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THE EFFECTS OF TRADER'S REPUTATION ON MARKET EXCHANGE

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ABSTRACT

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Reputation among traders may be an important phenomenon in commodity markets. A theory of reputation trading in commodity markets is advanced and tested, using experimental economics procedures. Results indicate existence of reputation decreases market efficiency, sellers demand higher prices from disreputable buyers, and sell smaller quantities to disreputable buyers.

REPUTATION TRADING IN COMMODITY MARKETS: AN EXPERIMENTAL ECONOMICS APPROACH

Introduction

There are several basic exchange mechanisms observed in use across various commodity markets. These include spot markets, formula pricing, administered pricing, various forms of contracting, and vertical integration, either contractual or ownership. These mechanisms, sometimes called price discovery processes, all serve to facilitate exchange (Forker). The study of the performance of various exchange mechanisms has been of interest to agricultural economists and general economists for several decades (Rogers; Frahm and Schrader; Williamson; Goldberg).

The allocative properties or consequences flowing from various exchange mechanisms have been of special interest. The casual marketing channel observer notes there are differences in the process used to "discover" price among traders and that differences in the process are related to particular exchange mechanisms. At issue is the performance and allocative properties of the exchange mechanisms. For example, is the performance of spot and contractual exchange similar in the short-run or long-run? If not, are there special conditions (e.g. risk, information symmetry, market structure) that would lead to similar results? The price behavior and cost of the exchange mechanisms relative to alternatives has received increasing attention in recent literature (Kilmer; Roberts, Adams and Hudson; Sporleder, 1984).

More theoretical investigations by general economists have focused on bargaining in a bilateral trading situation (Crocker; Grossman and Hart). The choice of exchange mechanisms in these bilateral trade situations is sensitive to prior investment in specific assets by the traders. A similar theory, recently advanced by Wiggins, examines the competitive forces which may mold the

choice of exchange mechanism. Wiggins posits a theory where competitive pressures dictates the choice of an efficient exchange mechanism.

Reputation Trading

Reputation is an aspect of the price discovery process that often is ignored. Recent theoretical investigations by Shapiro and Klein and Leffler suggest reputation is an important market mechanism. Reputation is a vehicle for providing incentives for traders to honestly report market shocks so that contractual adjustment among traders may occur at a low cost. However, these investigations involve adjustment in contractual terms, not spot markets. Colling and Sporleder provided the first study that investigates reputation in a commodity spot market.

The anecdotal evidence concerning the existence of reputation in commodity markets is compelling. Buyers and sellers of commodities make numerous private treaty sales daily over the telephone. This includes grain, livestock, and fruit and vegetable markets. The vast majority of these transactions are not reinforced with formal market rules, printed contracts, or third-party guarantees.

However, the experience of pilot projects on electronic marketing strongly suggested that remote-access spot trades via computer linkage required some form of "performance reinforcement".[1/] The electronic marketing pilot projects involved blind matches, in the sense that buyer and seller were not identified to each other prior to a transaction.[2/] This meant that buyers would buy from sellers they might not know and sellers would sell to buyers they might not know. In essence, the reputation normally inherent in a conventional private treaty transaction was *missing* from a computerized trading system transaction.

Reputation trading can imply that an attempt is made by buyers and sellers to minimize the perceived risks associated with non-performance or post-sale grievances by trading only with known parties. Examples of potential non-performance or post-sale grievance risks for sellers include non-payment, bounced checks, complaints about delivery, weighing conditions, and/or grade, etc. Non-performance risks for buyers include non-delivery and other non-performance items such as substitution of lower grades in a lot.

References to the importance of reputation have appeared in some computerized trading systems literature (Sporleder, 1983, for example), but no systematic examination reputation trading has been conducted. A model for reputation trading is advanced and tested. Also examined is the extent to which reputation must be *different* among buyers before sellers perceive a difference, the influence of reputation on price level from both a theoretical and empirical viewpoint, and the effect, if any, on market efficiency.

A Theoretical Model

When homogeneous commodities are traded in competitive markets, conventional theory implicitly assumes that all buyers and sellers are uniform or homogeneous regarding reputation. Under conditions of certainty and uniform reputation, equilibrium price is established at the equilibrium quantity. If the assumption of homogeneous reputation among traders is relaxed, ceterus peribus, the result is to inject uncertainty in the market and to each transaction, thus raising cost to traders.

Suppose buyers are dichotomously categorized into reputable and disreputable. Sellers may rationally presume that the price for a particular trade is a "net" or final price when negotiated with a reputable buyer. However, the seller's net price may be uncertain when negotiated with a disreputable buyer due to potentially unanticipated costs in completing the

transaction after price is negotiated. Specifically, a loss from greater-than-anticipated transaction cost may face sellers to disreputable buyers.

More formally, define conventional market equilibrium using simple linear functions as:

1) $Q_D = a - bP$

2) $Q_S = -c + dP$

3) $Q_D = Q_S$

Now suppose an expected loss function is formalized such that both the frequency and magnitude of the loss per unit is uncertain:

4) $E(L) = (F_L)(M_L)$

where E(L) is the expected loss, F_L is the probability or frequency of the loss per transaction, and M_L is the magnitude of the loss when it occurs. To reflect the E(L) function in the equilibrium price and quantity, suppose E(L) is evaluated at its mean, $\bar{E}(L)$, and Q_S is partitioned into reputable (Q_R) and disreputable Q_U supply. Let

5) $c^* = c + \bar{E}(L)$

where c^* is the supply function constant reflecting the mean expected loss and $\bar{E}(L) > 0$. Thus,

