Testing the Impacts of Structure and Information on Market Performance Using Experimental Economics

By

D. Lynn Forster

and

Dennis R. Henderson

The authors are associate professor and professor, Department of Agricultural Economics and Rural Sociology, The Ohio State University. Research was supported by the Ohio Agricultural Research and Development Center.

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The concept of efficient markets rests on the notion of informed buyers and sellers trading in a competitive market setting (Fama). Is it necessary for all market participants to be fully informed? This research rests on the notion that market participants need only limited information to assure efficient market performance. Specifically, buyers only need know their demand structure and be able to observe the price establishment process. Conversely, sellers only needs know their cost structure and also be able to observe the price establishment process. The first objective of this research is to test the efficient market hypothesis using the information set for buyers and sellers described above.

Economic theory holds that market efficiency is reduced by a monopoly market. This hypothesis is tested in a market setting similar to the one above: the monopolist has cost information and can observe the price establishment process. The buyers have information concerning demand and also can observe the price establishment process.

The ability to observe the price establishment process is thought crucial to an efficient market outcome. Specifically, the ability to observe bids (offers) of buyers (sellers), and actual transaction prices and quantities is the process which provides needed information for market participants. It is hypothesized that price establishment processes which fail to make public this information result in reduced efficiency, and this is the third hypothesis tested. Experimental economics is the tool used to test these hypotheses.

Methodology

Experimental economics is the study of individual decision behavior and market performance in a laboratory setting. The usefulness of experimental economics rests on the proposition that laboratory decision making and laboratory markets reflect "real" markets (Wilde). In real markets,

people pursue real profits and suffer real losses within a set of rules well known to market participants. In experimental markets, there also exists a monetary reward structure and a set of rules. The experimental market provides a "real" market, albeit less complex than the typical market environment.

Over the past 30 years standard procedures have evolved in the conduct of experimental markets (Plott; Forsythe, Palfrey and Plott; Issac and Plott; Kagel and Battalio). These procedures are used in this research. Individuals are voluntarily recruited to participate in an experiment. The assumption is made that the individual behaves "rationally"; that is, each individual prefers larger monetary rewards to less. Also, the individual is assumed to have no attitudes toward the commodity being traded. For this research, "amazin grain" is the commodity traded.

Participants are divided into buyers and sellers. Their preferences are induced by application of derived demand theory (Smith). Buyers may make money by buying from sellers and reselling the commodity to the experimenter according to a known redemption schedule. For the first unit sold, the buyer's redemption value is high. As additional quantities are redeemed, each is sold for less. Sellers make money by purchasing the commodity from the experimenter according to a predetermined cost schedule and reselling to buyers. Each additional unit costs the seller more than the previous one; the cost schedule is essentially a supply schedule. Inventories can be carried by either buyers or sellers but at a cost.

Markets are conducted over a series of five trading days. Each day consists of a one hour trading period. At the outset of each trading day, each buyer is given a redemption schedule. Each experiment uses six buyers. There are three different redemption schedules among the six buyers. Thus,

buyers have three different demand schedules, but all can be aggregated to produce a market demand curve for each trading day. Six sellers also are facing three different cost schedules. These too can be aggregated to produce a market supply curve for each trading day. Using aggregate supply and demand, the trading day's equilibrium price and quantity are determined by the experimenter prior to trading but are unknown to individual buyers and sellers. An efficient experimental market would be one where actual quantities and prices parallelled equilibrium values.

Competitive Experimental Market with Oral Double Auction

Each trading day, buyers know only their own demand schedules for that day. They know nothing of other buyers' demand schedules, nor do they know sellers cost schedules. Likewise, sellers know only their own cost schedules. No information about demand or cost in future trading days is given to participants. Buyers and sellers trade using an oral double auction. Bids and offers are verbally tendered by participants. When a transaction is completed, the price is recorded by the buyer, the seller, and the experimenter. Information is complete to the extent that each buyer knows his (her) redemption schedule, each seller knows his (her) cost schedule, and all participants can hear all bids, offers, transaction prices, and quantities traded.

