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Introduction

One component of price discovery involves the availability, use, and value of public market information. Structural and behavioral changes in agriculture have focused increased attention on all aspects of market information. The Fed Cattle Market Simulator (FCMS) has proven to be a useful research tool to study various aspects of and impacts on price discovery (Ward et al.; Dowty). In essence, the FCMS creates a closed market for fed cattle. Participants "role play" as feedlot marketing managers and meatpacking procurement managers. Fed cattle buyers (four packers) and sellers (eight feedlots) generate about 40 fed cattle transactions in each trading week. Each trading week simulates a week of business in real time.

The objective of this research was to conduct an experiment using the FCMS to assess the value of public market information by observing the impact information had on the fed cattle market. Emphasis was on the impacts of controlled experimentation designed to change the information available to participants.

Data and Procedure

Data for this research was collected from a semester-long agricultural economics course at Oklahoma State University. The one-credit course met weekly in 90 minute sessions. During the semester, students participated in the FCMS. Also during the semester, the amount of public information provided to students varied in a designed and controlled manner. Market reactions to more/less information and to the presence or absence of specific types of information was examined. The value of information to market participants also was measured by the participants' expressed willingness to pay for specific types of information.

Students began the course in trading week 21. Student teams were rotated twice during the learning phase and final teams for the research were established prior to week 33. At week 37, we began collecting data for later analysis. Data collection encompassed trading weeks 37 to 96. Teams were rotated a final time after week 72.

Trading began with complete or full reporting of public market information. At predetermined intervals, the amount and type of information changed. Three limited information alternatives were evaluated in relation to complete or full information. The alternatives were:

(A) Complete (full) information: Within-week "light bar" information, consisting of cash and contract volume of trading and high-low cash prices; plus end-of-week "black board" summary information, consisting of weekly average cash prices by weight groups, weekly average boxed beef price, weekly average feeder cattle price, cost of gain, and total volume of cattle traded the preceding week;

(B) Incomplete information: Removal of the within-week "light bar" information;

(C) Incomplete information: Removal of the end-of-week "black board" summary information; and

(D) Incomplete information: Removal of both the within-week "light bar" information and end-of-week "black board" summary information.

Each data record was one transaction, i.e., sale/purchase of one pen of 100 steers between one feedlot and one meatpacker. The number of observations for the 60-week simulation period totaled 2,197. Data for each transaction included: week traded, meatpacker purchasing cattle, feedlot selling cattle, weight of cattle traded, transaction price, and type of transaction (cash or forward contract). Other data for each week of trading in the simulated market included: break-even price for 1150-pound cattle for each feedlot and the largest meatpacker, boxed beef price at which meat will be sold that week, closing nearby futures market price for the preceding week, fed cattle marketings for the previous week, and number of pens of cattle on the show list at the beginning of each trading week.

After each period with complete information (A) and limited information (B), (C), and (D), students completed a short survey instrument indicating how important information was to them, how much they would pay for information, and how they adjusted to or compensated for the loss of information.

Periods of paying and not paying students based on their performance was superimposed onto the value of information experiment. Student payments were based on each team's profitability in randomly-selected 4-8 week periods. Care was taken not to have an information alternative period coincide exactly with a payment/nonpayment period. An outline of the experimental design follows:

Trading Weeks	Number of Weeks	Information Alternative	Trading Weeks	Number of Weeks	Payment Alternative
37-40	4	A	37-42	6	Payment
41-48	8	B	43-46	4	Nonpayment
49-52	4	A	47-54	8	Payment
53-60	8	C	55-61	7	Nonpayment
61-64	4	A	62-67	6	Payment
65-72	8	D	68-72	5	Nonpayment
Rotate Teams					
73-80	8	A	73-78	6	Payment
81-88	8	D	79-85	7	Nonpayment
89-96	8	A	86-90	5	Payment
			91-96	6	Nonpayment.

Econometric models were specified to explain the variation in transaction prices for fed cattle in the simulated market, specifically to determine impacts from reduced access to public information. Dummy variables were used to indicate alternative information periods in the econometric models. Model specification was based on the pricing process packers follow in determining bid prices for fed cattle and on previous research (Ward 1981, 1982, 1992; Jones et al.; Schroeder et al.; Ward et al.).

