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The Evolving Agricultural Marketplace: Selected Results and Implications for the West from the Laboratory

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Introduction

Agricultural markets continue to evolve creating issues of interest for market participants, analysts, and policy makers. Issues of interest in changing agricultural markets in the West include the following: 1) price discovery and transactions – shifting from open markets and auctions to tighter vertical linkages and private negotiation (Barkema, Drabenstott, and Welch 1991); 2) collusive behavior and market power of firms purchasing agricultural outputs (Barkema, Drabenstott, and Novack 2001); and 3) market impacts of new agricultural policies (Orden 2007). The effects of these changes on market outcomes/performance are difficult to determine using traditional methods of analysis such as econometrics, as data may not be available or because it is challenging to isolate the confounding influences of relevant variables. A baseline performance measure, such as the competitive equilibrium, is not observable in naturally occurring markets. One approach that addresses these issues is laboratory markets.[2] The focus of this paper is to explain how induced laboratory market experiments are conducted and how results from the laboratory can provide insights and policy prescriptions related to the above market issues. Results from selected studies are reported to demonstrate the application and contribution of experiments to policy development.

Laboratory Market Procedures

Isolating the impacts of marketplace changes in the laboratory involves creating a market. Four buyers and four sellers are sufficient to create a competitive environment. Buyers and sellers, respectively, are given a set of redemption values and unit costs for units traded in the market. Buyers make money by purchasing units at a price less than their assigned unit redemption value. Sellers earn a profit by selling units at a price greater than unit costs. Control, which is essential in experimental studies, is achieved by three conditions (Friedman and Sunder 1994, p.13) – monotonicity, more reward is preferred to less; salience, the reward depends on actions as defined by the institutional rules; and dominance, utility from the experiment comes from the reward medium and other influences are negligible. The experiment is set up to reward participants based on their decisions.[3]

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[2] Another approach is the use of laboratory market simulation such as the Fed Cattle Market Simulator (FCMS). Applications of the FCMS are reported by Ward et al. (2001). "The primary difference between experimental simulation using the FCMS and experimental economics is the degree of control over market participant behavior" (Ward et al. 1996, p. 464). There are numerous experimental studies in the literature related to a broad set of issues such as natural resources, environmental valuation, and value elicitation for product attributes (see Davis and Holt 1993 ; Kagel and Roth 1995, for different experiment examples).

[3] Friedman and Sunder (1994, p.17) provide basic practical guidelines for conducting economic experiments. Their guidelines focus on creating a controlled and simple economic environment in the laboratory and motivating subjects by monetary rewards based on their economic decisions in the experiment.

Consider a market demand where each buyer may purchase eight units. The redemption value for the first unit is 130 tokens. This value decreases incrementally by 10 tokens to 60 tokens for the eighth unit. Similarly, on the supply curve, unit costs begin at 30 tokens and increase by 10 tokens for each unit to 100 tokens for the eighth unit. Summing horizontally over four buyers and four sellers result in induced market demand and supply relations (figure 1). The predicted competitive equilibrium price is 80 tokens and the equilibrium quantity is 20 – 24 units. The earnings level at equilibrium prices and trades is 150 tokens for each buyer and seller. This translates to 1200 tokens total surplus for the market. These competitive predictions can serve as base comparators for market outcomes, which include prices; number of trades; and buyer, seller and total earnings.

