Chapter 8

SIMULATED AND REAL BUYERS IN POSTED OFFER MARKETS

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1. Introduction

This chaper uses the data from three previously published studies to examine the effect of real versus simulated buyers on laboratory outcomes. Real buyers can and occasionally do strategically deviate from full demand revelation. Further, the threat of strategic behavior appears to temper the pricing decisions by sellers. The next section presents the experimental design and a discussion of demand withholding as a buyer strategy. This is followed by results and discussion.

2. Summary of the Experimental Design

The data reported here come from Coursey, Isaac, and Smith (1984), Coursey et al. (1984), and Brown-Kruse (1991). Although each study had a distinct research thrust, all had many design and procedural features in common. This commonality in experimental design and procedures allow for a powerful test of the effect of real buyers on experimental market outcomes. The three studies are early tests of contestability theory as described in Baumol, Panzar, and Willig (1982). One implication of contestability theory is that in the case of a natural monopoly, competitive prices will prevail even when a single seller serves the market. This result that runs counter to the monopoly price prediction, is supported by the threat of entry by potential competitors.

Coursey, Isaac, and Smith (1984), Coursey et al. (1984), and Brown-Kruse (1991) chose a design that used two potential sellers with natural monopoly cost structures. The cost structure of a natural monopoly is such that scale economies provide declining average cost over the relevant range of the demand curve. With declining average costs and no price discrimination, the firm's marginal profit increases with each additional unit sold. In a posted offer market, sellers post a take-it-or-leave-it price. Buyers cannot negotiate over price, they can only choose to buy or not. The standard assumption is buyers will purchase all units that yield positive net benefit (full demand revelation). Under-revelation or demand withholding is defined as the case in which a buyer chooses not to purchase a unit when his/her marginal value exceeds the price. Buyers can use demand withholding as a punishment strategy. For example, if there is an increase in price, buyers can withhold demand and reduce the seller's profit. The natural monopoly setting provides the best opportunity for buyers to use withholding as a punishment

Handbook of Experimental Economics Results, Volume 1

DOI: 10.1016/S1574-0722(07)00008-X

because the last units sold yield the highest marginal profit. The ability of buyers to withhold demand countervails the market power concentrated in two potential sellers.

Coursey, Isaac, and Smith (1984), Coursey et al. (1984), and Brown-Kruse (1991) have many identical design features which permits analysis of the pooled data for the purpose of comparing simulated and real buyers. All three studies were conducted at the University of Arizona using the PLATO posted offer trading mechanism programmed by Jonathon Ketcham. A detailed description of the PLATO Posted Offer protocol is contained in Ketcham, Smith, and Williams (1984). For a discussion of the behavioral properties and history of laboratory posted offer markets, see Davis and Holt (1993, Chapter 4, pp. 173–239). Coursey, Isaac, and Smith (1984), Coursey et al. (1984) and Brown-Kruse (1991) used the same marginal unit costs and buyer marginal valuations expressed in deviation from average variable cost of unit 10 as shown in Figure 1. [See also Figures 1 in Coursey, Isaac, and Smith (1984), Coursey et al. (1984), and Brown-Kruse (1991).] Subjects were drawn from the pool of undergraduates at the University of Arizona. The conversion rate from accumulated laboratory dollar balances to U.S. currency was 1:1 that was paid in cash at the conclusion of a session. Marginal cost schedules were private information. Sellers were informed whether they faced human subject buyers or computer simulated demand. Sellers did not know *a priori* the demand schedule or the end period of an experiment.

The three contestability papers did impose different entry costs. Entry cost ranged from zero to \$0.50 per period. Sellers in the six Coursey, Isaac, and Smith (1984) duopoly experiments incurred zero entry cost. Coursey et al. (1984) imposed a sunk entry cost in the form of a \$2.00 permit that applied to five periods. At the end of five periods, the seller could renew for five more periods with another \$2.00 investment. Brown-Kruse (1991) induced a sunk opportunity cost of entry by offering a risk-free alternate market with \$0.50 per period payment in six of the nine experiments reported. The remaining three sessions reported in Brown-Kruse (1991) had zero opportunity cost of entry.