6) $Q_D = a - bP$

7) $Q_R = -c + dP$

8) $Q_U = -c^* + dP$

9) $Q_D = Q_S = Q_R + Q_U$

From equations 1 and 2 above, it can be shown that:

10) $$\frac{\partial P^*}{\partial c} = (b + d)^{-1}$$

where P^* is the equilibrium price. Therefore, a decrease in c to c^* will have the effect of establishing an equilibrium price and quantity from equation 8 for Q_U which satisfies the following conditions:

11) $P_R^* < P_U^*$

12) $Q_R^* > Q_U^*$

This case is graphed as Figure 1. Thus, disreputable buyers would pay more and not be able to purchase as many units compared to reputable buyers. As levels of F_L and/or M_L are varied, similar arguments could be made for variations in the reputations of buyers. If three levels of disreputable buyers, i.e. two $\bar{E}(L) < 0$ levels and one $\bar{E}(L) = 0$, were known to sellers the situation could be depicted as in Figure 2.

Methodology

Design of Reputation Experiments

The effects of seller and/or buyer reputation on price, efficiency and quantity traded were estimated through experimental economics procedures. This methodology allows one to empirically study reputation in a controlled laboratory environment. Three types of experiments are reported here, a baseline experiment where competitive structure and competitive price discovery processes were employed, experimental sessions where disreputable buyers were simulated using a uniform expected loss function identical across all buyers, and sessions where 3 levels of buyer reputation within the market were simulated.

Thirty-six subjects were selected (all students) and divided into three groups of twelve, each with six sellers and six buyers to produce a competitive market structure (Plott; Smith, 1979 and 1982). Each subject was randomly assigned to be a seller or buyer and paid according to their trade earnings from each market session. The experiments followed as closely as possible the procedures of experimental economics developed and used in previous experimental economics research (Plott).

Method of Analysis

The experiments all were oral-double auction trading and consisted of 6-12 market periods where average market price, volume traded, and efficiency were observed. Efficiency was calculated by summing the buyer and seller surplus during a period (Rhodus and Henderson).

Reputation levels of buyers were simulated using an expected loss approach, as in equation 4. Expected loss was a monetary per unit penalty (M_L) times the probability of the penalty (F_L). The penalty, M_L, simulates the seller's expected cost associated with a potential post-sale grievance by the buyer. The probability, F_L, simulates the notion that a post-sale grievance would not necessarily be associated with every transaction. Thus, with six potential buyers in a market, the six sellers were informed of various reputation levels among buyers through knowledge of penalty and probability of penalty associated with that buyer. The "efficiency with penalty" measure reflects the extent to which buyer and seller surplus is maximized for the market.

Empirical Results

Oral-Double Auctions With Regular Trading

These experiments gave subjects experience with the oral-double auction and allowed determination of prices and quantities converging to equilibrium. In these experiments, reputations of buyers were not simulated. That is, $\bar{E}(L) = 0$. As expected, learning occurs among traders and results in average prices closer to equilibrium with each successive period, Figure 3. In all sessions, the market was 100 percent efficient because all possible fictitious units traded. This is the result expected using a competitive structure combined with the double-oral auction price discovery process (Plott).

Oral-Double Auctions With a Uniform Level of Buyer Reputation

In this series of experiments, all buyers possessed equal reputations, meaning that sellers had no preference about which buyer purchased their units. In this case, sellers are expected to withhold supply (shift the supply function uniformly upward and to the left) and prices should rise. Two expected loss amounts were used, one at 18.0 cents per unit (60 cent penalty times 30 percent probability per unit) and a 27.0 cents per unit expected loss (60 cent penalty times 45 percent probability per unit).

In one experiment, sellers faced a 30 percent chance of loosing $0.60 for each unit sold to any buyer, Figure 4. Average prices stayed about 2-3 cents above initial equilibrium.[3/] Using the last sessions as a criterion, prices were 2.82 cents higher. Market "efficiencies with penalties" for the last two periods averaged about 71 percent.[4/] This reflects sellers being periodically penalized for units sold. During early sessions, quantities traded were near maximum, but as learning occurred quantities fell to about 82 percent of maximum possible.

During a second experiment, the probability of a penalty was raised to 45 percent and the penalty was still $0.60, for an E(L) of $0.27 per unit, Figure 5. Average market prices tended further from the initial equilibrium. Again, using the last two sessions as a guide, market prices were 5.86 cents higher. This indicates sellers sought about 6 cents per unit higher prices for selling to a disreputable buyer. The efficiencies and the trading volumes dropped during the last two periods to 44 percent efficiency. Only 26 units traded out of an equilibrium quantity of 33 units if E(L) = 0.

The results suggest that when sellers face buyers with the same uniform reputations, prices tend to be above the P* derivable from equations 1 to 3, market efficiencies drop, and trading volume drops compared to the Q* of equations 1 to 3. When the expected loss was 18 or 27 cents, price peaked at

seven to eight cents above initial equilibrium and volumes traded dropped to about 80 percent of the total possible. Thus, sellers demanded roughly one-third to one-half of the $\bar{E}(L)$.

Oral-Double Auctions With Multiple Levels of Buyer Reputation

Experiments were designed to determine if prices paid and quantities received are different where different levels of (E(L), or reputations, exist among buyers in a market. In addition, the "level" of difference in reputations detectable by sellers was addressed. The theoretical outcome of n levels of reputation among buyers within a market would be that n supply functions develop, as depicted in Figure 3. The supply function to buyers associated with the greatest expected loss should be shifted upward and to the left, from the baseline case, relatively more than supply functions to other buyers.