Monopoly Experimental Market with Oral Double Auction

Sellers are allowed to collude during each trading day. They share their cost schedules with other sellers and jointly determine their pricing strategy. The price actually received by sellers is the average price for the trading day rather than prices actually received in the market. Buyers face the monopoly as individuals having no knowledge of other buyers' redemption schedules. Again, an oral double auction is used

with bids and offers being verbally tendered by participants. All sellers can trade in this market, or one seller can trade for the monopoly. When a transaction is completed, it is recorded by the buyer, seller, and the experimenter. Again, information is complete in the sense that all participants hear bids, offers, transaction prices, and quantities traded. Buyers have no knowledge of sellers cost schedules, but they suspect collusion when sellers pursue monopoly pricing strategies.

Monopoly Experimental Market with Posted Pricing

Again, sellers are allowed to collude. They share their cost schedules and jointly determine their pricing strategy. Again, the price received by sellers is the average market price for all transactions during the trading day. Posted pricing is used to limited information. Sellers jointly post a price and the length of time of the posting. During this posting period, each buyer can purchase as much of the commodity as he (she) wishes. Notice of purchase is transmitted to sellers in writing. There is no information available to a buyer concerning other buyers' purchases. Thus, the only information available to a buyer is the posted price and his (her) redemption schedule. Other information provided by an auction market - bids, offers, transaction prices, and quantities traded - is not present.

Results

Prior to participating in each experiment, traders are involved in at least one competitive experimental market using the double oral auction procedure. Thus, all traders are knowledgeable about the market, the double auction trading procedure, and their opportunity for profit. They can expect to receive approximately $15 for an experiment's five one hour trading days. That is, the buyers' and sellers' returns average about

$15 for each participant.

Experiment A presents the participants with a competitive market. Each buyer knows his (her) redemption schedule. Each seller knows his (her) cost schedule. A double oral auction is used. Results from the first trading day are shown in Figure 1. The buyers' aggregate demand (line A) and sellers' aggregate supply (line B) are depicted along with the actual transactions (dots). The competitive equilibrium price established a priori by the experimenter is $0.32 per unit, and actual transaction prices are between 0.32 and 0.35 per unit. The number of transactions (49) is slightly less than the equilibrium quantity (54). Buyers' returns are equivalent to the concept of consumer surplus, and sellers' returns equate with the producer surplus concept. The sum of consumer surplus and producer surplus totals $19.70 for this trading day. Actual returns realized by buyers and sellers are $19.40.

Buyers redemption schedules and sellers cost schedules are shifted from one trading day to the next. The competitive equilibrium prices and quantities compared with actual prices and quantities for each trading day are depicted in Table 1(a). The number of actual transactions for the 5 day experiment is 94 percent of the equilibrium quantity, and the average transaction price is 98 percent of the average equilibrium price.

Experiment B permits sellers to collude but uses an oral double auction. During the first trading day, monopolists are able to achieve prices significantly higher than equilibrium (Table 1(b)). However, in later trading days, this ability is eroded. In these later trading days, buyers tend to delay selling until late in the trading day forcing sellers to lower their prices. For all five trading days, actual prices are just 1.5 percent higher than equilibrium prices; however, quantity traded is

only 87 percent of equilibrium. Apparently, the oral double auction generates significant information even in a monopoly setting. Market performance in terms of achieving competitive equilibrium prices and quantities is nearly the same with the monopoly market structure as with the competitive market structure.

In Experiment C, posted pricing is used by monopolists, and buyers transmit acceptance in writing. Sellers know the quantities being purchased with each posted price, but buyers know nothing of other buyers' purchases. Thus, relatively little buyer information is generated by the trading procedure itself. Actual prices are significantly higher than competitive equilibirum prices on two of the trading days and near equilibrium on two (Table 1(c)). There are no transactions during one trading day. On that day, high posted prices result in buyers choosing to forego small returns or losses by staying out of the market. No learning is evident in that there are higher than competitive prices in days 1 and 3, but there is little divergence in days 3 and 4. For the entire experiment, quantity traded is only 78 percent of equilibrium, and actual prices are 104 percent of competitive equilibrium.