Table 1 summarizes the 27 experimental sessions used for this analysis. The three studies provide 14 sessions which used human buyers and 13 sessions which simulated demand-revealing buyers. In order to compare the prices from experiments with different entry costs, trading prices for all experiments are reported in terms of deviation from the competitive (zero profit) outcome. Therefore, the zero entry cost experiments are reported in deviation from average variable cost of unit 10, AVC(10). Prices from sessions with \$2.00 entry permits are reported in deviation from AVC(10)+\$2/(5×10). Sessions with \$0.50 per period opportunity cost of entry are reported in deviation from AVC(10) + \$0.50/10.

3. Results

Figure 2 shows the mean prices for the eighteen potentially contestable trading periods common to all experiments. Clearly, the presence of possibly strategic human buyers

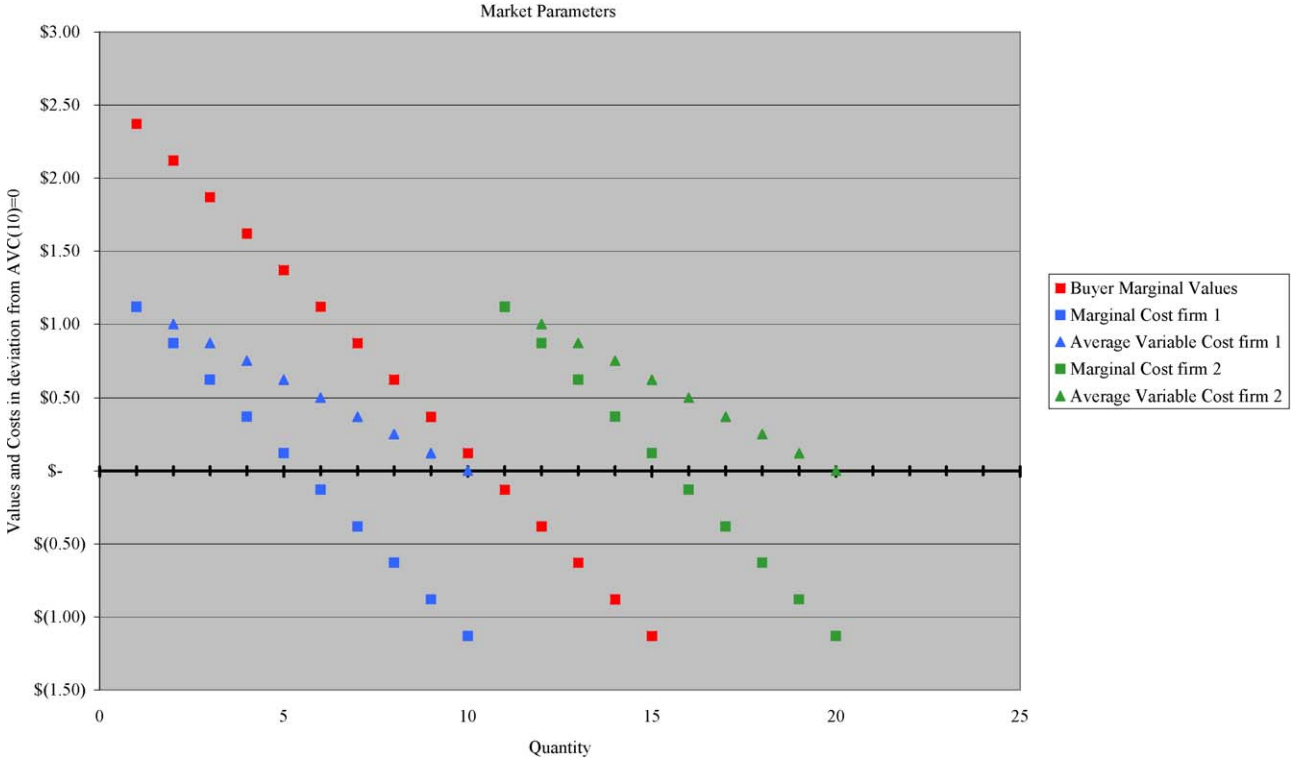

Figure 1. Figure illustrates the marginal valuations that comprise laboratory market demand (in red). The identical marginal cost schedules of firms 1 and 2 generate average variable cost curves as shown (blue for firm 1 and green for firm 2). This is a natural monopoly cost structure. A single firm can serve the entire market demand more efficiently than two competing sellers. At the efficient price, a single seller will earn zero profit selling 10 units whereas two firms each selling a fraction of the 10 units will incur losses.

Table 1
Data sources and experimental design characteristics

Author(s)	# of sessions/ID #	Demand	Entry cost
Coursey, Isaac, and Smith (1984)	6 sessions 37, 45, 47, 48, 51, 52	Human	Zero
Coursey et al. (1984)	6 sessions 70, 79, 82, 87, 96, 97	Human	$2.00 for 5 periods
	6 sessions 113, 114, 115, 116, 118, 119	Computer simulated	$2.00 for 5 periods
Brown-Kruse (1991)	3 sessions 210, 211, 237	Computer simulated	Zero
	2 sessions 194, 236	Human	$0.50 opportunity cost per period
	4 sessions 179, 181, 206, 207	Computer simulated	$0.50 opportunity cost per period

