Chapter 22

PREDATORY PRICING: RARE LIKE A UNICORN?[1]

ROSARIO GOMEZ[†], JACOB K. GOEREE[‡] and CHARLES A. HOLT[‡]

1. Introduction

Despite the discovery of predatory intent in several widely cited antitrust cases, many industrial organization economists have argued that predatory pricing is irrational and rarely observed. For example, one of our colleagues, Kenneth Elzinga, in an address to the American Bar Association posed the question of whether predatory pricing is rare like an old stamp or "rare like a unicorn." The argument is that pricing below cost in order to drive competitors out of the market will be irrational for two reasons: (1) there are more profitable ways (e.g., acquisitions) to eliminate competitors, and (2) future price increases will result in new entry.

Decisions in antitrust cases have often resulted from documented predatory intent, which is sometimes attributed to an "irrational" motive for management to eliminate rivals. In the absence of a "smoking gun," arguments turn on Areeda–Turner cost-based tests, which are difficult to apply given the multi-product nature of most business operations. For these reasons, the issue of predatory pricing is a natural topic for laboratory studies where costs are induced directly.

2. Single Market Designs

The first experiment designed to investigate the possibility of predation is reported by Isaac and Smith (1985). They conducted a series of posted offer markets with a large seller that has a cost advantage over a small seller. Besides having a larger cash endowment to cover initial losses, the incumbent was given a higher capacity and lower costs, as shown in Figure 1. In order to construct the market supply function, consider the average costs for the two sellers, shown on the left side of the figure, in red for the large seller and in green for the small seller. Since the large seller's minimum average cost is at \$2.50, no units would be supplied at lower prices, and the (thick) market supply function (in yellow on the right) follows the vertical axis up to \$2.50. At this price, the large seller would supply the seven units with decreasing costs shown on the left side of the figure. The small seller would not supply any units until the price rises to \$2.66,

[1] This research was supported in part by a grant from the National Science Foundation (SBR 0094800).
[†] Gomez: University of Malaga.
[‡] Goeree and Holt: University of Virginia.

Handbook of Experimental Economics Results, Volume 1

DOI: 10.1016/S1574-0722(07)00022-4

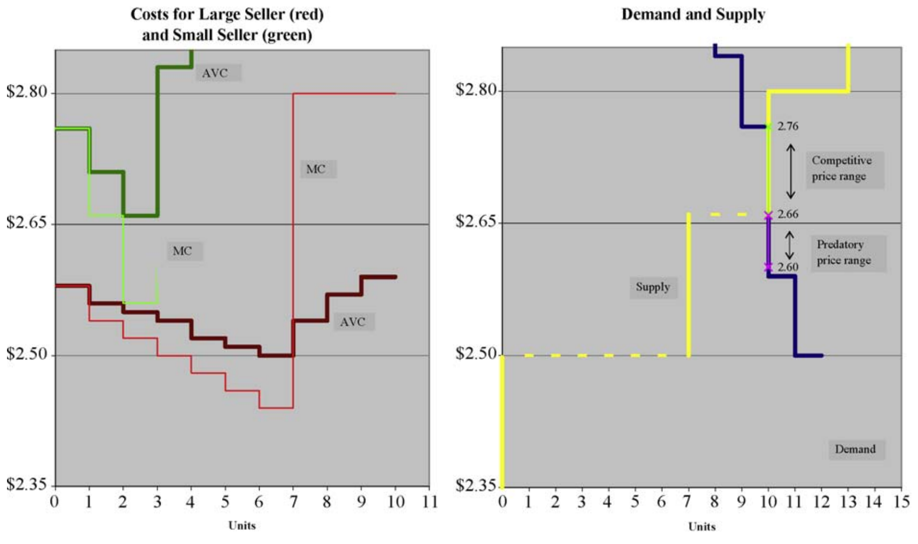

Figure 1.

the minimum of the small seller's average cost. So the market supply curve is vertical at seven units between $2.50 and $2.66, a price at which the small seller provides the three units with decreasing costs shown on the left side of the figure. Supply overlaps market demand in the vertical range from $2.66 to $2.76, which is labeled the competitive price range.

The most obvious case of predation would be where the large seller chose a price below the small seller's minimum average cost of $2.66 and supplied a quantity such that market demand is exhausted. Such a price together with a quantity of ten units would not result in a loss if the price is above the large seller's average cost, as would be the case in the "predatory price range" shown on the demand curve in Figure 1. This action, which leaves no room for positive earnings for the small seller, is predatory in the sense that price is below the $2.80 marginal cost of the 10th unit. It is inefficient for the large seller to sell ten units, since the large seller's three extra-marginal units are more costly than the three infra-marginal units of the small seller. Therefore, this design permits an inefficient predatory outcome that does not require the predator to sustain losses, although profits during the predation phase are lower than would be the case in a competitive equilibrium. A predatory action that drives the other seller out of the market *may* result in much higher, monopoly profits if entry does not occur. The small seller in Isaac and Smith's design can ensure earnings of zero by exiting the market, although there is only one active market in this setup.

