Minding Your Own Business

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Abstract:

I report an experiment to evaluate the Contestability thesis where the entrant and the incumbent have multi-market contacts. In such a setting the entrants might not like to hit-and-run as the theory predicts since the cost of a "hit" in the incumbent's market is borne by the entrant in its own market due to the multi-market interactions. When there are multi-market contacts between firms the contestability result depends crucially on the relative profits between markets. I find that in cases where an entrant has its own monopoly market the sellers manage to cooperate and achieve profits close to the monopoly level. Instead if an entrant is from an oligopoly or perfectly competitive market it exerts considerable disciplining force in the monopoly market.

Introduction

Natural monopoly is an intriguing environment to study. It is usually associated with a decreasing average cost structure which suggests that one firm serving the market is the efficient solution. With more than one firm serving the market there is a duplication of costs which reduces the welfare. However, only one firm serving the market opens up another possible welfare distorting situation, that of a monopolist price gauging and extracting monopoly rents.

There have been different suggestions to restrain the monopoly behavior such as regulations and public ownership in such a context. Probably the most noted and cited solution to this has been the theory of contestable markets as presented by William Baumol in his 1981 address as outgoing president of the American Economic Association. The Contestability theory argues that the threat of new entry in the monopoly market can provide just enough of a deterrent for the monopolist incumbent to charge a price equal to the average cost of production (the Ramsey optimal price).

The idea relies on four crucial conditions. First, on the production side, entrant and the incumbent must be symmetrically placed, having access to the same technologies and producing outputs of homogeneous quality. Second, the production sunk costs must be absent. This is likely whenever the capital employed is reusable, saleable, moveable or rentable. These two conditions imply that the entrant is able to compete successfully and at little risk, since he is able to withdraw from the market if necessary without incurring any costs. Third, the pricing practices of the market prevent immediate responsive pricing by incumbents. That is consumers respond to price differences with a shorter reaction time than do incumbents. Fourth, and a critical behavioral assumption is that the entrant can observe the price in the incumbent's market before they decide to enter the market. This last assumption along with the cost-less exit seems to me as the prime disciplining whip for the incumbent that makes him wary of charging a monopoly price.

Even after allowing for the above four assumptions and their justifications I find that the models of contestability lacks in an important direction. In particular, it remains silent about the entrant firm's own market, and the interaction environment of the entrant and the incumbent. Just any other firm seems an unlikely candidate for an entrant in Natural Monopoly Markets. It seems a common observation that firms producing similar commodities in other markets are the likely entrants. If we take that into account then we can think of multiple markets where these firms have scopes of repeated interactions in each other's markets. If we allow for such an environment it is important to verify whether contestability still retains its effectiveness as possible means of improving market efficiency in such an environment.

In this paper I put forward an experimental market environment where each firm is an incumbent in a market but has the option to enter another market. I then look at symmetric and asymmetric markets to see whether different opportunity costs of the entrant affects the pricing in the Natural Monopoly Markets. My results are as follows: When the entrant has its own monopoly market, prices are closer to the theoretical monopoly price in the natural monopoly market. If the entrant comes from a perfectly competitive market or an oligopoly market it disciplines the monopoly incumbent in the natural monopoly market and final prices are closer to the Ramsey optimal price.

Section 1 provides a brief review of past experimental work on contestability. I introduce the market environment in Section 2 and derive some possible equilibrium behaviors. Section 3 explains the experimental design; Section 4 discusses the results and Section 5 concludes.