Three levels of expected loss of 0, 9, and 18 cents were used in one experimental market. The composition of the expected loss was a 60 cent penalty with 0, 15, and 30 percent probability, respectively. The same penalties and probabilities were assigned randomly to 2 buyers in each experiment and revealed only to the sellers. Thus, the 6 buyers were assigned to three buyer reputation groups without their knowledge, or three levels of $\bar{E}(L)$, one being $\bar{E}(L) = 0$ and two different levels of $\bar{E}(L)$, where $\bar{E}(L) > 0$.

The results of this experiment were in the direction expected, Figure 6. For the aggregate market, price variability increased as learning occurred. Using the last two sessions as a guide, price averaged 2.55 cents above P* equilibrium, quantity traded was 89 percent of baseline, and efficiency averaged 73 percent. Three distinct supply functions to buyers emerged from the experiment, as expected. Sellers actually discounted prices to "zero expected loss" buyers just over 4 cents per unit from a 70 cent equilibrium baseline.

Buyers associated with the 9 cent expected loss paid 2.37 cents above initial equilibrium and quantity fell to 73 percent of the initial equilibrium quantity. Similarly, buyers associated with the 18 cent expected loss paid 8.58 cents more while quantity fell to 54 percent. The price differences observed among the three groups was roughly constant at 6 cents per unit. That is, the 9 cent expected loss supply function was 6 cents above the zero expected loss supply function, and the 18 cent expected loss supply function was 6 cents above the 9 cent supply function.

A second experiment of 3 levels was conducted where the absolute level of expected loss among buyers purposefully was small, Figure 7. The notion is that absolute level of expected loss and differences among buyers' reputations will have an impact on sellers' perception. The three levels of expected loss were 1.8, 3.6, and 5.4 cents. The composition of the expected loss was a 60 cent penalty with 3, 6, and 9 percent probability, respectively. The same assignment procedure was followed as before.

For the aggregate market, using the last two sessions as a guide, price averaged 1.39 cents above initial equilibrium, quantity traded was 100 percent of baseline, and efficiency averaged 93 percent, Figure 7. When absolute levels of expected loss were low and differences low, sellers *did not* discount prices to the most reputable traders. Rather, all buyers paid some premium compared to the P* expected from the market situation of $\bar{E}(L) = 0$. Sellers apparently perceived little or no difference between the 1.8 and 3.6 cent expected loss buyer groups, since these two groups had roughly comparable prices and quantities. However, the 5.4 cents expected loss group tended to pay 1-2 cents more than the other two groups with a reduction in equilibrium quantity sold to about 77 percent of baseline.

Conclusions and Implications

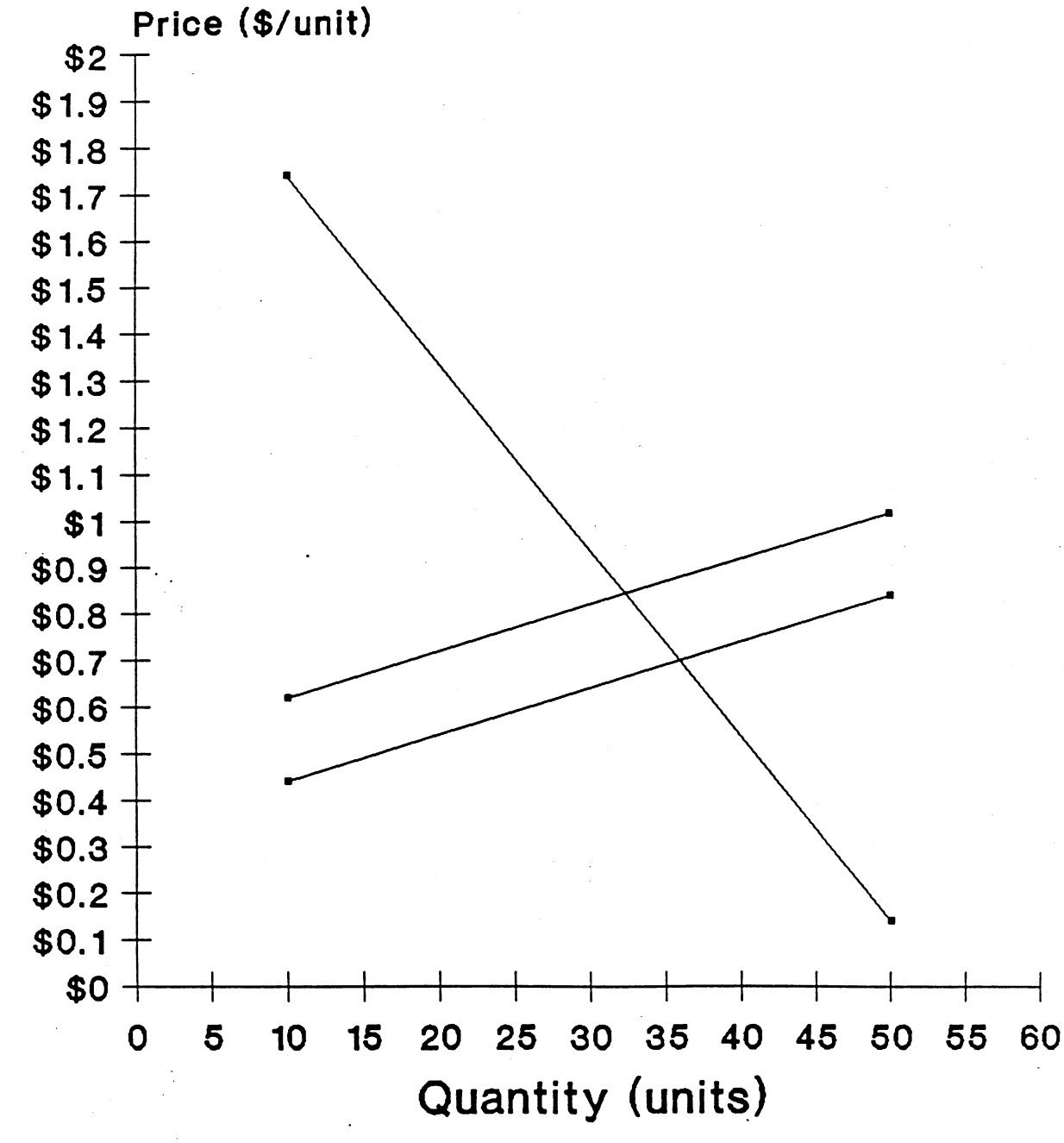
The implicit assumption in commodity markets is that traders have uniform reputations. There are theoretical formulations for commodities which are not homogeneous, but the potential significance of differences in reputation among traders has received little attention. A theoretical model is advanced which incorporates reputation differences among buyers for homogeneous commodity markets.