Predatory pricing was not observed in any of the Isaac and Smith markets, even after they introduced several design variations (e.g., sunk costs) intended to be progressively more favorable to such pricing, and hence the provocative title "In Search of Predatory Pricing.” Since subjects may not want to be left out of the market trading activity, this raises the issue of whether predation might occur in the presence of a reasonable alternative activity for the “prey,” which is the topic of the next section.

Jung, Kagel, and Levin (1994) report an experiment that implements repetitions of a simple signaling game in which one of the equilibrium outcomes can be given a predatory pricing interpretation. Each play of the game involved a subject monopolist who encountered a different potential entrant in a series of eight periods. In each period, the potential entrant would choose to enter or stay out, and the monopolist would choose to fight or accommodate. The monopolist’s decision was observed by the prospective entrants. The entrants earned more by staying out, unless the monopolist chose to accommodate. Following Kreps and Wilson (1982), the monopolist was given one of two possible cost structures: a strong monopolist would prefer to fight and a weak monopolist would prefer to accommodate in a single period. The monopolist was informed of her cost type that was determined randomly at the start of the eight-period sequence, but a prospective entrant would have to infer the monopolist’s type on the basis of observed responses to previous entrants. There is a sequential equilibrium in which a weak monopolist will fight entry in early periods in order to deter subsequent entry. This “predatory” response by weak monopolists was commonly observed.

The market interpretation of this pooling equilibrium is that there may be a monopolist with costs so low that the profit-maximizing choice in the presence of entry would be below the entrant’s average cost (that depends on the opportunity cost of foregoing earnings in the alternative market). Thus the theoretical possibility that behavior with a predatory flavor can exist in equilibrium is confirmed in the experiments. The setting used was rather abstract, e.g., the monopolist was called a “type-B player,” and there was no mention of prices, quantities, entry, etc. Thus the Jung, Kagel, and Levin (1994) results are suggestive, although somewhat difficult to evaluate in the context of the industrial organization literature on predatory pricing.

3. Multiple Market Designs

Harrison (1988) modified Isaac and Smith’s (1985) market structure in a clever manner. He implemented five simultaneous posted-offer markets with eleven sellers, each of whom could enter only one market at a time. Seven of the sellers were given the Isaac and Smith small-seller cost function, shown in green on the left side of Figure 1. Each of the other four sellers had a preferred market in the sense that they were a low-cost seller in that market, but they would become high-cost sellers if they entered any other market. There was only one potential low-cost seller in each of four markets. The efficient entry pattern required each of the four potential low-cost sellers to go to their own market and share it with a high-cost seller, and for the remaining high-cost sellers to congregate in the only market for which no seller had low costs. Demand in each market was simulated and corresponded to the demand in Isaac and Smith’s (1985) setup.

Although Harrison only ran one session with this multi-market version of Isaac and Smith's design, he found evidence of predatory pricing. For example, the large seller in one market offered ten units at a price of $2.64, which is below the minimum average cost of the small seller and below own marginal cost. This predatory behavior drove the small seller out of the market, and the incumbent took advantage of the resulting monopoly position by posting high, profitable prices in the following periods. Since price and market entry decisions were made simultaneously, the large sellers had no way of knowing when entry would occur. For instance, one large seller posted a predatory price/quantity combination in period 10, presumably in an attempt to counter or deter entry, which occurred anyway in the next period.

In a survey of experimental work on predation and contestable markets, Holt (1995) concludes that Harrison's "behavioral existence proof" for predatory pricing would be more convincing with replication. Goeree and Gomez (1998) report such a replication, using Harrison's five-market design (see Capra et al., 1998, for a similar setup).[2] Subjects were provided with an experience profile similar to that used by Harrison (1988). In particular, each subject in the Goeree and Gomez replication began as a monopolist for several periods. These monopoly periods were followed by several periods of competition in which two or three identical sellers were exogenously assigned to one of four markets. Finally, all eleven subjects participated in the asymmetric cost, multi-market setup. In each market, the demand schedule was that used by Isaac and Smith.[3]