1. Literature Review

Coursey, Isaac and Smith (1984) conducted the first experiments to look at the effects of monopoly under decreasing cost conditions in a posted offer market setting. In their experiment, sellers all simultaneously post prices and quantities at the beginning of the trading period. Also human buyers were used instead of computerized buyers for possible buyer strategic behaviors. In six of the contested experimental markets, four of the duopolies yielded competitive price outcomes and the other two exhibited downward trends in prices. This was one of the earliest attempts to operationalize the contestatibility thesis. A point to note here is that buyer strategic behavior could have been responsible for the downward trend in prices rather than the contestability hypothesis. Coursey, Isaac, Luke and Smith (1984) introduced a small amount of sunk cost to evaluate how robust Contestability is to slight changes in its assumptions. They ran twelve sessions, six with simulated buyers and six with human buyers and found that the prices supported a "weak version" of the contestable market hypothesis. It was weak in the sense that prices were found to be closer to the competitive (Ramsey-optimal) level than to the monopoly. In a different study, Harrison and McKee (1985) observed similar low values of monopoly effectiveness in their version of a contested market with designs similar to the Coursey, Isaac, Luke and Smith design except for the introduction of simulated buyers. Harrison

(1987) pointed out that a key behavioral assumption about the entrant being able to evaluate the profitability of a market before entry was absent in all the above work since the sellers simultaneously posted prices. In a modified series of experiments to accommodate the behavioral assumption he found stronger evidence in favor of Contestable Markets Hypothesis. V, Millner, Pratt, and Reily (1990) altered the price cutting assumption in an experimental design using a continuous-time flow market. In their design the seller with the lowest price at any instant, made the sale and in this sense was an incumbent. The other seller could observe the price and decide whether to undercut at the next moment. They found that market efficiencies were low and there weren't any stable pricing behavior. Brown-Kruse (1991) changed the zero opportunity cost of entry present in earlier experiments and added an alternative market which provided a safe haven for the entrant. The entrant could get a fixed payment for being in the alternative market. She found that the mean prices were not significantly different from the earlier zero opportunity cost cases.

2. The Market Environment

I consider a simple two-firm two-market setup. Each firm is an incumbent in one of the markets and has the option to enter the other market. I look at a two-stage game where each firm chooses a price in its own market in the first stage. In the second stage the firm gets to know the 1^{st} stage price in the other market and decides whether to enter there or not. The profits are realized at the end of the two stages, where the firm with the lower posted price in a market gets profits.

Before I proceed to the analysis of the firm behavior, I would like to specify the demand and cost conditions that I consider. Each market has the following cost function

$$C(q) = F+cq$$

where 'q' is the quantity produced. If a firm enters and sells in any market it faces the cost technology in that market. I assume 'F' to be a fixed cost only incurred if the firm actually sells and 'c' the marginal cost. Such a quasi-fixed cost allows for the cost-less exit condition for an entrant crucial for the Contestability results. The demand function is the usual downward sloping

$$D(p)= a - bp$$

where p is the selling price. Define p_0 to be the price at which the demand curve intersects the average cost curve. Let Π_0 be the profit associated with charging a price p_0. So p_0 is the Ramsey Price and Π_0 is the profit associated with charging the Ramsey price. Let Π_m be the *net* monopoly profit in each market if a firm charges the monopoly price p_m.

Having defined the variables needed for later reference, let me now proceed to the possible pricing behavior of the two firms. One possibility is that each incumbent posts p_0 in its own market to ward off possible entry and enters and undercuts the other firm whenever the latter posts a price greater than p_0. This would conform to the contestability thesis where each firm prices at average cost in its own market apprehending a hit-and-run entry. However, when each firm has its own Home Market Monopoly this seems unlikely a situation. Instead, if they cooperate they can realize far greater profits over time.

Let's look for a trigger strategy which enforces tacit collusion by each firm. Consider the following strategy: the firm remains in its own Home Market unless the other enters its Home Market. If the other firm does enter the incumbent's Home Market then the incumbent prices at price=average cost in the next period and at every subsequent period after that forever. Further, in the second stage decision, every time it finds the rival pricing above average cost in the rival's own Home Market it undercuts that price. This essentially means that once an entrant "hits" a market he loses the scope of monopoly profits not only in that market, but in his own market as well for every subsequent periods thereafter.