Models Estimated

Data from two previous semester-long classes were collected and analyzed (Ward et al.; Dowty). It is relevant to review the purpose for those studies and models specified prior to discussing the models estimated in this study.

Ward et al. estimated three models to compare the results using FCMS data relative to models using industry data and to gain a better understanding of the price discovery process. Data came from a semester-long class but no formal experiment was specifically designed during the semester. The model estimated was:

(1) Transaction price = f(Lagged boxed beef price, Lagged futures market price, Lagged total show list, Lagged marketings, Industry profit potential, Dummy variable for weight of cattle, Dummy variable for type of transaction, Dummy variable for feedlot, Dummy variable for packer).

Dowty estimated several models for two purposes. One was to determine the impacts on fed cattle prices from formal marketing/purchasing agreements between a packer and two feedlots. The second objective was to determine the price difference between cash prices and forward contract and marketing agreement prices. The Dowty study incorporated a payment/nonpayment reward system in the semester-long class, as in this study. The two core models estimated were:

(2) Transaction price = f(Lagged boxed beef price, Lagged futures market price, Lagged total show list, Lagged marketings, Industry profit potential, Dummy variable for feedlot, Dummy variable for packer, Dummy variable for marketing agreement period, Dummy variable for marketing agreement participants during the marketing agreement period, Dummy variable for marketing agreement participants during the non-marketing agreement period, Dummy variable for payment periods)

(3) Transaction price = f(Lagged boxed beef price, Lagged futures market price, Lagged total show list, Lagged marketings, Industry profit potential, Dummy variable for weight of cattle, Dummy variable for feedlot, Dummy variable for packer, Dummy variable for type of transaction).

Similar transaction price variance models were also specified and estimated.

The transaction price models estimated in this study were similar to the above three models. The base model was:

(4) Transaction price = f(Lagged boxed beef price, Lagged futures market price, Lagged total show list, Lagged marketings, Industry profit potential, Dummy variable for feedlot, Dummy variable for packer, Dummy variable for payment periods, Dummy variable for information periods).

Alternative versions of (4) were estimated with varying definitions for the information period variables. Version 4A grouped all limited information periods (B, C, D) together into a single period which was compared with the complete information periods (A). Version 4B had a separate variable for the one limited information period B, the one limited information period C, and for the two periods of limited information D; all compared with the complete information periods (A). Version 4C had a separate variable for each limited information period (B, C, D1 and D2); all compared with the complete information periods (A).

A similar transaction price variance model was also estimated.

An ordered logit model was also specified and estimated. Reduced market information potentially creates inefficiency in the behavior of market participants. Therefore, the dependent variable was absolute deviations from marketing/purchasing cattle at 1150 pounds, which is considered the most efficient strategy in the FCMS. Twenty-five pound deviations above and below 1150 pounds was set at 1; 50 pounds, at 2, and 75 pounds above 1150, at 3. Marketings at 1150 pounds equaled 0. The model was:

(5) Weight deviations from 1150 (0-3) = f(Lagged boxed beef price, Lagged futures market price, Lagged total show list, Lagged marketings, Industry profit potential, Dummy variable for feedlot, Dummy variable for packer, Dummy variable for payment periods, Dummy variable for information periods).

Alternative versions of (5) were estimated with the same varying definitions for the information periods as were discussed above.

Results

Econometric Models -

Coefficients on the dummy variable for information periods is the primary focus of the estimation results. However, comments on selected other variables are appropriate for the transaction price models.

Lagged boxed beef price - Both using industry data as well as using FCMS data in previous studies, there is a relatively strong relationship between transaction prices and boxed beef prices. The relationship was similar to previous studies using the FCMS (Ward et al.; Dowty) for version 4A, treating all limited information periods equally. However, in other versions of the current model, the relationship was weaker than in previous studies. The coefficient on the boxed beef variable was smaller and the t value was smaller, though the coefficient was statistically significant at the 0.01 level. Feedlots did not have access to boxed beef prices without the end-of week summary information (limited information period C). Packers did have the information but only via their profit and loss statements, not as publicly reported information. This reduced access to boxed beef prices appears to have altered, i.e., weakened, the normal relationship between transaction prices and boxed beef prices.

