together to accomplish a common set of goals. Previous research has indicat that these collective differences result in different types of market behavior and performan which is often linked to price differences among competing firms (Ward et al. 1996b; Carlton a Perloff). Previous research using the FCMS suggests that significant price differences do inde occur between the simulated meatpacking and feedlot firms (Ward et al. 1996b). In this stud several of the simulated feedlot firms ($DFDLT_1$ - $DFDLT_8$) received higher prices for cat marketed than other feedlot firms. Accordingly, two of the simulated meatpacking firms (*DPK* -$DPKR_4$) paid lower prices for the cattle that were purchased than the other meatpacking firr These results are consistent with previous findings that consider price differences among firr (Jones et al.; Schroeder et al.; Ward 1982, 1992, 1996b). Significant feedlot price differenc

found here range from $0.49/cwt. to $0.22/cwt. higher than the mean price received by feedlot #1. Significant price differences among the meatpacking firms range from $0.48/cwt. to $0.32/cwt. lower that the mean price paid by meatpacker #1. These results are not consistent with economies of size theory due to the fact that the smallest meatpacker (#1) paid the highest price on average. Economies of size studies typically suggest that the largest meatpacking firm can pay the highest price given that there is adequate inter-firm competition within the market (Ward 1993). Similar results were found by Ward et al. 1996b where the authors suggested that these results may be due to the differences in the managerial skills of the individuals operating the simulated firms.

Exclusive Marketing/Procurement Agreement Variables

Specific types of captive supplies have been found in previous research to have a negative relationship with fed cattle transaction prices (Schroeder et al.; Barkley and Schroeder; Ward et al. 1996a). This study examines more closely one type of captive supplies, exclusive marketing/procurement agreements. To go beyond the general impacts of captive supplies, this study distinguishes the participating firms of these agreements during agreement periods ($DMAP_1$) from the non-participating firms during the agreement periods ($DMAP_2$). Results suggest $DMAP_1$ realized significantly lower mean prices than $DMAP_2$ during agreement periods which is consistent with previous research (Ward et al. 1996a). Specifically, the mean price realized by $DMAP_1$ was $0.71/cwt. lower on average than the mean prices realized by $DMAP_2$ during the agreement periods. In addition to different mean prices, the $DMAP_1$ coefficient in [2] suggests that $DMAP_1$ realized a significantly lower price variance than the price variance realized by $DMAP_2$.

This study also distinguishes participants ($DNMP_1$) from non-participants ($DNMP_2$) during the non-agreement periods. Results indicate that $DNMP_1$ and $DNMP_2$ did not realize significantly different mean prices during the non-agreement periods. Furthermore, results from model [2] indicate that $DNMP_1$ and $DNMP_2$ did not experience significantly different price variances during the non-agreement periods.

Another variable in this study that extends previous captive supply studies is the response of market prices during agreement periods ($DMPA_1$) versus market prices during the non-agreement periods ($DMPA_2$). Results suggest that significant price differences do exist in the fed cattle market between $DMPA_1$ and $DMPA_2$. The coefficient in model [1] indicates that the mean level of fed cattle transaction prices was $1.27/cwt. higher during agreement periods than the mean price level during non-agreement periods. Additionally, $DMPA_1$ in model [2] suggests that fed cattle transaction prices are significantly more variable during agreement periods than during non-agreement periods.

Economic Reward Variables

Economically rewarding the subjects of experimental economic research has been found to be an effective method of inducing subjects to maintain a high level of interest while participating in economic experiments. Previous experimental economic research results suggest that properly rewarding subjects who are rational or who prefer more income to less controls their individual

preferences in such a way that they remain competitive throughout the duration of the experiment. As a result, the extended competition allows the market to realistically respond to repeated applications of a particular economic treatment (Smith 1976, 1982; Plott; Friedman and Sunder). This study evaluates rewarding the subjects of experimental simulation to determine whether or not changes in subject preferences and subsequently subject competition impact market prices. Here, it is hypothesized that any increases in the level of competition due to preference changes would be reflected by significantly higher prices during periods where the subjects were being rewarded ($DRNR_1$) than prices during periods where the subjects were not being rewarded ($DRNR_2$). Results in model [1] indicate that fed cattle transaction prices are not significantly different between $DRNR_1$ and $DRNR_2$. However, the $DRNR_1$ variable in model [2] suggests that transaction prices are significantly more variable during periods where the subjects of experimental simulation are rewarded.