Overall, there was little evidence of predatory pricing from the three sessions conducted. One low-cost seller did select a price of $2.65 with a quantity of ten, but this was in the final period of the experiment. Since the number of periods had been announced in advance, this price could not have had a predatory intent unless the subject was confused about the endpoint. In another session, there were three cases in which a low-cost seller offered prices below the minimum average cost of $2.66, but the quantity was set at seven units in all cases, which would allow the entrant to earn positive profits.[4]

In a second series of experiments, Goeree and Gomez (1998) modified Harrison's five-market design in two important dimensions. Recall that prices and entry decisions are made at the same time in the Harrison setup, so the incumbent would not know whether a monopoly price is appropriate or whether an aggressive low price is needed to induce exit. Since price choices are more quickly changed than entry decisions in most markets, a reasonable alternative design is to have sellers choose their markets, with the entry choices announced prior to the posting of prices. Large sellers were required

[2] Although Harrison's instructions for the five-market design were unavailable, Harrison's monopoly instructions from an earlier paper were modified to allow entry, exit, and cost asymmetries.

[3] The demand schedule in each of the five markets was $3.92, 3.72, 3.52, 3.35, 3.21, 3.07, 2.97, 2.90, 2.84, 2.76, 2.59, 2.50, 2.32, 2.10, 1.88, 1.66, 1.44, 1.22, 1.11 and 1.00 for units 1–20, respectively. These values were assigned in descending order to buyers 1, 2, 3, 4, 5, 5, 4, 3, 2, 1, 1, 2, 3, 4, 5, 5, 4, 3, 2 and 1.

[4] Harrison classifies such prices as "type 2" predatory prices, because they are above the large seller's average cost, and moreover, are below $2.60.

to stay in their home markets, which should speed the adjustment process. A second change made by Goeree and Gomez involved a simplification of the demand structure. In Harrison's original setup, there were many steps in the market demand function, and this situation was further complicated by the fact that sellers were told nothing about market demand. Goeree and Gomez provide large sellers with complete information about demand, and simplified demand to a three step function: one at the monopoly price of \$3.55, one at the highest competitive price of \$2.85, and one at \$2.60. Since the lowest cost for the small sellers was \$2.80 and the lowest cost for the large sellers was \$2.60, any price in the \$2.60–\$2.80 range would be predatory, as long as the quantity offered by the large seller was large enough (ten) to preclude sales by the small seller. The incumbents had seven units with costs of \$2.60, and the three remaining units had higher marginal costs, which pulled average costs up to \$2.72 for ten units, so entry could be deterred without pricing below average cost. This new design makes it clear what the monopoly price is and when it can be charged safely, thereby increasing the rewards from driving out entrants. Moreover, the incumbents knew the entrants' costs, which made it clear what price would preclude profitable entry.[5]

Sessions with these design changes resulted in a consistent pattern of predatory pricing in most markets, as shown in Figure 2. There are three parts to the graph; the top two panels plot prices in the two markets with a natural incumbent, and the bottom panel shows the prices for the remaining market with no natural low-cost seller. The Y-axis shows prices in pennies, with the upper predatory price (\$2.80) indicated with a horizontal dashed line. Prices are plotted for the 12 periods in the 12 vertical columns. The prices selected by the natural incumbents are connected by solid lines (blue for seller 1 in the top panel and red for seller 2 in the middle panel). The prices chosen by the high-cost floating seller 3, for instance, are given by the yellow squares, regardless of which market seller 3 entered.

The prices for the low-cost sellers in the top two panels were often at predatory levels (below the dashed line) in periods when an entrant was present. Pricing at the monopoly level of \$3.55 was generally observed in periods with no entry. Smaller sellers sometimes set high prices in initial periods, but undercutting drove prices down toward competitive levels in later periods, as can be seen in the bottom panel of Figure 2. Overall, these sessions show a clear picture of predatory behavior in a market setting.

[5] The small sellers did not know the large sellers' costs. This informational asymmetry was to a large extent present in Harrison's setup because the large sellers were told what their costs would be if they stayed in their home market and what the costs would be if they became a "type A" seller in another market. This information about the high cost structure provided a very strong hint, if not complete information, about entrants' costs in one's own market.