Lagged futures market price - In this model, the relationship between transaction price and futures market price was relatively strong, as in previous studies using FCMS data. However, again with the exception of version 4A when all limited information periods were treated equally, the relationship between transaction price and futures market price was stronger than between transaction prices and boxed beef prices, unlike previous studies using FCMS data. Students had access to futures market information throughout the simulation period, unlike information for boxed beef which was part of the end-of-week information kept from participants during selected periods. Students appear to have relied more on futures market prices for price discovery than boxed beef prices when market information was not available.

Lagged marketings and lagged total show list - Ward et al. found a significant negative relationship between transaction prices and the lagged total show list but not a significant negative relationship for lagged marketings. They concluded that total size of the show list, i.e., the short-run market-ready supply of cattle, was more important in discovering fed cattle prices than were week-to-week marketings. In Dowty, coefficients on both supply variables were negative and significant. In this study, the coefficients on lagged total show list were negative and significant in versions 4A and 4B, but not significant in version 4C where each limited information period was treated separately. Lagged total marketings was not statistically significant in versions where an attempt was made to model impacts of specific losses of information on transaction prices (versions 4B, 4C). However, when all limited information periods were treated equally (version 4A), a theoretically unexpected positive and significant coefficient was observed between lagged marketings and transaction prices. Limited information appears to have weakened, if not altered, the normal relationship between transaction prices and the two supply variables.

Dummy variable for feedlot - Significant differences were found among feedlots in all three studies. However, price differences were larger in this study (a maximum of $0.96/cwt.) than in the previous two studies ($0.34 and $0.49/cwt., respectively, for Ward et al. and Dowty). Some feedlots may have adjusted to or compensated better for the changes in amount and type of available information than others.

Dummy variable for packer - Differences among packers in all three studies were $0.38, $0.48, and $0.40/cwt., respectively, for the two previous studies (Ward et al.; Dowty) and this one, all using the FCMS. Thus, results in this study were similar to the previous two studies. Packers appear to have more easily adjusted to or compensated for changes in amount and type of available information than did feedlots.

Dummy variable for payment/nonpayment - In the Dowty study, no significant effect was found on transaction prices during the payment period. In this study, transaction prices were significantly higher during payment periods.

Dummy variables for information period - Three versions of the model were estimated. In version 4A, a single dummy variable (Info1) was included for the four limited information periods. In version 4B, three information dummy variables were included in the model: Info2=no within-week cash-market information; Info3=no end-of-week summary information; Info4=both periods of no within-week cash-market information and no end-of-week summary information. In version 4C, four information dummy variables were included in the model: Info2=no within-week cash-market information; Info3=no end-of-week summary information; Info5=first period of no within-week cash-market information and no end-of-week summary information; Info6=second period of no within-week cash-market information and no end-of-week summary information.

There was no significant effect from reduced information on transaction prices when all limited information periods were grouped together (Info1 in version 4A). In version 4B, removal of the within-week cash-market trading information (Info2) was associated with a $2.37/cwt. decline in fed cattle transaction prices. Removal of the end-of-week summary information (Info3) was associated with no significant change in fed cattle transaction prices. Removal of both types of information (Info4) was associated with $2.52/cwt. higher transaction prices. In version 4C, removal of the end-of-week summary information (Info2) was associated with a $2.73/cwt. decline in fed cattle prices. Again, there was no significant change in fed cattle transaction prices associated with removal of the end-of-week summary information (Info 3). Removal of both types of information the first time (Info5) was associated with $1.35/cwt. higher transaction prices. The second time (Info6), there was no significant effect on price level. Overall, results were mixed. Aggregating the limited information periods suggested no significant price level effects. However, when attempting to account for specific changes in information, prices were affected, sometimes positively, in favor of feeders, and sometimes negatively, favoring packers. There is evidence to suggest transaction prices will be more variable when market information is not available or is inadequate.

Dummy variable for information period (price variance model) - In the transaction price variance model, loss of information increased price variance when all limited information periods were grouped together (Info1 in version 4A). In version 4B, when limited information periods were divided into three categories, limited information increased price variance in two periods (Info2 and Info4) but decreased price variance in the other (Info3). In version 4C, limited information resulted in higher price variance in three of the four periods (Info2, Info5, and Info6, but not for Info3) when limited information periods were disaggregated further. Again, the evidence supports a conclusion of more variable prices when information is insufficiently available.