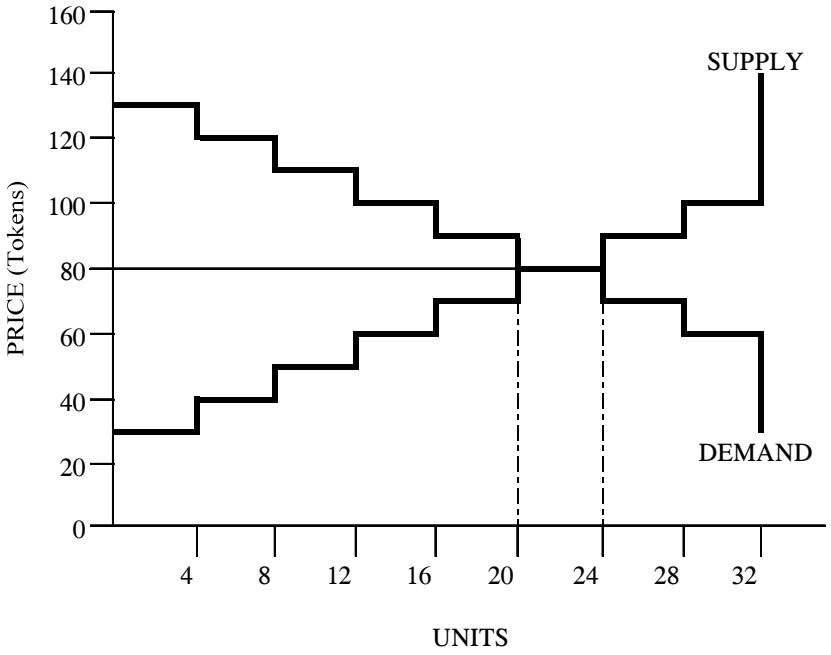

Figure 1. Induced market demand and supply

Recruited participants come to a computer laboratory where they are presented instructions for the specific experiment. Trial runs, using different unit values and costs than in the main experiment, are conducted until all participants are comfortable with the procedures. Multiple trading periods (15 – 20) are conducted for each treatment to allow for learning and convergence of market outcomes. Subjects are paid in cash at the end of the session. Treatments are repeated, with the number of replications depending on the variability of results across replications. Market outcomes are analyzed over the replications to separate out individual agent influences.

Results from the experiment sessions often are graphed. An additional description of the data and statistical analysis can be conducted by means of a convergence model (Noussair, Plott, and Reizman 1995), which is estimated by the Parks (1967) method, given the time-series and cross-sections in the data. The convergence model explains the path of market outcomes over

trading periods. It can be used to test statistical significance of asymptotes/convergence levels of the variables of interest between treatments. Davis and Holt (1993) provide additional details on conducting market experiments.

Laboratory Market Experiments as a Source of Data

The strength of laboratory methods is control, allowing the investigator to isolate the effects of a particular variable of interest. This may be viewed by some as a weakness because reality is compromised. An appropriate experimental design will vary only by a few, or perhaps only by one, variable. Usually phenomena proceed such that variables are changing simultaneously. Inquiries into complex choice occasions may require that numerous experiments be conducted before final results are obtained.

Agricultural economists trained in applied analysis techniques may question experiments as a source of valid data. There is no basis necessarily to accept implications from a mathematical specification of human behavior as more accurate than those derived from direct observation of human behavior from the laboratory. Theoretical analyses can be augmented with observation of human behavior from the laboratory, particularly if data from naturally occurring markets are unavailable. Examples include market outcomes from privately negotiated transactions, outcomes from potential policies that have not been implemented, and the inability to ascertain competitive equilibria for comparison with actual market data.

Selected Studies Using Laboratory Markets/Experimental Auctions

The following offers a summary of the results and implications from laboratory market studies that address selected issues in agricultural markets in the West. These studies are discussed as per the behavioral/policy relevance of results rather than procedures.

Price Discovery and the Environment in which Transactions Occur

Price discovery occurs in alternative trading institutions and methods of delivery, which may result in different market outcomes and performance. Common trading institutions include private negotiation, English auction, posted bid auction, and posted offer auction. In the West, the English auction is used primarily in the sale of cattle. However, there is increasing reliance on private negotiation trading. Private negotiation of prices also is prevalent between processors and retailers. Posted bid pricing is used at grain elevators and posted offer is typical for food retailing procurement. The double auction characterizes the trading institution used in the exchange of futures contracts (i.e., buyers and sellers are simultaneously posting calls (bids) and puts (asks)).

Two methods of delivery are possible. The first, forward or PTD delivery means the transaction price and quantity are agreed upon before the product is produced. The alternative, spot delivery, requires inventory in stock before negotiation/trading begins. This has costs/risks that are not present in PTD delivery. The spot seller incurs sunk production cost before trading begins. Inventories must equal or exceed sales in order to make a trade if carry-over to the next production period is not possible (e.g., the case of perishable food products).

Producer concerns have arisen about price discovery in cattle markets as individually negotiated pricing has become the most common method used to establish prices for fed cattle purchases (Taylor et al. 2007). Menkhaus, Phillips, and Bastian (2003) report results related to market outcomes across alternative price discovery institutions and delivery methods in

response to this concern (table 1). Sellers do well in an auction-spot setting, in both double and English auctions, but particularly in a competitive English auction. Sellers are passive in the English auction, while buyers actively bid against each other as in the traditional sale barn setting. Mestelman, Welland, and Welland (1987) and Bastian et al. (2008) find market prices and trades in spot posted-offer and posted-bid auctions, respectively, to be near the predicted competitive equilibrium levels. These results suggest agricultural producers as commodity sellers may be better off in competitive auctions as compared to private negotiation.