To formalize the above, consider an infinitely repeated game where each firm discounts the future by an amount δ. In my framework if a firm stays in its own Home Market its discounted profit stream is

$$\Pi_m / (1 - \delta)$$

If it decides instead to price cut and enter the Other Market, and each firm follows the "grim" trigger strategy specified above, it gets

$$2\Pi_m + \delta \Pi_0 / (1 - \delta)$$ [1]

I assume $\Pi_0 = 0$, a profit level associated with average cost pricing.

If $$\Pi_m / (1 - \delta) \geq 2\Pi_m + \delta \Pi_0 / (1 - \delta)$$

or, $$\delta \geq ½ \qquad \text{(A.1)}$$

When condition (A.1) holds then each firm would like to maintain its monopoly position in their HMs rather than encroach or predate the other market.

The above analysis has some implications for Contestability where the threat of entry acts as the prime disciplining force to the monopoly incumbent. It is plausible that even though a market is vulnerable to a "hit-and-run", an entrant firm might be reluctant

[1] Strictly speaking the profit from the entry is $\Pi m + \Pi_m - \varepsilon + \delta \Pi_0 / (1 - \delta)$; where $\Pi_m - \varepsilon$ is the profit the entrant gets by undercutting the incumbent slightly.

to enter if it fears retaliation in its own market. The “hit-and-run” strategy might not work so well where firms have scopes of interactions in multiple-markets. The point to note is that although the entrant can ‘hit’, he cannot quite ‘run’ away because the incumbent might decide to enter and price aggressively in the entrant’s own market in an effort to punish him. Curiously, in an environment where contestability has potential as a disciplining force, it seems more likely that the firms would have multi-market interactions or at least the scope of such interactions. Since contestability hinges on the possible threats of entry, a possible price war in each other’s market might actually mitigate that threat to a large extent. This in turn might make the firms behave in more collusive manners. If firms indeed behave in a tacitly collusive fashion then contestability loses its bite as a possible policy prescription.

This naturally makes me go a step further in search of a market environment where Contestability has more of a chance to be successful in restraining monopoly pricing. In our framework, an entrant firm should be able to do a hit-and-run entry without the fear of retaliation in its own market. This would suggest that an entrant from a competitive market would be an ideal candidate, since the profits in a perfectly competitive market are not influenced by entry. An entrant from an oligopoly market (Bertrand competition or Cournot competition) might be another possibility.

Consider first a situation where one of the firms is from a perfectly competitive market and the other has a natural monopoly market. If the firm from the competitive market enters the monopoly market it gets

$$\Pi_m + \Pi_0/ (1 - \delta)$$

If it does not enter he gets the payoff from producing in his own market only

$$\Pi_0/ (1 - \delta)$$

So the entrant enters provided

$$\Pi_m + \Pi_0/(1-\delta) \geq \Pi_0/(1-\delta)$$

or, $$\Pi_m \geq 0 \quad \text{(A.2)}$$

If condition (A.2) holds then contestability should be successful in curbing monopoly pricing. The intuition behind the above condition is obvious. If the entrant is from a perfectly competitive environment then any positive profit in the incumbent's market would lure him to attack that market, since in its own home market all it can hope to achieve is just normal profits. This in turn would make the monopolist firm wary of charging a monopoly price. So the Contestability hypothesis should work well in such a situation in curbing monopoly pricing.

Next consider one of the firms an incumbent in an oligopoly market, and the other an incumbent in a natural monopoly market. Let the maximum profit possible for a firm in the oligopoly market be Π_H and the lowest possible profit be Π_L. A similar grim strategy would suggest that contestability would work as a disciplining force[2] as long as

$$\Pi_m \geq \delta/(1-\delta)[\Pi_H - \Pi_L] \quad \text{(A.3)}$$

The above provides us a background for setting up an experiment to evaluate the Contestability thesis and investigate firm behavior under different profit conditions. This in turn should shed light on the conditions which facilitate or hinder Contestability as means of improving welfare.