Dummy variable for information period (ordered logit model) - Results showed that for version 4A that limited information (Info1) resulted in marketing cattle at weights different from what is considered most efficient in the FCMS. In version 4B, loss of information significantly contributed to marketing cattle at more inefficient weights in two of the three limited information periods (Info3, Info4). There was a significant deviation away from marketing/purchasing cattle at the most efficient weight in two of the four limited information periods (Info3, Info5)in version 4C. Overall, there was a tendency to market/purchase cattle at heavier weights, away from the most efficient weight. Marketing at heavier weights favors packers in the FCMS. Cattle feeders have higher cost of production for heavier weight cattle and are at a significant bargaining disadvantage to packers as cattle approach 1200 pounds. Reduced market information appears to have led to trading fed cattle at heavier, more inefficient weights, a response that is negative to the entire industry.

Value of Information Survey -

Students were asked to rate on a scale of 1 to 10, how important various amounts and types of information were to them. There were several repetitions of the survey, after each time the amount of information changed. An analysis of variance (AOV) was conducted on their responses, to account for effects from the loss of a specific amount and type of information and for differences by feeders and packers. Two significant differences were found.

Packers rated the value of futures market information to them significantly lower than did feeders. This may be because packers have less incentive to hedge fed cattle purchases than feeders have to hedge fed cattle on feed.

Students were asked to indicate how much they would be willing to pay (in simulation dollars) to maintain or restore the various types and amounts of information. Packers were willing to pay significantly less than feeders. Perhaps packers were better able to adjust to or compensate for the loss of information than feeders and were therefore less willing to pay for market information.

Students were asked how they compensated for the loss of information. Responses indicated clearly that market participants missed information when it was not available. Responses suggested the following as a result of not having market information:

* Greater reliance on feeders visiting with other feeders, packers visiting with other packers
* More reliance on costs and break-even prices as a basis for price discovery rather than market price signals
* Increased use of previous profit and loss experiences as a basis for price discovery
* Increased use of futures market prices
* Much more guessing.

It is clear that market participants made less-informed decisions, used whatever information could be found, and made more "same as last time" decisions when less market information was available. Comments indicated that participants believed the quality of their decisions were reduced. Some participants guessed correctly and others did not. While only one firm noted that it increased its use of contracts without public market information, this is a logical response and one that may have been more prevalent had the length of periods without information been longer.

Conclusions

The quality of decision-making declined in the absence of current market information. This was clear from the written comments by market participants, from increased marketings/purchases at more than industry-efficient weights, and from increased transaction price variance when market information was removed from the market. Differences in econometric results for this study compared with the two previous studies suggests that removing and restoring different types and amount of information into the FCMS altered the normal economic relationships between transaction prices and traditional variables, most notably boxed beef prices, but futures market prices, total show list inventory, fed cattle marketings to a lesser extent. Reducing cash price information increased the reliance on futures market prices. From this experimental simulation there is evidence that traditional, predictable economic relationships may be altered in the absence of public market information, thereby contributing to pricing inefficiencies.

Price impacts from reduced information were sometimes in the feeders' favor and sometimes the packers. Just as there is asymmetry in the availability of information, there may be asymmetry in the absence of market information. Increased price variance and the concomitant increase in price risk raises the cost of doing business for both feeders and packers. However, in the case of marketing cattle at less efficient weights, loss of market information clearly was in the packers' interest.

There was a tendency for buyers and for sellers to jointly share more information than when market information was publicly available to all participants. That finding suggests market participants would somehow band together to collect and disseminate market information if public funding did not support such collection and dissemination of needed market information. However, it also suggests buyers may attempt to share more information, potentially leading to collusion or noncompetitive pricing practices. Packers valued futures market information less than feeders and were less willing to pay for market information. This supports the contention that the closer a firm is to final demand, the better they can assess market demand and the less need they have for public market information. This asymmetry in demand for market information again supports the conclusion of asymmetry in the impacts of reduced information on buyers and sellers. Therefore, public market information may be more advantageous to sellers and to smaller firms as a means of balancing the trading position between buyers and sellers.

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