This research has shown that in experimental markets sellers will react and adjust to various reputations of buyers. In markets where there are reputable and disreputable buyers, sellers will generally demand higher prices and sell fewer units to disreputable buyers *and* may tend to sell at a discount *to* reputable ones.

Prices to disreputable buyers generally were not as high as hypothesized on a theoretical basis. This possibly is because of the inherent competitive nature of oral-double auctions, inexperienced traders, or the risk aversion level of the market participants. However, when faced with a potential loss, there was a definite tendency for sellers to withhold marginal and low-valued units and to demand higher prices.

Experiments with different levels of reputation among buyers suggest that different "markets" can develop among buyers. Buyers with good reputations were able to purchase units at a *discounted price*. With small differences in reputations among buyers, apparently it is difficult for sellers to perceive those differences. When expected loss differences among buyers were small in an absolute sense, differences were barely noticeable in terms of price.

The evidence presented here suggests that efficiency of commodity markets declines when "reputation" among buyers is unequal. Remedies such as third party guarantees and/or services which provide information on reputation of traders clearly would improve market efficiency.



Uniform E(L)=$0.18, P*=$0.70, Q*=36.

Figure 1. BUYER REPUTATION - Supply Shift Expected

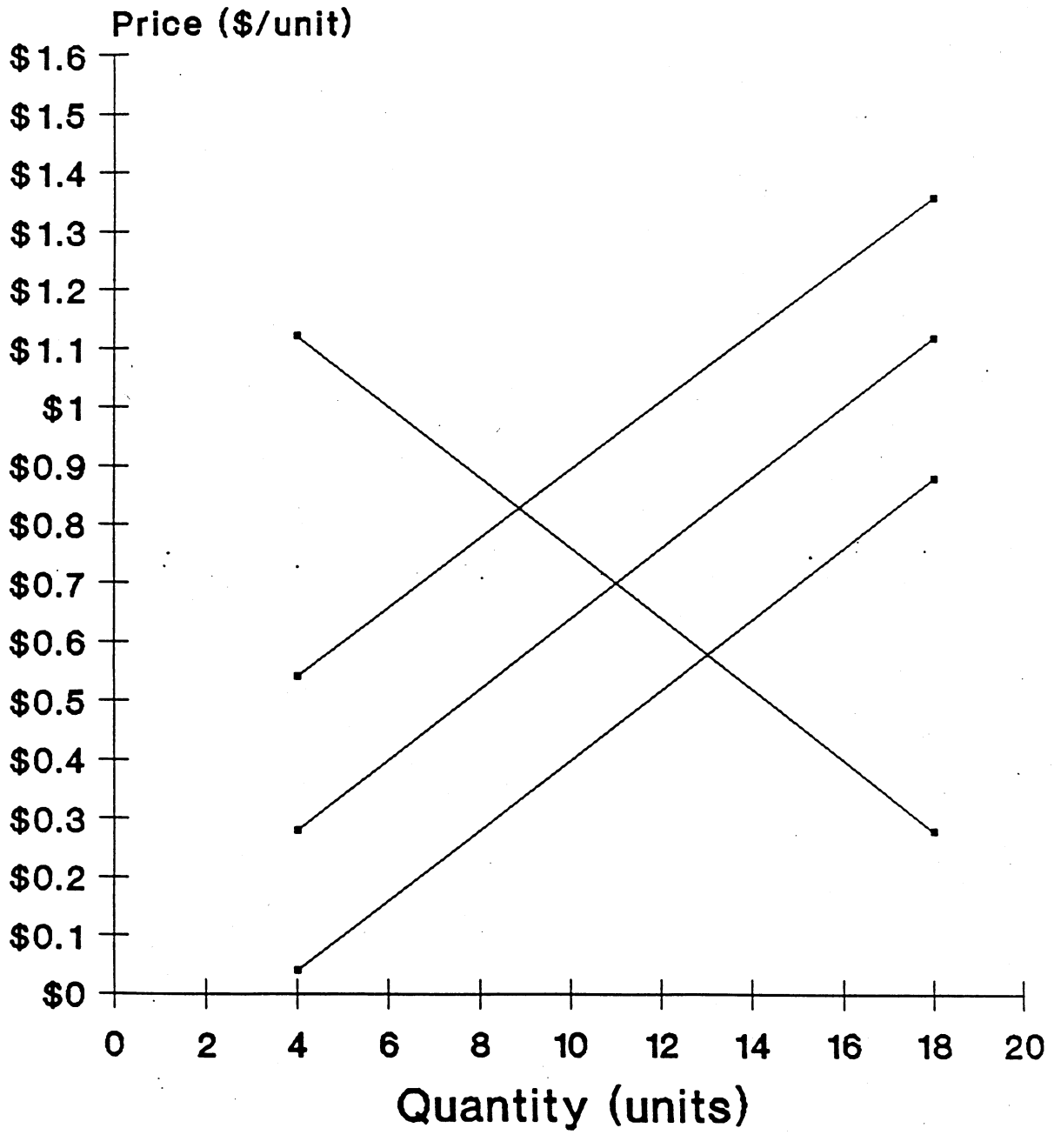


Figure 2. BUYER REPUTATION - Tri-Level Reputations

AVE. PRICE	88.55	88.67	88.85	89.13	89.45	89.67
VOLUME	33	33	33	32	33	33
EFFICIENCY	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
EFF. W/PEN.	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%