The distribution of earnings changes dramatically in private negotiation trading with spot delivery. As reported in table 1, the advantage goes to the buyer, leaving the seller with the lowest earnings among all of the trading scenarios studied. Two risks affect earnings in the private negotiation spot market environment – matching risk, which is faced by both buyers and sellers, and advance production risk faced by sellers. Advance production risk results in fewer trades and a bargaining disadvantage for sellers, relative to buyers. Unlike private negotiation, auctions provide many matches. Limited matches (matching risk), and the associated bargaining advantage by buyers when there is advance production, may facilitate monopsony power (Menkhaus et al. 2007). Sellers have a bargaining disadvantage in the environment just described highlighting the impacts of advance production risk. If the risk between sellers and buyers is reversed or equal, the results are expected to be affected accordingly.

Table 1. Estimated Convergence Levels of Market Outcomes for Alternative Trading Institutions and Methods of Delivery and the Competitive Base.

Treatment	Trades	Prices	Total Surplus	Buyer Earnings	Seller Earnings
Base	20.00	80.00	1200.00	150.00	150.00
Forward					
Double Auction	22.60*	76.68*	1200.00	166.49*	135.61*
Private Negotiation	16.58*	82.20*	1076.63*	124.80*	143.86*
Spot					
Double Auction	20.20	83.34*	1162.80*	130.51*	160.25*
Private Negotiation	14.59*	72.21*	1013.09*	155.82*	97.91*
English Auction	18.72*	93.25*	1153.76*	77.07*	211.50*

Source: Calculated from results presented in Menkhaus, Phillips, and Bastian 2003.
Notes: Experiment sessions for each treatment were conducted for 15 periods. Private negotiation was for limited matches (three).
* Significantly different from the base, competitive equilibrium, 99 percent confidence level from the convergence model.

These results suggest the trend away from auctions toward more private negotiation, in some sectors of the food industry, may result in lower returns for sellers of agricultural commodities/products. This is particularly relevant when price negotiation follows production and sellers incur greater risk compared to buyers, as is the case in many agricultural markets. Total market surplus, also deviates from the competitive model most in private negotiation trading for both forward and spot delivery (advance production) with limited matches. Thus,

trading institution and method of delivery can influence market outcomes.

These results offer evidence useful to researchers and policy makers regarding agricultural markets becoming more concentrated and dominated by private negotiation. Ward et al. (1996) indicate that in private negotiation trading bargaining ability of agents impacts market outcomes. As private negotiation becomes more dominant and concentration of buyers increases, the risk of sellers being matched with buyers that have improved bargaining power is increased. Two industry practices in the fed cattle market that may exacerbate this phenomenon include grid marketing and short trading windows. Increased use of grid marketing and increased incidences of captive supplies being held by buyers, which potentially creates short trading windows in cattle markets, both may reduce the ability of sellers to be matched with buyers willing to pay higher prices for cattle in a private negotiation setting (Menkhaus et al. 2007).

Collusive Behavior in English Auctions

While the auction environment is generally advantageous for sellers, repeated English auctions are susceptible to cooperative behavior among buyers, which can be detrimental to seller earnings (Milgrom 1989). Buyers are able to acquire knowledge of rivals' bidding strategies and reservation prices by observing their bidding behavior, especially in repeated auctions of multiple items such as in livestock auctions. An example of this is the use of shared agents in livestock auctions. This has the potential to increase concentration of bidders within an auction setting. Several studies provide evidence of price depression resulting from increased concentration of bidders in a single English auction market (Bailey, Brorsen, and Fawson 1993; Adam et al. 1991).

Laboratory markets were used to study collusion in a series of sequential English auctions in which participants (either two or six buyers) were only bidders and quantities for sale were exogenously determined (Phillips, Menkhaus, and Coatney 2003; Menkhaus, Phillips, and Coatney 2003). Several facilitating influences were examined – the same set of bidders over a series of seven auctions (base treatment); knowledge of the number of units for sale; communication via an online chat; and the provision of multiple buy orders by competing principals to the same agent buyer. Another set of treatments involved analyzing how trade prices were impacted as the market evolved to a more concentrated state via a buyer selection process designed to retain the most successful agents throughout all auction rounds. These treatments mimic behavior at many livestock auctions. Auction participants observe cattle quality and quantity prior to the auction and may in some cases converse with other buyers regarding their intentions. The industry practice of using shared agents with multiple buy orders from several packer principals results in increased market concentration at livestock auctions.

