Supra-Competitive Pricing in Laboratory Markets
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Abstract: Despite the robust tendency of laboratory markets to generate competitive outcomes, some market designs deviate persistently from competitive predictions. This essay discusses the primary drivers of supra-competitive prices that have been observed in market experiments.

Trading Institutions and Market Performance. The robustness of competitive market predictions stands as one of the most impressive results in experimental economics. Laboratory markets regularly generate competitive outcomes in environments populated by just two or three sellers. However, as in natural contexts, competitive outcomes do not always emerge from laboratory markets. This essay reviews results of laboratory markets in which price increases are driven by factors such as the exercise of unilateral market power or by collusion.

Prior to reviewing this literature I offer two observations. First, laboratory methods represent an important but limited complement to existing empirical tools for investigating supra-competitive pricing. Given the stark simplicity and limited duration of laboratory markets, experimentalists can aspire to say little about specific naturally occurring markets. Experiments can, however, provide important insights into the behavioral relevance of theories upon which antitrust policies are based.

Second, the trading rules defining negotiations and contracting can exert first-order effects on market competitiveness. For example, markets organized under the double auction trading rules used in many financial exchanges, are much more robustly competitive than markets organized under the posted-offer trading rules used in most retail exchanges. Indeed, one of the motivating factors in the emerging field of institutional design was an interest in developing institutional rules that promoted efficient market outcomes.

For specificity I focus here on results from posted-offer markets, primarily because posted-offer markets allow a particularly intuitive illustration of the factors affecting market competitiveness. However, a host of other trading institutions exist, ranging from single and multi-unit auctions, to multi-sided computerized ‘smart’ markets, and again to institutions that exist primarily as theoretical constructs, such as quantity-setting Cournot mechanisms. The competitive implications of each of these institutions must be evaluated independently.

Posted-Offer Markets and Unilateral Market Power. Unilateral market power is perhaps the most frequently observed reason why prices in laboratory markets deviate from competitive predictions. This market power exists when one or more sellers, acting on their own, find it profitable to raise prices above the competitive level. The supply and demand structures, shown in the two panels of Figure 1 illustrate how capacity restrictions can create market power. In each panel, the market consists of three sellers,
S1, S2 and S3, each of whom offers four units for sale, under the conditions that two units cost $2 and two units cost $3. A buyer will purchase a fixed number of units (seven in the left panel or ten in the right panel) at prices less than or equal to $6.00.

Exchange in these markets proceeds in a number of trading periods. At the outset of each period, sellers simultaneously make price decisions. Production is ‘to order’ in the sense that sellers incur costs only for the units that actually sell. Once all sellers post prices, a simulated fully-revealing buyer makes all possible purchases, starting with the least expensive units first. In the case of a tie, the buyer rotates purchases among the tied sellers. (For a more complete description of the posted-offer institution and associated results see Davis & Holt, 1993, or Holt 1995.)

In the market shown in the left panel of Figure 1 the buyer will purchase at most seven units. Given an aggregate supply of twelve units, sellers in this market have no market power: at any common price above $3, each seller can increase sales from an expected 2.33 units to 4 units by posting a price just slightly below the common price. For any vector of heterogeneous prices above $3 only the seller posting the lowest price will sell all four units. The seller posting the second highest price will sell three units, while the high pricing seller will sell nothing. The unique Nash equilibrium for the stage game has each seller posting the competitive price of $3.00, selling 2.33 units in expectation and earning $2.00.

Expanding demand to ten units, as shown in the right panel of Figure 1, limits excess supply, and thus creates market power. Given that the highest price seller is now certain to sell at least two units, the competitive price of $3.00 is no longer a Nash equilibrium for the stage game. At a common price of $3.00 each seller sells 3.33 units (in expectation) and earns $2.00. By posting a price of $6.00, any seller can sell two units and increase earnings to $8. A common price of $6.00 is not an equilibrium for the stage game, since any seller would find that deviating from $6.00 increases sales to four units. Sellers have similar incentives to undercut any common price down to a minimum $p_{\min} = $4.50, where the profits from selling four units as the lowest pricing seller equals earnings at the limit price. The equilibrium for this game involves mixing over the range from $4.50 to $6.00. As shown in the figure, median of unique symmetric equilibrium is $4.71. (See e.g., Holt and Solis-Soberon, 1992 for details.)