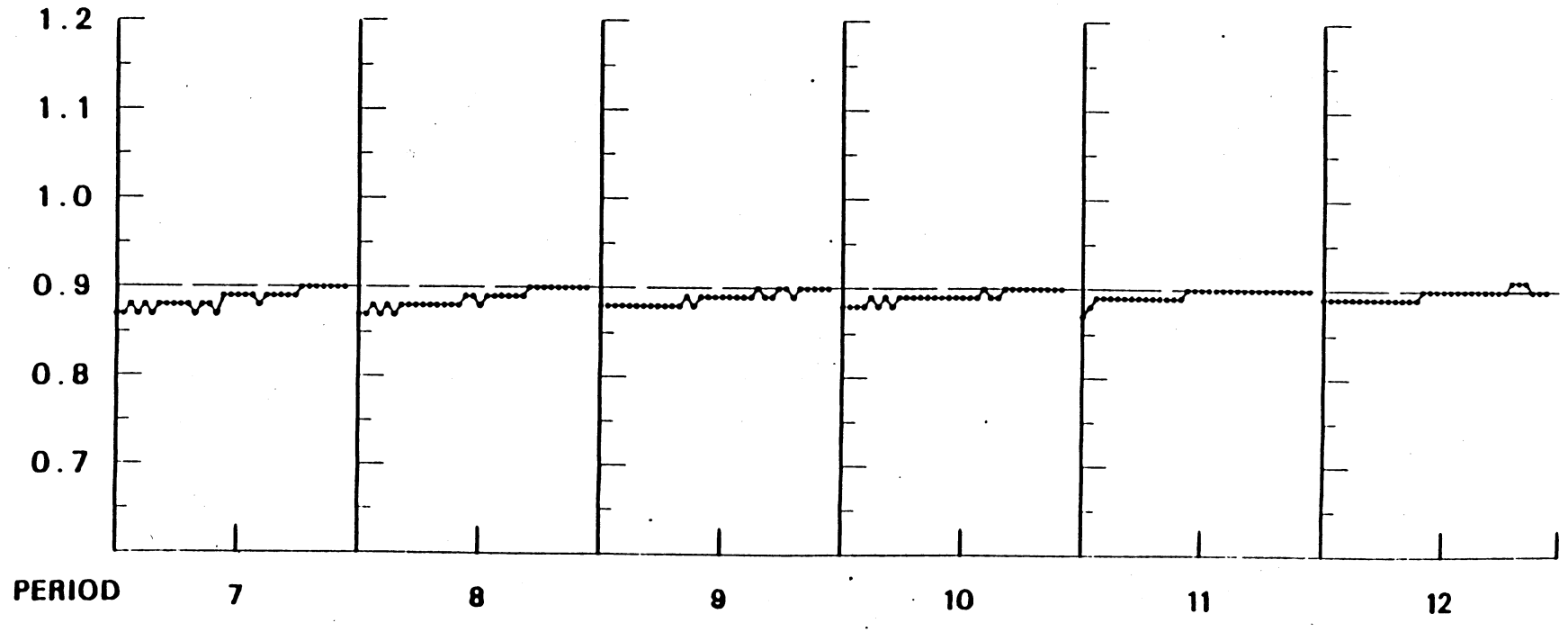


Figure 3. Results from a Competitive Market Structure with Oral-Double Auction Price Discovery (No Reputation).

AVE. PRICE	70.71	71.42	73.18	73.07	72.64	73.00
VOLUME	31	31	28	28	28	27
EFFICIENCY	100.00%	100.00%	100.00%	100.00%	99.40%	99.23%
EFF. W/PEN.	100.00%	100.00%	78.57%	82.14%	77.98%	63.52%

