The effects of discounting opportunities in laboratory posted-offer markets

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ABSTRACT

This experiment isolates the effects of allowing sellers to offer private discounts from posted prices. Although discounting was pervasive when permitted, it did not always improve performance. High prices and low efficiencies were observed in half of the "discount" markets.

1. Introduction

In a laboratory posted-offer market, sellers choose prices independently, and buyers cannot bargain individually for price concessions. This institution is of interest because the take-it-or-leave-it nature of sellers' prices resembles pricing in many naturally occurring (e.g., retail) markets. Unlike more competitive institutions, deviations from competitive outcomes are frequently observed in laboratory posted-offer markets. In stark contrast to double auctions, for example, posted-offer markets are susceptible to collusion (Isaac, Ramey and Williams, 1984), monopolization (Smith, 1981), and the exercise of market-power (Davis and Williams, 1991). An important qualification to these laboratory results is that sellers can and do offer private discounts from the posted price in many markets for producer goods and big-ticket consumer goods.

The standard presumption is that private, buyer-specific discounts should make markets more competitive. The intuition is that secret discounting prevents sellers from maintaining high, tacitly collusive prices. Indeed, federal antitrust authorities become concerned when discounting

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is proscribed by contracts or industry practices. It is not necessarily the case, however, that private discounts make markets more competitive. If shopping costs are high, for example, sellers may find it profitable to post relatively high prices and then price discriminate through discounts. In these circumstances, the possibility of granting private discounts may actually raise *transactions* prices.

This paper reports an initial investigation of the effects of non-public discounts in posted-offer markets. The results of six baseline posted-offer duopolies are compared with six duopolies where sellers can offer private discounts.

2. Experiment design and procedures

All markets used the supply and demand arrays in figure 1, where values and costs are listed as deviations from the highest competitive price, which is normalized to 0. The markets consisted of 3 symmetric buyers, B1, B2 and B3, each with a high-value unit (85 cents), a medium-value unit (40 cents) and a low-value unit (0 cents). The two sellers, S1 and S2, were each endowed with two low-cost units (− 35 cents) and two high-cost units (− 10 cents). The range of competitive prices is from minus 10 cents to 0. In total, sellers could profitably offer a maximum of 8 units for sale at any price in this range or above.

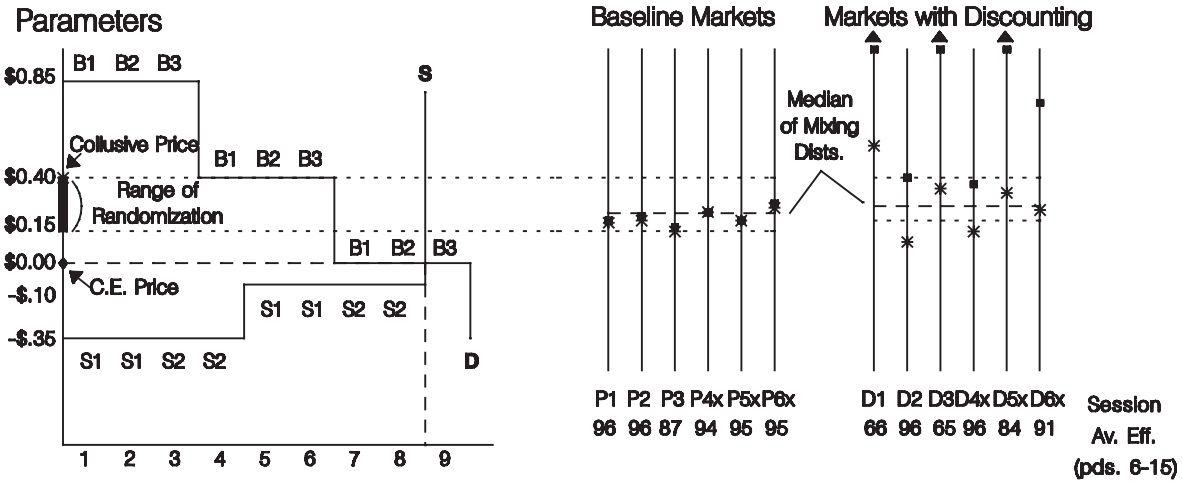

Figure 1. Supply and demand arrays, and median list (■) and contract (*) prices for all sessions.