An extensive series of experiments show that sellers respond to market power by raising prices. Further, power drives pricing outcomes more powerfully than do changes in the number of sellers. For example, when they reallocated units among five sellers to create market power Davis and Holt (1994) observed substantial price increases. However, reducing the number of sellers from five to three in a way that held market power conditions fixed, Davis and Holt observed only modest additional price increases. Market power of the sort illustrated in the right panel of Figure 1 has wide applications, ranging from distortions in markets for emissions trading (Godby, 2000) and for electricity transmission (Rassenti Smith and Wilson, 2003), to price-stickiness in the face of aggregate demand shocks (Wilson, 1998).
**Tacit Collusion.** Experimentalists have also observed supra-competitive prices in repeated market games where sellers have no market power. This *tacit collusion* has been observed most frequently in duopolies. (e.g., Alger, 1987; Benson and Faminow, 1988, Fouraker and Seigel, 1963). However, tacit collusion has also been observed in thicker markets where sellers possess no market power. For example, Cason and Williams (1990) observe persistently high prices in a four-seller design similar to that shown as the left panel of Figure 1. Experimentalists often measure tacit collusion as the difference between observed prices and prices consistent with the Nash equilibrium for the market analyzed as a stage game. Importantly, other than exceeding equilibrium price predictions, tacitly collusive laboratory outcomes typically exhibit no obvious signs of coordinated activity.

Tacit collusion may co-exist with market power. For example, prices in the market power sessions reported by Davis and Holt (1994) were significantly above prices consistent with the equilibrium mixing distribution. In this context, the difference between mean observed prices and the mean of the equilibrium mixing distribution may be reasonably taken as a measure of tacit collusion.

Tacit collusion is not yet well understood, and isolating the causes of tacit collusion represents an important project for future experimental work. Price signaling activity at least partially explains tacit collusion (see, e.g., Durham et al. 2004). However, evidence suggests that more than price signals and responses may be at play. Dufwenberg and Gneezy (2000) report an experiment where duopolists deviate from the static Nash (competitive) prediction for a game, even when sellers are re-paired after each decision. In such a context price signaling is not possible.

**Explicit Collusion.** Opportunities to explicitly discuss pricing, laboratory sellers quite persistently organize profit-increasing cartels (Isaac, Ramey and Williams, 1984). However, a capacity to monitor agreements and prevent secret discounts appears critical to the success of these arrangements (Davis and Holt, 1998, List and Price, 2005). Given the illegality of explicit agreements, the more interesting questions regarding explicit collusion regard the capacity of authorities to detect such arrangements through the actions of sellers in the market (Davis and Wilson, 2002).

**Other Factors Affecting Pricing.** A host of experimental studies indicate that standard ‘facilitating practices’ can contribute to price increases. Experimental studies where supra-competitive prices have been attributed to facilitating practices include ‘most favored nation’ and ‘meet-or-release’ clauses (Grether and Plott, 1982), nonbinding price signals (Holt and Davis 1990) and multi-market competition (Cason and Davis, 1996, Phillips and Mason, 1991).

Buyer behavior can also affect market outcomes. When buyer decisions are simulated, details of the purchasing rules can have a large effect on prices (Krusie, 1993, Puzzello, 2006). Powerful human buyers can substantially undermine both market power and tacit collusion (Ruffle, 2000; Davis and Wilson, 2006; Normann, Ruffle and Synder, 2005). However, the use of real rather than simulated buyers appears to generate more competitive prices even when the human buyers engage in no strategic behavior (Coursey et al. 1984, Davis and Williams, 1993).
Finally, information conditions and even sellers expectations can significantly affect pricing outcomes. For example, Huck Norman and Oechssler (2000) report that information regarding underlying supply and demand conditions facilitates the exercise of predicted market power (markets are drawn to static Nash predictions). However, information on rival sellers’ profits made markets more competitive in a market where the high-profit seller has the highest market share, so imitation by others will tend to expand quantity and reduce price. Also, in a Cournot context, Huck et al. (2006) report that seller aspirations for increased profits helped consolidated sellers maintain prices substantially above static Nash levels.

References


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Figure 1. Supply and Demand Arrays for Markets without and with market power.