Summaries of market performance for the three experiments are shown in Figures 2 and 3. Efficient markets theoretically result in equilibrium quantities being sold at the equilibrium price during each trading day. Efficient market performance is illustrated by the point in the upper right hand corner of Figure 2. Efficient markets also maximize consumer surplus and producer surplus. These maximum surpluses are depicted in Figure 3 by an index of 100. Actual levels of combined producer and consumer surpluses for these experiments are scaled accordingly.

The competitive experimental market performance is close to the efficient market ideal. Consumer and producer surpluses are 99 percent of the maximum. Average price is within 2 percent and quantity traded is within 6 percent of those of the efficient market. Performance is slightly worse in the monopoly experimental market with a double auction than in the competitive experimental market. By far the worse performance is shown by the monopoly market with posted pricing. However, prices are the highest, quantities traded are the least, and consumer and producer surpluses fall far short of those associated with the more efficient markets. As would be expected, monopoly markets raise producer surplus and lower consumer surplus relative to competitive markets. However, the magnitude of the increase in producer surplus and decrease in consumer surplus is significantly greater in the price listed monopoly than when double auction procedures are used.

Conclusions

Prices in the competitive experimental market with a double auction are quite close to theoretical equilibrium prices. In this market, prices adjust very quickly to changes in either supply or demand, and trading occurs near the equilibrium price throughout each trading day. Consumer and producer surpluses are within 1 percent of maximum.

The monopoly experimental market with an oral double auction results in slightly inferior performance compared to the competitive market. Prices are higher, although not significantly higher, than competitive equilibrium prices and competitive market prices. Quantities traded are less than the competitive market. Consumer and producer surpluses total 4 percent less than maximum.

Market structure, i.e. monopoly vs. competitive market, does affect market performance. Higher prices, lower quantities, and lower consumer and producer surpluses are the result of the monopoly. But performance of the monopoly market when the double auction trading procedure is used is surprisingly near that of the competitive market.

The monopoly market with posted pricing provides the worst performance. Prices average appreciably higher and quantities traded are far less than with the other trading procedures tested. Consumer and producer surpluses total 12 percent less than the efficient market with income distribution skewed sharply in favor of monopolists.

Market information in these experiments results simply from each participant's ability to observe all transactions. Participants know nothing of others' cost or demand schedules; they just are able to watch market transactions. Results suggest that poor market performance may be more the fault of limited information associated with the type of trading system (i.e. posted prices) than monopoly market structure.

Table 1(a). Results of Experiment A, Competitive Experimental Market

Trading Day	Quantity		Average Price		Standard Deviation of Actual Price
	Equilibrium	Actual	Equilibrium	Actual	
1	54	49	32	33.6	1.20
2	57	40	42	41.9	2.92
3	106	112	52	50.5	1.12
4	93	89	49	47.5	0.94
5	97	91	48	44.6	1.13
Total	407	381	46.3	45.3	1.30[a]