Summary, Implications, and Conclusions

This study focused on exclusive marketing/procurement agreements as a captive supply method within in an experimental simulation setting. This type of agreement is quickly becoming a common arrangement used by large meatpacking and cattle feeding firms in the current fed cattle market. As a result of structural changes in the fed cattle market over the past decade, the amount of price discovery data that is available to the public is limited. This data is imperative to economic research that attempts to adequately answer industry and market questions about how different types of captive supplies affect specific characteristics of the fed cattle market. Ward et al. 1996b notes that the Fed Cattle Market Simulator (FCMS) was developed to provide a realistic market framework and institutional structure which allows market participants to complete decision making processes in an experimental simulation setting. This setting was used to evaluate the manner in which exclusive marketing/procurement agreements impact the level and variability of fed cattle transaction prices. By applying experimental agreements to the simulated market and then observing the response of the market prices, many of the real-world data limitations are overcome.

Data for this study were provided by university junior and senior level agricultural economics and animal science students who were participants of the FCMS during the Spring 1995 semester at Oklahoma State University. Transaction price level and variability models were employed to determine the effects of exclusive marketing/procurement agreements on fed cattle transaction prices. Data from 75 weeks of trading were collected, representing 2,770 independent transactions within two experimental periods.

Many economic variables were found to be generally consistent with a prior FCMS study (Ward et al. 1996b) and other research projects dealing with fed cattle transaction prices (Jones et al.; Schroeder et al.; Ward 1981, 1982, 1992). These variables include boxed beef prices from the previous week, live cattle futures market prices from the previous week, the potential profit/loss within each week, total marketings/slaughter from the previous week, the number of cattle on the show list from the previous week, the individual feedlot firms, and the individual meatpacking

firms. Results indicate a significant positive relationship exists between fed cattle transaction prices and both lagged boxed beef prices and lagged live cattle futures market prices. The number of head on the total show list and the number of cattle marketed each week were consistent with economic theory in that they had significant negative impacts on fed cattle transaction prices as supply variables. The amount of potential profit/loss to be shared by the meatpacking firms and feedlot firms was found to have a significant negative effect on fed cattle transaction prices. This is parallel to findings in a previous study that relates the inverse relationship of the bargaining range to the cost-plus pricing strategy that is believed to be followed by cattle feeding firms in the FCMS (Ward 1996b).

Differences in the prices paid by meatpacking firms and the prices received by cattle feeding firms were found not to be consistent with economies of size theory (Ward 1993) but were consistent with previous research (Ward et al. 1996b). An explanation that is commonly offered for this discrepancy is that managerial skills differ among individuals within each firm. These differences are magnified as a group of individuals cooperate to achieve similar goals which affect the way a feedlot or meatpacking firm or team behaves within a market.

The central question to be answered by this study is centered around the impacts of exclusive marketing/procurement agreements on the level and variability of fed cattle transaction prices. Research findings indicate that there are significant price differences between the participants and non-participants of exclusive marketing/procurement agreements, that exclusive marketing/procurement agreements have a negative impact on fed cattle transaction prices, and that market prices are significantly different between agreement versus non-agreement periods. Results indicate that the meatpacking and cattle feeding firms that enter into exclusive marketing/procurement agreements realized a significantly lower mean and variance of prices than those firms that did not enter into such agreements. Furthermore, participating firms did not realize significantly different prices during non-agreement periods.