affects the laboratory market outcome. A Wilcoxon non-parametric test for paired samples indicates that the mean prices from human buyer sessions are significantly different from simulated demand sessions at the 1% significance level. A two-sample z-test for differences in means uses each trading period as a cross section. We can reject the null hypothesis of equal mean prices in seventeen of the eighteen trading periods at the 5% significance level. Table 2 contains the resulting p-values by trading period.

Is strategic demand withholding observed? Coursey et al. (1984) report that withholding of demand occurred at the low rate of 1.24% of full revelation. This is consistent with 1.16% observed in the Coursey, Isaac, and Smith (1984) duopoly experiments. Brown-Kruse (1991) identified a single buyer that withheld demand after a substantial price increase. Brown-Kruse (1991) partitions the Coursey, Isaac, and Smith (1984) sample of human buyer experiments into sessions with demand-revealing real buyers and sessions in which real buyers withheld demand. Using a Wilcoxon non-parametric test for matched samples, the hypothesis that the prices from experiments with strategic withholding and from demand revealing human buyers arose from the same distribution can be rejected at the 1% significance level. Further, using sessions in Brown-Kruse (1991) to compare demand revealing human buyers with demand revealing computer simulated buyers, the hypothesis that prices arose from the same distribution can be rejected at the 5% level. Evidently, the possibility that buyers may retaliate is sufficient to discipline the market.

Is the effect of human buyers experimentally robust in other designs? Davis and Williams (1991) report successful buyer withholding in a five seller market-power design. In two of four human buyer posted offer sessions, considerably lower price paths prevailed. The strategic behavior by buyers provides a countervailing force to the tac-