Table 1(b). Results of Experiment B, Monopoly With Oral Double Auction

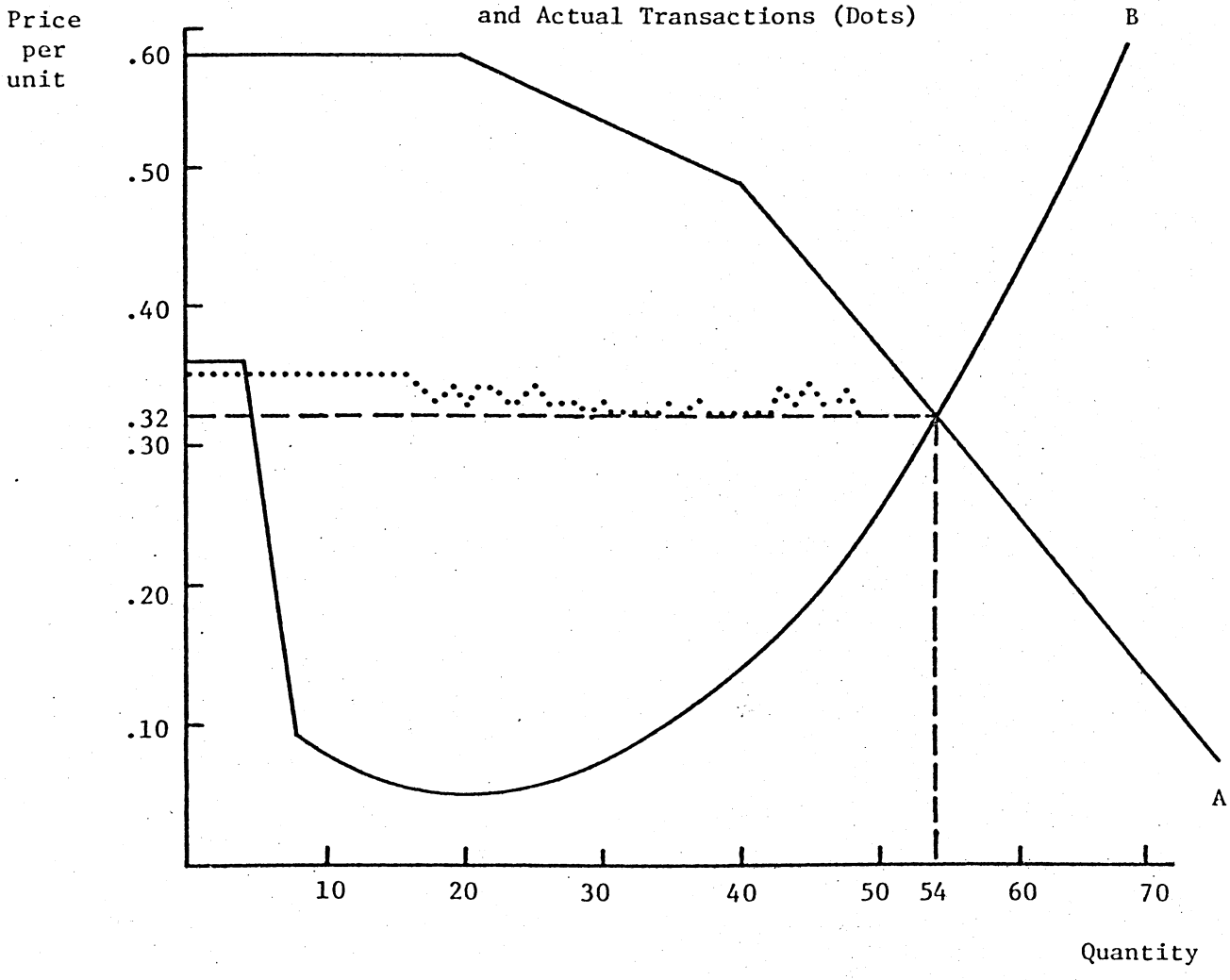
Trading Day	Quantity		Average Price		Standard Deviation of Actual Price
	Equilibrium	Actual	Equilibrium	Actual	
1	68	64	32	44.7	1.55
2	105	84	52	49	0.16
3	57	43	42	45.2	0.41
4	78	75	49	47.8	0.70
5	96	86	48	44.6	0.52
Total	404	352	45.7	46.4	0.65[a]

Table 1(c). Results of Experiment C, Monopoly With Posted Pricing

Trading Day	Quantity		Average Price		Standard Deviation of Actual Price
	Equilibrium	Actual	Equilibrium	Actual	
1	105	90	52	58.2	0.82
2	81	74	62	60.4	0.79
3	57	-	72	-	-
4	93	86	78	84.5	2.34
5	97	87	78	76.9	1.35
Total	433	337	67.9	70.2	1.34

[a]Weighted average of the standard deviations for the five trading days.