Results indicate that market practices in multiple-unit, repeated English auctions may facilitate collusive behavior when there are two buyers, as well as when there are six buyers. Moreover, the knowledge of the number of units for sale in an upcoming auction was found to be at least as effective in helping two agents cooperate as open communication. Without facilitating influences, two buyers were about as competitive in their bidding behavior as six buyers in this auction setting. A comparison of two-buyer auctions with six-buyer auctions reveals how cooperative six buyers can become. Knowledge of quantity for sale did not coordinate six buyers as well as two. Communication, however, helped six buyers coordinate at least as much as in the two-buyer case. A simple bid-sharing plan that let bidders alternate taking the low bid was focal and allowed for successful collusion among six buyers. Simple turn taking became focal for two buyers when quantity for sale was announced, which contributes to stability for the bidding ring. A decreasing number of firms, and a greater concentration of buyers, suggest

opportunities for collusive behavior. The evolution of concentration that left the most successful buyers in a sequence of laboratory auction sessions depressed price to levels about 26% below the competitive prediction – about the same amount as when two buyers participated in the sequence of auctions with quantity for sale known.

Quantities in naturally occurring livestock auctions are often known. Historical trends indicate increased concentration among agent-buyers. This changing auction environment suggests an increased risk of collusive behavior in livestock auctions.

Ex Ante Evaluation of Alternative Agricultural Policies – The Case of Decoupled Subsidies

As agricultural markets adapt to globalization, increasing scrutiny of traditional agricultural policies that provide income transfers to producers has occurred. This indicates the need to investigate the policy alternatives *apriori* (OECD 2006). The use of subsidy payments decoupled from output has been proposed to meet the World Trade Organization goal of not distorting production and trade (Orden 2007; Orden and Diaz-Bonilla, 2006). The question becomes how to investigate potential market impacts of a decoupled policy when little or no data exist for use in economic analyses. Research reported by Bastian et al. (2008) investigated the issue using laboratory market experiments.

A posted-bid auction, used for price discovery in grain markets, was chosen as the trading institution for the laboratory sessions. Four alternative treatments were investigated: 1) no policy; 2) coupled support price and deficiency payment; 3) coupled support price and switch to lump sum subsidy (decoupled); and, 4) coupled support price and switch to period or annual subsidy (decoupled). Sellers were made aware of policy treatments via instructions prior to conducting each experiment. Sellers were informed of the policy change before the period in which the switch occurred (treatments three and four).

Results indicate the stylized coupled support price and deficiency payment treatment produced market outcomes consistent with those from known target-price policy effects. Relative earnings suggested the subsidy was largely passed on to buyers through lower prices under the coupled deficiency payment policy treatment. Despite identical total payment amounts, buyers did not do as well under decoupled policies (lump sum or annual subsidy) as in deficiency payment treatments. Buyer earnings were still higher than in the no policy treatment since prices were lower. Production levels in the decoupled treatments (three and four) were similar in production levels as compared to that in the no policy treatment. Thus, the experiments confirmed theoretical predictions by Tangermann (1991) that decoupled policies do not distort production. Experiment results also indicated a potential moral hazard issue related to price negotiation when subsidies (both coupled and decoupled) are given to sellers. Producers were less aggressive in negotiating price when receiving a subsidy, thereby transferring a portion of income to buyers. Policy makers continue to investigate alternative policies that are decoupled. These results suggest some policy alternatives may be more efficient at transferring income while reducing market distortions.

Conclusion

These results show experiments can provide insights for Western agricultural market trends. Spot sellers likely will become increasingly disadvantaged as agricultural markets become dominated by private negotiation. The impacts of regulations and programs designed to address competitiveness and transparency must be studied under this new trading environment.

The experiments provide powerful predictions of the role certain factors may play in facilitating potential collusive behavior in cattle markets. The use of shared agents representing multiple principals requires further scrutiny.

It appears that policy analysts are increasingly interested in results from laboratory studies. They view experimental economics as a potential tool for *ex-ante* policy analyses. This is not surprising as policy analysts often do not have access to relevant data to address questions raised by decision makers and legislators. As structural change in the food supply chain and budget constraints for gathering agricultural statistics continue, the interest in the use of experimental methods seems likely to increase.

As markets in the West become less transparent, agricultural economists will continue to be called upon to provide policy relevant analyses. New research methods will be needed to conduct investigations with limited data. Experimental economics techniques will become an increasingly relevant methodology. It should be noted that wherever possible, additional analyses that complement experimental results will be of increasing interest.

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