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[2] See Appendix A for the proof

3. Experimental Setup

I have tried to incorporate the key points of Contestability in the experimental setup. First, the cost function is of a quasi-fixed nature. So the firm incurs a cost only if it actually sells at its posted price. This facilitates costless exit from a market for an entrant since all he has to do is not to post a price in the rival firm's Home Market in any period following an entry. I formulate the game as a simple two-stage game each period. In the first stage, each firm posts a price in its own Home Markets. This is then announced to both the firms at the beginning of the next stage. The firms in this stage decide whether to post a price in the Other Market. At the end of the two stages the payoffs are realized for that period for each firm. With firms being able to see the first stage choices of the incumbent, imposes the condition that each firm can actually evaluate the profitability in the Other Market before it decides whether to enter a market. As mentioned earlier this is one of the critical behavioral assumptions on which contestability hinges upon and has been absent in some of the earlier experiments on Contestability.

For the baseline symmetric natural monopoly markets the cost and demand functions are as follows:

$$C\ (q) = 32 + 2q$$

$$p = 20 - q$$

The associated $p_m = 11$ and $\Pi_m = 49$. The Ramsey price $p_0 = 4$. A price of 4 generates zero profits. However to make the payoffs salient in the experiment if a single seller charges a price of 4 he gets a profit 1. I will call this the Monopoly Treatment.

In the second treatment, one of the markets is a natural monopoly market. The other market is a perfectly competitive market. The payoff in the competitive market is fixed at 1 independent of the number of firms. The conditions in the monopoly market are the same as the baseline treatment. The profits in the perfectly competitive market remain unaffected by an entry. I will refer to this as the Perfect Competition Treatment.

For my third treatment, let me label two markets as Market A and Market B for expositional convenience. Market A is the natural monopoly market characterized by the same baseline cost and demand functions. Market B has two existing firms operating in a Bertrand environment. Market B, has an inelastic demand of 2 units. The firms in market B can choose prices between 4 and 11, same as in the monopoly market. The final profit depends on the number of firms in the market. The seller with the lowest price gets a profit equal to two times the price chosen by him. If two sellers post the lowest price, then each get profits equal to their posted price. If three sellers post the lowest price then each get a profit equal to 2/3rd the price chosen. Further only one of the sellers (pre-designated) has the option to enter the natural monopoly market. This restriction might seem a bit unnatural, but is imposed so that when comparing between treatments the experimental results are not affected by an increase in the number of potential entrants. Using the experimental parameters $\Pi_H = 20$, and $\Pi_L = 8/3$. I will refer to this treatment as the Oligopoly Treatment.

In all the treatments, the sellers interact repeatedly with the same person with a random stopping rule to facilitate the condition on δ. The number of firms in the market, the exchange rate of experimental earnings into real currency are clearly explained in the instructions to the participants (See Appendix B). The experiments were computerized using the Z-tree software. This enabled handling multiple market pairs at the same time. Also it enabled me to give information on price choices on rival firms and profits from each markets more conveniently using the computer screen.

The experiments were conducted in the Economic Science Laboratory (ESL) at the University of Arizona. For each of the treatments I gathered observations between five to seven market pairs. Each of the market pairs consisted of an incumbent firm in a monopoly market and another firm in the 'treatment' market. The subjects were recruited over email using the ESL subject database.

3. Results

At this point I would like to point out that this experiment is an attempt to establish the following two conjectures to better identify the boundaries of the Contestability thesis:

Conjecture 1: when firms have their own home market monopoly and have scopes of multimarket contact, under 'appropriate' conditions the threat of entry would fail to improve market efficiency due to strategic interactions between firms.

Conjecture 2: If the entrant firm comes from a competitive market Contestability can be effective as a restraint on monopoly behavior, even though there are scopes of multi-market contact. Under 'appropriate' conditions an entrant from an oligopoly market can have similar effects on restraining monopoly power in the natural monopoly market.