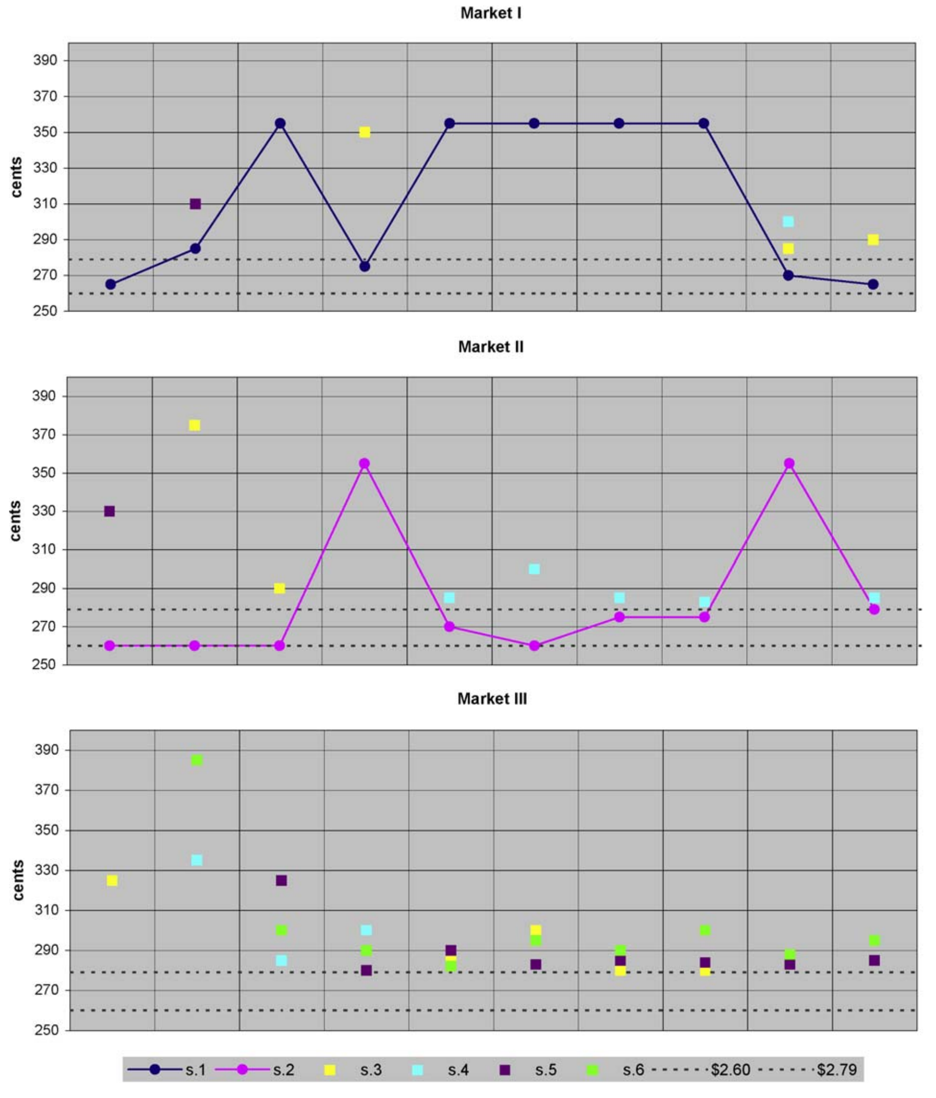

Figure 2.

4. Summary

Isaac and Smith's (1985) single market design did not produce predatory pricing. Such pricing was observed in the single multi-market session reported in Harrison (1988), but this pattern did not emerge in three replications run by Goeree and Gomez (1998). In a simpler design with prices being chosen after entry decisions are made and announced, the incumbents knew when to enjoy monopoly profits and when to punish entrants. This setup resulted in reliable predation in most markets. The lesson that predatory pricing experiments provide to date depends on an assessment of the realism of the design characteristics. What is clear is that predatory prices can be generated reliably, both in stylized signaling games and in rich market settings.

References

Capra, C.M., Goeree, J.K., Gomez, R., Holt, C.A. (1998). "Predation, asymmetric information and strategic behavior in the classroom: An experimental approach to the teaching in industrial organization". International Journal of Industrial Organization 18, 205–225.

Goeree, J.K., Gomez, R. (1998). "Predatory pricing in the laboratory". Working paper, University of Virginia.

Harrison, G.W. (1988). "Predatory pricing in a multiple market experiment. A note". Journal of Economic Behavior and Organization 9, 405–417.

Holt, C.A. (1995). "Industrial organization: A survey of laboratory research". In: Kagel, J., Roth, A. (Eds.), Handbook of Experimental Economics. Princeton University Press, Princeton, pp. 349–443.

Isaac, R.M., Smith, V.L. (1985). "In search of predatory pricing". Journal of Political Economy 93, 320–345.

Jung, Y.J., Kagel, J.H., Levin, D. (1994). "On the existence of predatory pricing: An experimental study of reputation and entry deterrence in the chain-store game". RAND Journal of Economics 25, 72–93.

Kreps, D.M., Wilson, R. (1982). "Reputation and imperfect information". Journal of Economic Theory 27, 253–279.