An implication of these results is that cattle feeding firms are willing to accept lower prices and subsequently lower profits in order to ensure that: (1) cattle inventories are kept current and (2) less variable market prices are realized. On the other hand, the meatpacking firm is able to realize lower purchase prices and lower price variability. During the periods when participating firms were actively engaged in agreements, mean transaction prices realized by the entire market were $1.27/cwt. higher than periods when there were no agreements. The price variance during the agreement period was also found to be higher. An explanation offered for this finding is that the exclusive marketing/procurement agreements create a short-term reduction in the quantity of cattle which are available to the market. This occurs because the largest meatpacking firm secures about 80 percent of its optimal slaughtering capacity by entering into the agreement with feeders. That 80 percent is about 25 percent of the cattle typically marketed or slaughtered from week to week in the FCMS. This reduction in the supply of cattle causes upward pressure on market prices which translates into higher mean prices during the agreement periods. In the midst of the supply reduction, firms that are excluded from the marketing/procurement agreements counter by adjusting their marketing or procurement strategies in order to maximize profits or minimize losses. These strategy adjustments are hypothesized to cause more variable market prices, an indirect result of the exclusive marketing/procurement agreements.

Another question considered by this study is centered around the effects of economically rewarding or not rewarding the subjects of experimental simulation. Rewarding the subjects of experimental economics research where the environment is highly controlled has been found to be an effective method of retaining subject motivation and controlling subject preferences in economic experiments where the validity of specific economic theories are to be tested. This study evaluates rewarding subjects in an experimental setting where very little of the environment is controlled, which allows dynamic interrelationships between both the simulated firms and economic variables much like in the real world. Results indicate that mean fed cattle transaction prices are not significantly different during periods when the subjects of the FCMS system are being rewarded. However, transaction prices were found to have a significantly higher variance during periods when the subjects were being rewarded than during periods of no economic rewards. Rewarding subjects in experimental simulation settings did not affect firm financial performance in a such a way that the level of market prices was significantly impacted, but it did create added variability in market transaction prices. The added variability is most likely caused by the reaction of the subjects to the reward periods instead of an increased motivation which is hypothesized to impact price levels.

Future research involving the use of experimental simulation is possible provided that an adequate market and institutional structure is developed. The FCMS is an example of an experimental simulation setting that allows participants to learn from the consequences of different types of decisions they make in the fed cattle price discovery process. This creates a realistic relationship between the simulated cattle feeding and meatpacking firms which can be used to create experiments on real-world occurrences in the fed cattle market. The FCMS offers an opportunity to extend the topic considered in this study to determining the effectiveness of marketing agreements compared with contracts in securing desired cattle quality characteristics in a value based marketing system. Beyond captive supply issues within the fed cattle market, there are growing numbers of fed cattle market questions that could be adequately addressed using experimental simulation approaches within the FCMS.

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Table 1: Variable Definitions and Expected Signs

Variables	Definition of Variable	Expected Sign
Dependent Variables		
$TPFC_{it}$	i^{th} transaction price for one pen of fed cattle ($/cwt.) in week t	N/A
$AVGPRC_t$	The weekly mean of fed cattle transaction prices ($/cwt.) in week t	N/A
$VTPFC_{it}$	The natural log of the i^{th} transaction price variance estimate ($/cwt.) calculated from model **[1]** in week t	N/A
Independent Variables		
BBP_{t-1}	The boxed beef price ($/cwt.) for Choice Yield Grades 1-3 550-700 lb. carcasses, lagged one week	Positive
$LCFMP_{t-1}$	The live cattle futures market closing price ($/cwt.) for the nearby contract period, lagged one week	Positive
TM_{t-1}	The total number of pens (100hd./pen) marketed or slaughtered, lagged one week	Negative
TSL_{t-1}	The total number of pens of cattle (100hd./pen) on the market ready show list, lagged one week	Negative
PPL_t	The potential profit or loss per head ($/cwt.) in week t which is the largest meatpacker's break-even price for 1,150 lb. cattle less the mean feedlot break-even price for 1,150 lb. cattle	Negative
$DFDLT_{ijt}$	Binary dummy variables distinguishing each individual feedlot firm, j=1-8, 1=FDLT1 (Base), 2=FDLT2, 3=FDLT4, 4=FDLT4, 5=FDLT5, 6=FDLT6, 7=FDLT7, and 8=FDLT8	Pos./Neg.
$DPKR_{ijt}$	Binary dummy variables distinguishing each individual meatpacking firm, j=1-4, 1=PKR1 (Base), 2=PKR2, 3=PKR4, and 4=PKR4	Pos./Neg.
$DMPA_{ijt}$	Binary dummy variables distinguishing the active and non-active exclusive marketing/procurement periods, j=1-2, 1= Agreement and 2=Non-Agreement (Base)	Pos./Neg.