I start by reporting the results for the final prices in the Monopoly Treatment and the Perfect Competition treatment. In Figure 1, I have graphically illustrated the average prevailing price in the natural monopoly market.

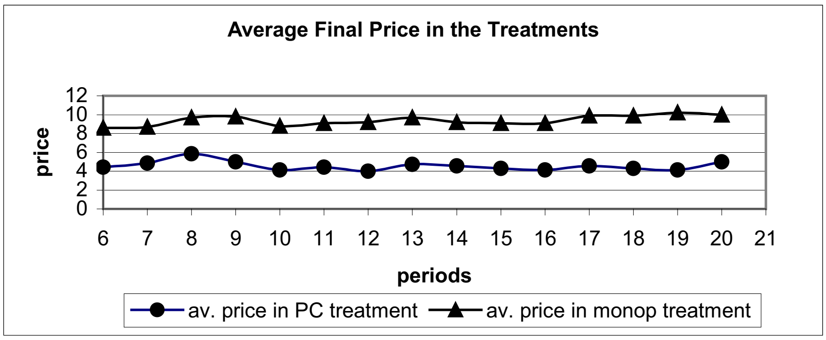

Figure 1: Average Prices in the Monopoly vs. Perfect Competition Treatment

The first 5 periods are not reported since the subjects are learning about decisions in the market, although the choices aren't starkly different. Using a Mann-Whitney test I found the average prices in each treatment significantly different between the two treatments (two tailed test) and also that the Monopoly treatment generates significantly higher prices (one-tailed test).

In Figure 2, I report the average prices in the Monopoly vs. the Oligopoly treatments. Using a Mann-Whitney test I found the average prices in each treatment significantly different between the two treatments (two tailed test) and also that the Monopoly treatment generates significantly higher prices (one-tailed test).

Using a Mann-Whitney test I also found that the average prices in the Oligopoly and the Perfect Competition treatments were not significantly different.

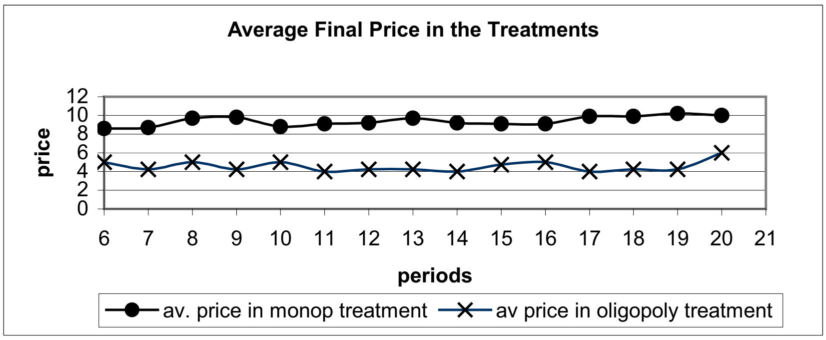

Figure 2: Average Prices in the Monopoly vs. Oligopoly Treatment

In Figure 3, to give an overview of the effects the average prices in the monopoly market in all three treatments are stacked together.

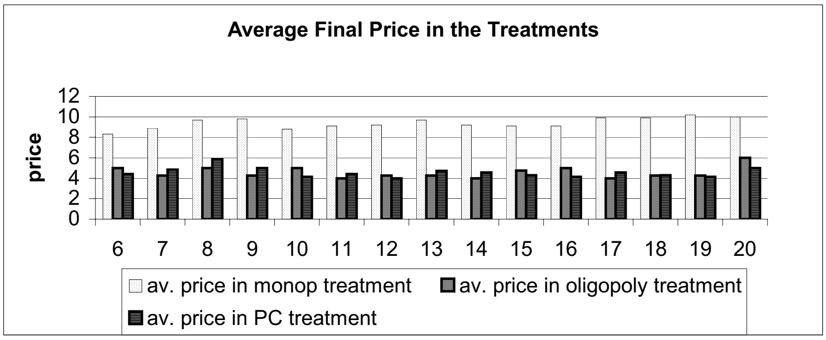

Figure 3: Average Prices in all three treatment

The average prices in the Monopoly treatment remain very different from the other two treatments. The Oligopoly treatment and the Perfect Competition treatment generated very similar results.