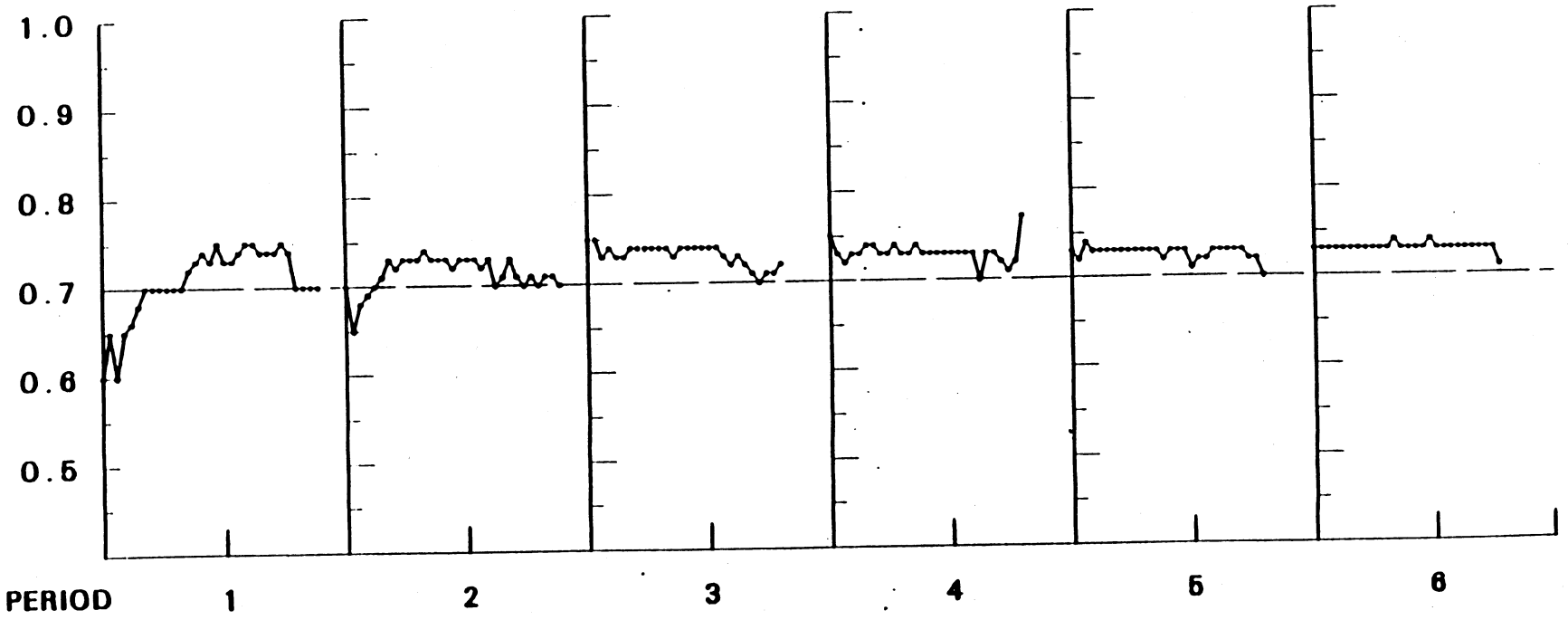


Figure 4. Results from a Uniform Level of Buyer Reputation Where Expected Loss is $0.18.

AVE. PRICE	72.16	71.10	71.14	70.79	76.96	74.76
VOLUME	31	31	29	29	26	26
EFFICIENCY	99.40%	100.00%	99.23%	98.63%	93.69%	92.14%
EFF. W/PEN.	99.40%	100.00%	63.62%	37.92%	50.83%	38.57%

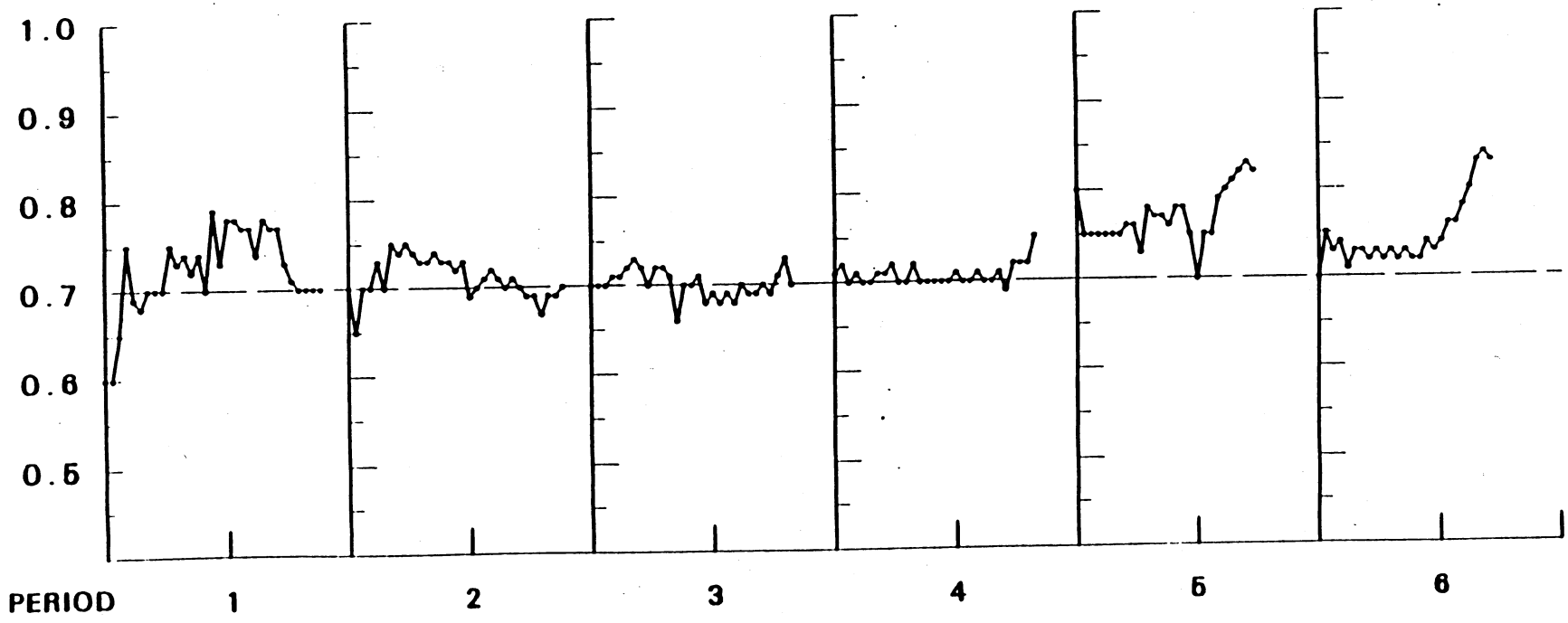


Figure 5. Results from a Uniform Level of Buyer Reputation Where Expected Loss is $0.27.