To give discounting a better chance to affect equilibrium outcomes, sellers were given market power in the sense that the competitive equilibrium price is not a Nash equilibrium for

the posted-price stage-game.[1] At the competitive price, both S1 and S2 sell 2 low-cost and 2 high-cost units, and earn 90 cents (= 35 × 2 + 10 × 2). This is not a Nash equilibrium, because either seller could increase earnings by unilaterally posting a price 40 cents above the competitive prediction.[2] Standard arguments reveal that there is no equilibrium in pure strategies for this stage game. The unique mixed-strategy equilibrium involves randomization over the range between 15 and 40 cents. The median of the distribution is 23.3 cents.[3]

Half of the markets proceeded under standard posted-offer procedures (see e. g., Ketcham, Smith and Williams, 1984). Discounting was introduced in the remaining six markets as follows: When a buyer approaches a seller, the buyer may purchase at list or request a discount. The seller can grant a discount of any size (including no discount at all), and the discount is not observed by anyone other than the buyer. The buyer may either purchase at the discounted price, or shop elsewhere. In this initial investigation, switching among sellers was costless, but if a discounted offer was rejected, the buyer could not return to the seller in that period.

Discounting creates multiple equilibria for the market stage game, depending on how the buyers shop. If buyers initially approach the seller with the *lower* list price and purchase units whenever profitable, the low-price seller will find it optimal to grant no discounts, and an equilibrium very similar to the posted-offer mixing equilibrium results.[4] But suppose that buyers initially approach the seller with the *higher* list price, reasoning that the high-pricing seller must

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[1] Previous research indicates that market power generates supra-competitive prices in posted-offer markets (Davis and Holt, 1993).

[2] Suppose that S1 unilaterally raises price to 40. Then S1's earnings would increase 60 cents; the 20 cents foregone by failing to sell two high-cost units would be more than offset by the 80-cent earnings increase realized by selling the two remaining units at a 40-cent premium.

[3] The equilibrium mixing distribution is calculated as the price distribution that one seller must follow in order for the other to be indifferent between posting the security price (40 cents) and every other price in the mixing range. Specifically, define G(p) as the probability that a price p is the highest of the two posted prices. Then, in order for a seller to be willing to randomize, it must be the case that expected earnings at every price equals security earnings, or $G(p)[2(p+35)] + (1-G(p))[2(p+35)+ 2(p+10)] = 2(40+35)$.

[4] The lower bound of the mixing distribution is 20, rather than 15 cents, since the high-pricing seller can now price discriminate. As before, this seller makes 2 sales at list to the final shopper. But with discounting, the high-pricing seller can increase profits by selling units to each of the first two buyers at a (discounted) price of 0 after they purchase high-value units (at no discount) from the low-pricing seller. Via a calculation like that in note 3, $G(p)[2(p+35)+20] + (1-G(p))[2(p+35)+ 2(p+10)] = 2(40+35) + 20$, and it follows that the median of G(p) is 26.6 cents.

grant a more generous discount.[5] The buyers then make any profitable purchases if this seller's discount is below the lower list price, and switch otherwise. Suppose that at least one of the list prices is below 40. In this case, the high-list-price seller's best response is to discount just below the low list price.[6] Moreover, since the high-list-price seller gets a "first shot" at the buyers and earns more money, each seller has a unilateral incentive to *raise* the list price from any common level below 40. Similar arguments apply to when list prices are between 40 and 85, and an equilibrium will involve list prices above 85, with price discrimination.[7] There can be other, similar equilibria with high prices; the point is that the buyers who expect a bigger discount from a high-list-price seller end up discouraging competition in list prices.

Each market consisted of a minimum of fifteen trading periods. To control for end-game effects, markets were terminated randomly. For each period after the fifteenth, a die was rolled, and the market was terminated if the outcome was 5 or 6. To assess possible experience effects, half of the sessions in each treatment used participants who had previously participated in a market using the same trading rules.