Table 1: Continued

Variables	Definition of Variable	Expected Sign
Independent Variables		
$DNMP_{ijt}$	Binary dummy variables distinguishing the participants and non-participants during the non-active exclusive marketing/procurement periods, j=1-2, 1=Participants and 2=Non-Participants (Base)	Pos./Neg.
$DMAP_{ijt}$	Binary dummy variables distinguishing the participants and non-participants during the active exclusive marketing/procurement periods, j=1-2, 1=Participants and 2=Non-Participants (Base)	Pos./Neg.
$DRNR_{ijt}$	Binary dummy variables distinguishing the economic reward periods, j=1-2, 1=Reward and 2=Non-Reward (Base)	Pos./Neg.

Table 2: Estimated Impacts of The Relevant Economic Variables on Fed Cattle Transaction Prices

Explanatory Variable	Price Level Estimates Model [1]	Price Variability Estimates Model [2]
Intercept	24.9020 *** [a]	3.1753 ***
	(3.866) [b]	(7.359)
BBP_{t-1}	0.3277 ***	0.0282 **
	(11.272)	(1.852)
$LCFMP_{t-1}$	0.2688 ***	-0.0401 **
	(3.881)	(-1.713)
TM_{t-1}	-0.0605 ***	-0.0689 ***
	(-2.752)	(-5.978)
TSL_t	-0.0498 ***	0.0433 ***
	(-4.304)	(8.786)
PPL_t	-0.1460 ***	-0.1884 ***
	(-3.392)	(-7.971)
$DFDLT_1$	Base	Base
$DFDLT_2$	0.0816	-1.0901 ***
	(0.904)	(-3.327)
$DFDLT_3$	0.4948 ***	-1.8381 ***
	(6.759)	(-7.196)
$DFDLT_4$	0.2452 ***	-1.5533 ***
	(2.916)	(-6.122)
$DFDLT_5$	0.3296 ***	-1.0498 ***
	(3.577)	(-3.211)
$DFDLT_6$	0.2904 ***	-1.1419 ***
	(3.710)	(-4.594)
$DFDLT_7$	0.2221 ***	-1.1254 ***
	(2.853)	(-4.457)
$DFDLT_8$	-0.0095	-1.7957 ***
	(-0.121)	(-7.119)
$DPKR_1$	Base	Base
$DPKR_2$	-0.3254 ***	0.4098 **
	(-6.462)	(2.112)
$DPKR_3$	-0.4801 ***	0.1343
	(-10.247)	(0.708)

Table 2: Continued

Explanatory Variable	Price Level Estimates Model [1]	Price Variability Estimates Model [2]
$DPKR_4$	-0.0672	0.5609 **
	(-0.877)	(1.794)
$DMPA_1$	1.2656 ***	0.5375 ***
	(4.006)	(2.642)
$DMPA_2$	Base	Base
$DMAP_1$	-0.7059 ***	-0.8581 **
	(-6.201)	(-1.833)
$DMAP_2$	Base	Base
$DNMP_1$	-0.0292	-0.5291 *
	(-0.354)	(-1.593)
$DNMP_2$	Base	Base
$DRNR_1$	0.0373	0.5631 ***
	(0.163)	(4.559)
$DRNR_2$	Base	Base
N	2770	2770
Adjusted R^2	0.8423	0.0723
$F_{[19, 2750]}$ [c]	773.1942 ***	11.9052 ***

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

[b] All figures presented in parenthesis are the calculated t-statistics for each coefficient.

[c] The F-statistic in this study was used in a hypothesis test which is structured as follows:
Null Hypothesis (H_o): The estimated coefficients in the respective model ([1] or [2]) are equal to zero.
Alternative Hypothesis (H_a): At least one of the estimated coefficients in the respective model ([1] or [2]) is significantly different from zero.