AVE. PRICE	72.73	72.70	71.90	71.38	71.37	73.72
VOLUME	33	33	30	29	30	29
EFFICIENCY	100.00%	100.00%	98.21%	97.62%	96.25%	96.43%
EFF. W/PEN.	100.00%	100.00%	83.93%	83.33%	67.68%	78.67%

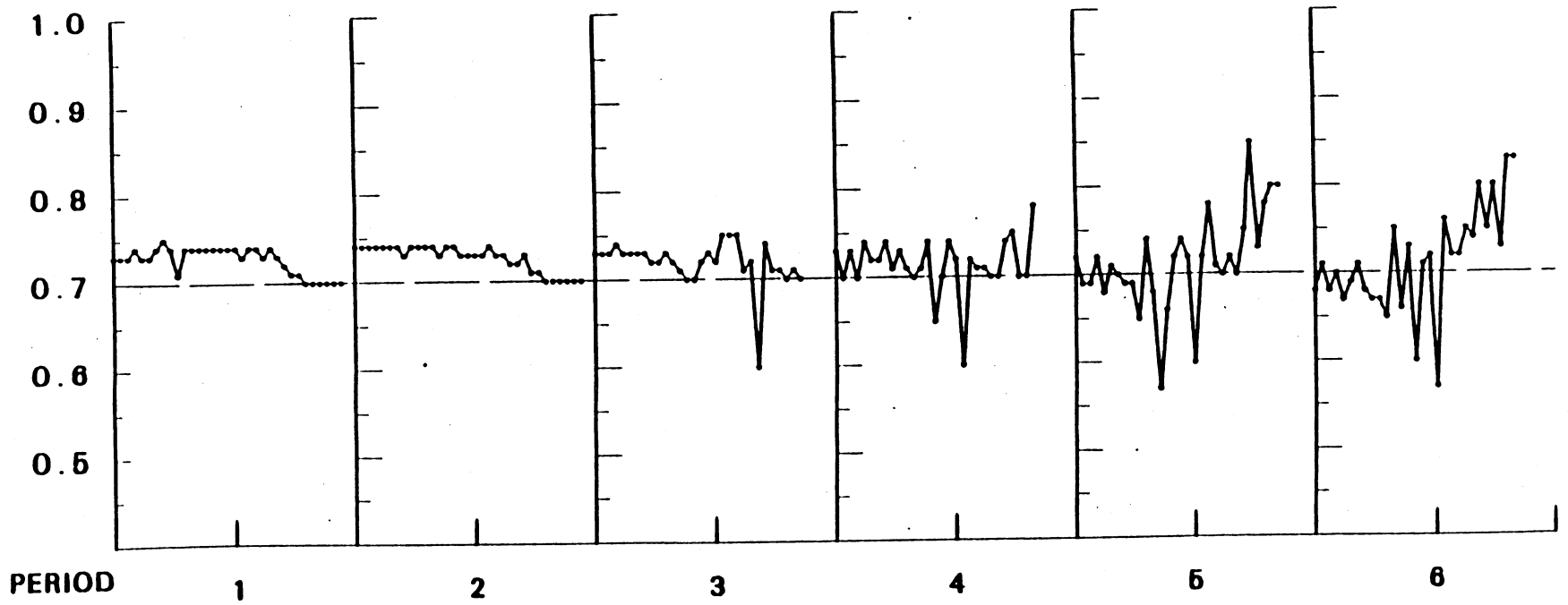


Figure 6. Results from Three Levels of Buyer Reputation Where Expected Loss is $0.00, $0.09, and $0.18.

AVE. PRICE	72.31	72.00	72.00	71.69	71.36	71.42
VOLUME	32	33	30	32	33	33
EFFICIENCY	100.00%	100.00%	99.40%	100.00%	100.00%	100.00%
EFF. W/PEN.	100.00%	100.00%	96.83%	100.00%	100.00%	85.71%