3. Results

Market outcomes are summarized by the vertical lines on the right side of figure 1. Each line shows the median list price (■) and median transactions price (*) for periods 6 to 15 (the last 10 periods common to each session). In the six baseline posted-offer sessions, denoted by the "P" identifiers, any difference in posted and transactions prices is due to the tendency for high posted prices to yield fewer transactions. Although there was far too much serial correlation in prices across periods of a session to conclude that sellers were randomizing, elements of the equilibrium mixed distribution summarize outcomes well. Not only are median posted prices are within the bounds of the equilibrium mixing distribution (bounded by the dotted horizontal lines),

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[5] Suppose also that sellers are randomly approached if prices are either equal or are above the buyers' limit price of 85.

[6] The low-pricing seller acts as before, selling units to the first two buyers at a discounted price of 0, and offering no discount to the third buyer.

[7] When the low list price exceeds 40, each seller will offer a discounted price of 40 for the second unit requested by each buyer. When both prices exceed 85, the sellers are approached randomly, and they stop offering discounts on the residual purchases by the first two buyers.

but they cluster about the median of the theoretical mixed distribution (represented by the dashed horizontal line). The baseline markets were also uniformly efficient: As indicated by the mean efficiencies printed below each session identifier, 94% or more of the possible surplus was extracted in all but one session.

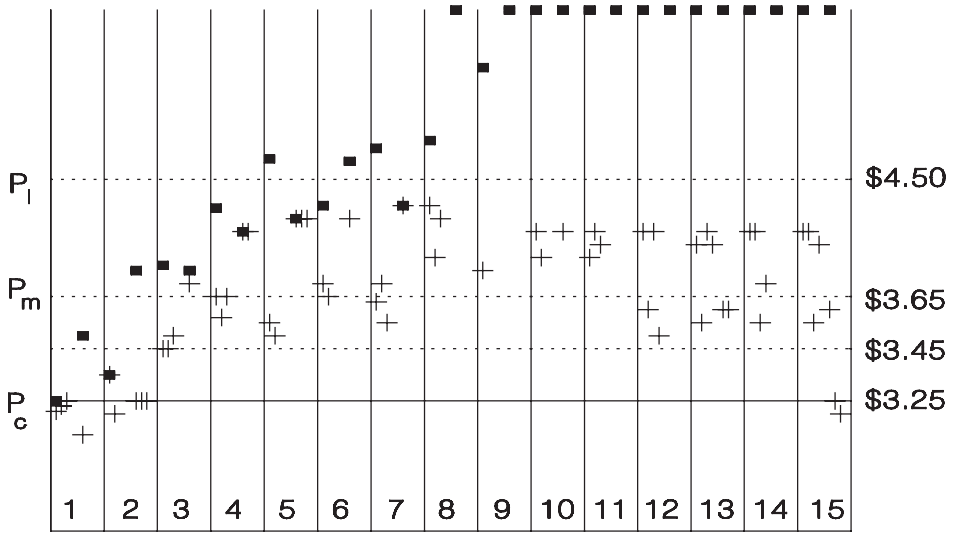

Figure 2. The sequence of list (■) and contract (+) prices for session D1.

Dramatically different results were obtained in the discounting sessions, denoted by the "D" identifiers in figure 1. First note that discounting uniformly raises list prices, sometimes dramatically. Although sellers uniformly granted discounts, as indicated by the wide disparity between median list and transactions prices in each market session, the effects of discounting on transactions prices are variable. In sessions D2 and D4x, sellers competed both on the basis of list and discount prices, generating low transactions prices and high efficiencies. In sessions D1, D3 and D5x, sellers posted uninformative, high list prices (with a median above 85), and then attempted to price-discriminate among the buyers, generating high transactions prices and low efficiencies. Comparing prices across experience levels ("x" denotes experience) it is seen that these results are not sensitive to experience. The variable, and generally high transactions prices that arise when sellers fail to compete on the basis on list prices are illustrated by the sequences of list (■) and transactions (+) prices for the 15 periods of session D1, in figure 2.

4. Conclusions

Discounting clearly matters, and the possibility of discounting should not be excluded from either theoretical or experimental analysis. This finding raises a series of important new questions, such as the effects of secret discounting on the stability of price-fixing conspiracies, and more broadly, the effects of different search and switching costs on pricing behavior.

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