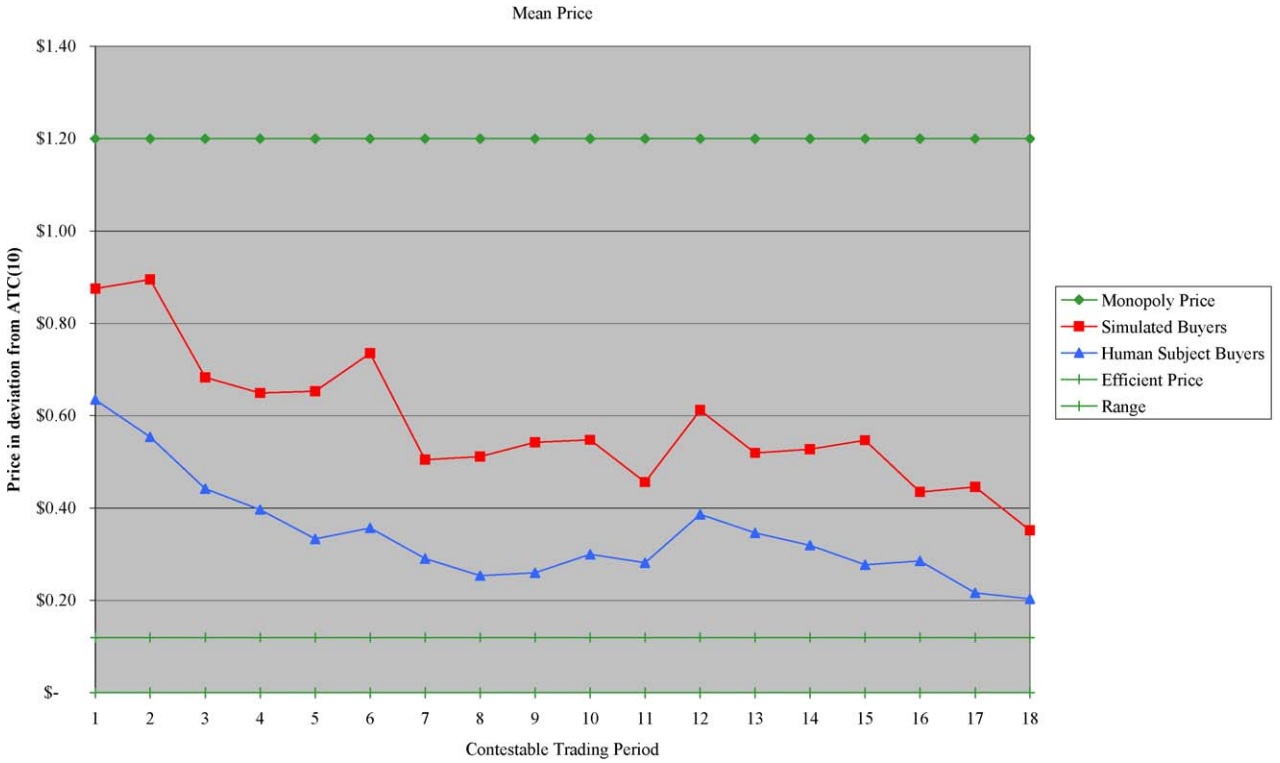

Figure 2. The figure plots the period-by-period mean prices of 14 sessions with real buyers and the mean prices of 13 sessions with computer-simulated demand. When the prices arising from a trading period are taken as a cross section, mean prices are significantly different at the 5% level in 17 of 18 trading periods. When the threat of strategic buyer behavior is absent, sellers initiate and sustain higher prices.

Table 2
P-values for a two sample z-test for differences in means by trading period

Trading period	$P(Z \leqslant z)$ two tail	Trading period	$P(Z \leqslant z)$ two tail
Period 1	0.012	Period 10	0.009
Period 2	0.005	Period 11	0.021
Period 3	0.004	Period 12	0.038
Period 4	0.003	Period 13	0.050
Period 5	0.000	Period 14	0.021
Period 6	0.011	Period 15	0.012
Period 7	0.021	Period 16	0.061
Period 8	0.009	Period 17	0.013
Period 9	0.003	Period 18	0.030

itly collusive efforts of sellers. At this point, oligopoly theory largely ignores buyers' ability to punish by choosing not to buy. As experimental evidence mounts, theory will eventually catch up.

Acknowledgements

I wish to thank Don Coursey, R. Mark Isaac, Margaret Luke, and Vernon L. Smith for providing data from their laboratory research.

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