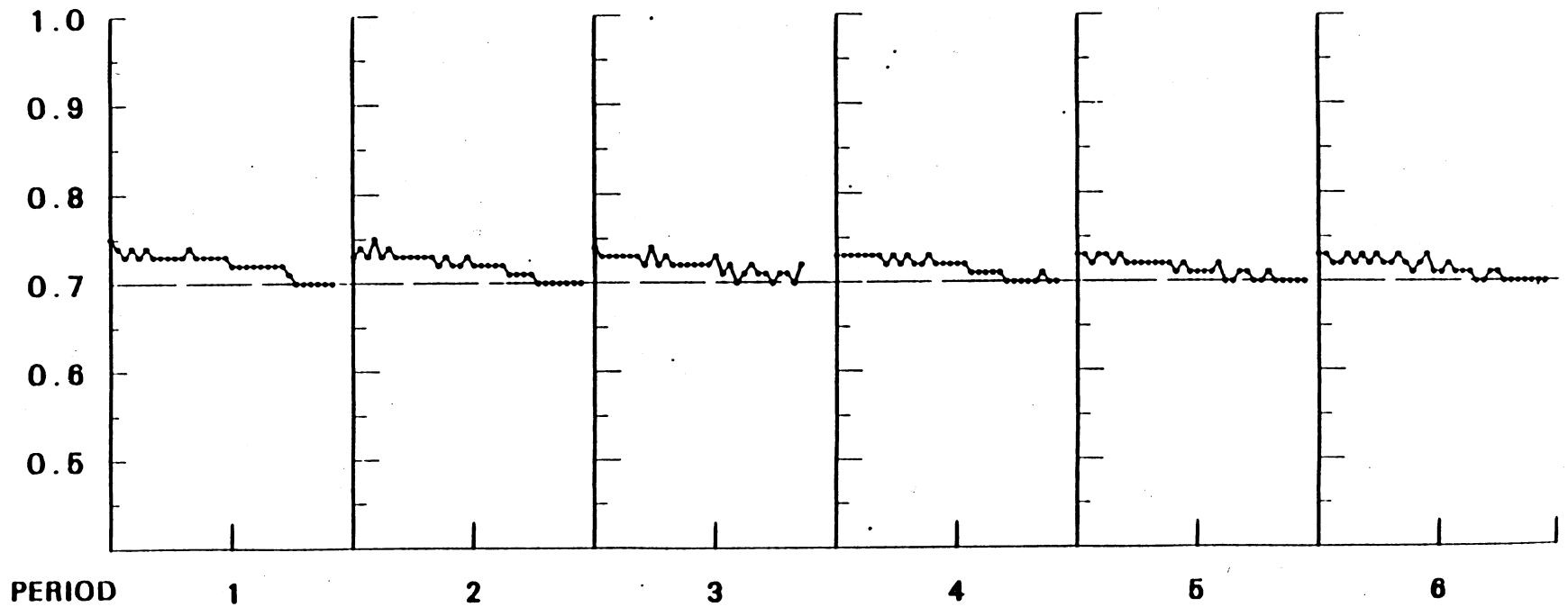


Figure 7. Results from Three Levels of Buyer Reputation Where Expected Loss is $0.018, $0.036, and $0.054.

Footnotes

1. There were four pilot projects on electronic marketing. These were Henderson at Ohio State, Purcell at Virginia Tech, Sporleder at Texas A&M, and Sirhan at University of Illinois, All of these projects were influenced by the system operating at Plains Cotton Cooperative Association in Lubbock for cotton. The projects covered from 1979 through 1982, and represented experimental economics in an ultimate form -- build the operating procedures and trading techniques for a commodity and make actual trades using the system (Sporleder, 1980).

2. The one exception to this was the pilot project for wholesale meat. In this system, a "book" was made during private negotiation and buyer and sellers could be known to each other prior to making the book.

3. The "initial equilibrium" refers to the equilibrium quantity and price that occurs when regular trading takes place (no buyer or seller reputation). In this case, 70 cents.

4. The "efficiencies with penalties" are better measures of true market efficiencies because they account for sellers loosing money (surplus) for making certain trades through assessed penalties.

References

Colling, Phil and Thomas L. Sporleder. "Reputation Trading in Commodity Markets: An Experimental Economics Approach." Department of Agricultural Economics, Texas A&M University, College Station, TX., January, 1988.

Crocker, Keith. "Vertical Integration and the Strategic Use of Private Information." *Bell Journal of Economics.* 14(1983): 236-250.

Forker, Olan. *Price Determination Processes: Issues and Evaluation.* FCS Information Report 102, Farmer Cooperative Service, U.S. Department of Agriculture, Washington, D.C., September, 1975.

Frahm, Donald G. and Lee F. Schrader. "An Experimental Comparison of Pricing in Two Auction Systems." *American Journal of Agricultural Economics.* 52(1970): 528-534.

Goldberg, Victor. "Regulation and Administered Contracts." *Bell Journal of Economics.* 10(1976): 45-61.

Grossman, Sanford and Oliver Hart. "The Costs and Benefits of Ownership: A Theory of Vertical and Lateral Integration." *Journal of Political Economy.* 94(1986):691-719.

Kilmer, Richard L. "The Economic Efficiency of Alternative Exchange Mechanisms." in Kilmer and Armbruster (ed.) *Economic Efficiency in Agricultural and Food Marketing.* (Ames, Iowa: Iowa State University Press, 1987), pp. 134-149.

Klein, Benjamin and Keith B. Leffler. "The Role of Market Forces in Assuring Contractual Performance." *Journal of Political Economy.* 89(1981): 615-41.

Plott Charles R. "Industrial Organization Theory and Experimental Economics." *Journal of Economic Literature.* 20(1982): 1485-1527.

Rhodus, W. Timothy and Dennis R. Henderson. "Measuring Allocative Efficiency in Experimental Markets: An Alternative Approach." Paper presented at the Southern Agricultural Economics Association Meetings, New Orleans, February, 1988.

Roberts, Clark A., Brian D. Adams, and Michael A. Hudson. "The Impacts of Varying Information Levels on Competitive Bidding Processes: An Experimental Investigation." Paper presented at the NCR Conference on Applied Commodity Price Analysis, Forecasting, and Market Risk Management, Chicago, Illinois, April 22-23, 1987.

Shapiro, Carl. "Premiums for High Quality Products as Returns to Reputations." *Quarterly Journal of Economics.* 98(1983): 659-679.

Smith, Vernon L. *Research in Experimental Economics: A Research Annual.* (Greenwich Connecticut: JAI Press, Inc., 1979), Volume 1.

Smith, Vernon L. *Research in Experimental Economics: A Research Annual.* (Greenwich, Connecticut: JAI Press, Inc., 1982), Volume 2.

Sporleder, Thomas L. "Implications of Electronic Trading for Structure of Agricultural Markets." *American Journal of Agricultural Economics.* 66(1984): 859-63.

Sporleder, Thomas L. "Functional Alternatives for Computer - Based Trading Systems" in *Proceedings of Electronic Marketing Conferences.* James B. Bell, ed. Virginia Tech, Publication No. 448-003, January, 1983.

Wiggins, Steven. "The Comparative Advantage of Long Term Contracts and Firms." Faculty Paper, Department of Economics, Texas A&M University, January, 1988.

Williamson, Oliver. *Markets and Hierarchies.* (New York, New York: The Free Press, 1975).