Figure 1. Experiment A, Trading Day 1:
Buyers' Aggregate Redemption Schedule (Line A),
Sellers' Aggregate Cost Schedule (Line B),
and Actual Transactions (Dots)



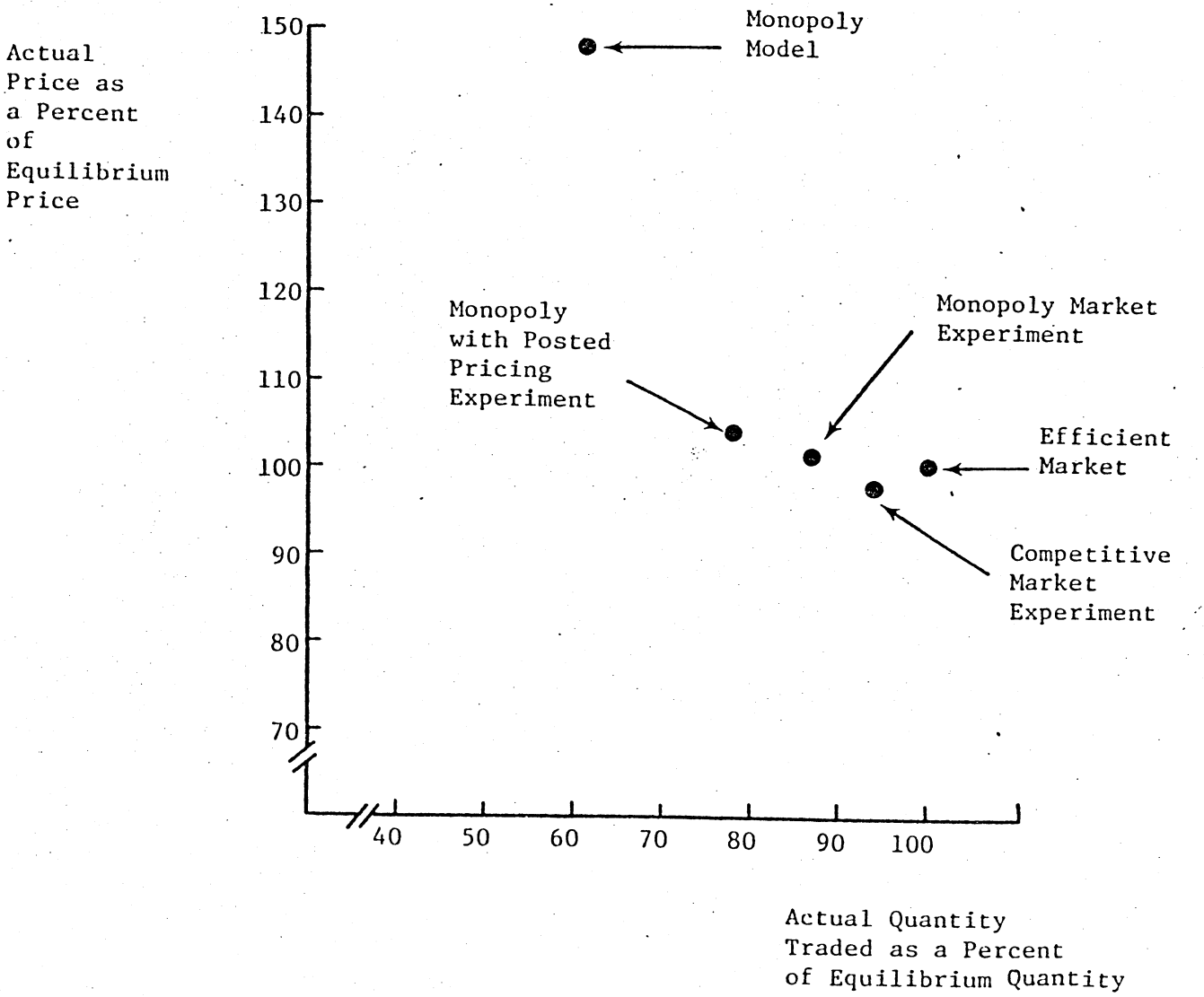
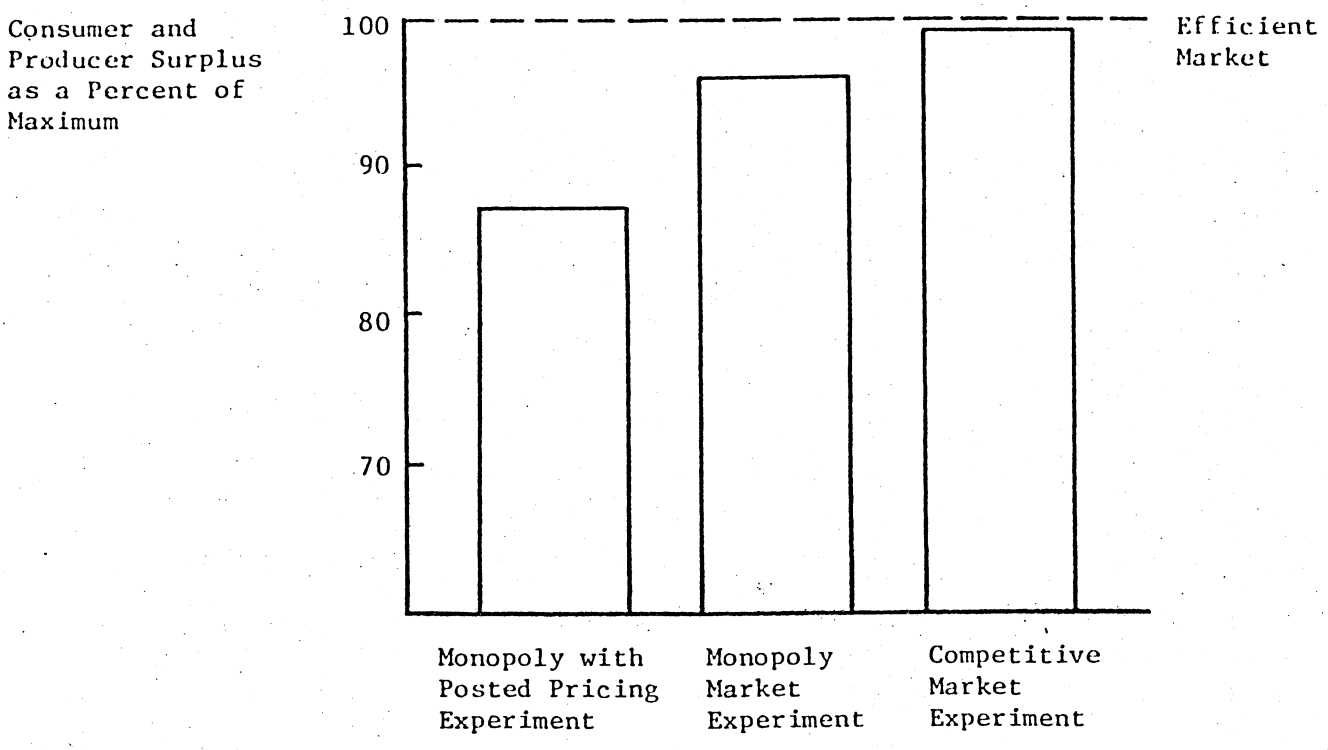


Figure 2. Market Performance in Experimental Markets, Prices and Quantities Traded

Figure 3. Market Performance in Experimental Markets, Consumer and Producer Surplus.



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