Let me define a welfare measure to better illustrate the results in each market. Let

$$\mathbf{W = (\Pi_{m} - \Pi_{a}) / (\Pi_{m} - \Pi_{0})}$$

Where Π_a is the actual price observed in the experimental markets, Π_m is the theoretical monopoly profits and Π_0 is the profit associated with the Ramsey pricing. When $\Pi_a = \Pi_m$, W=0. Figure 4 illustrates the average price across all periods in each market for every treatment.

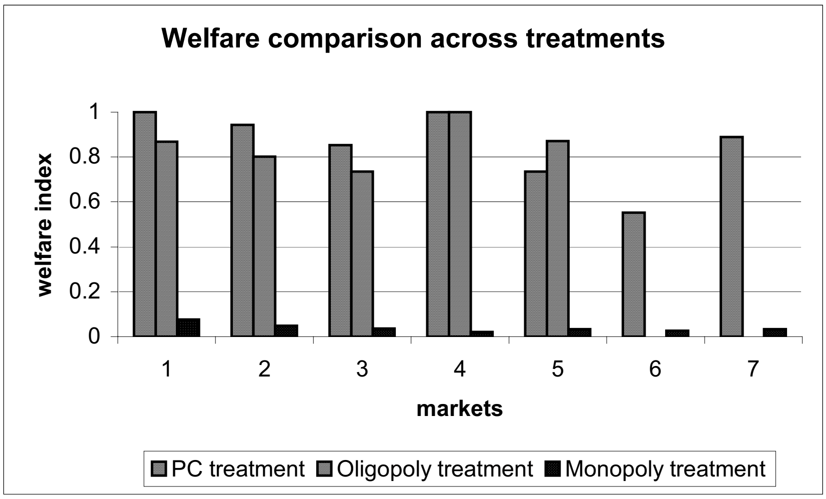

Figure 3: Average Prices in all three treatment

The difference in W across treatments is quite stark. While the Monopoly treatment yielded W close to zero in each of the markets, the other two treatments had W closer to one and sometimes actually one.

5. Conclusion

In this experiment I tested for the viability of the Contestability thesis when the entrant and the incumbent have multi-market contacts. I found that the threat of entry is successful in lowering prices only if the entrant has relatively lower profits in its own market. Both in the Perfect Competition treatment and the Oligopoly treatment prices in the Natural Monopoly market quickly adjusted to the Ramsey Price level. However, in the Monopoly Treatment prices remain very close to the theoretical monopoly price level.

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Appendix A:

1.Entrant from a Monopoly market

If each firm decides to stay in its own market then the present discounted profit stream each will get is

$$\Pi_m + \delta\Pi_m + \delta^2\Pi_m + \delta^3\Pi_m + \ldots = \Pi_m / (1 - \delta) \qquad \text{(B.1)}$$

Instead if a firm enters and undercuts the incumbent of the Other Market in a period he gets

$$\Pi_m + \Pi_m - \varepsilon$$

in that period and Π_0 from then onwards. So the discounted profit stream to the entrant is

$$2\Pi_m + \delta\, \Pi_0 / (1 - \delta) \qquad \text{(B.2)}$$

I ignore ε for convenience. Assume $\Pi_0 = 0$, a profit level associated with average cost pricing. If (B.1) is greater than (B.2), a firm is better off not entering the Other Market.

i.e., $\Pi_m / (1 - \delta) > 2\Pi_m + \delta\, \Pi_0 / (1 - \delta)$

or, $\delta > ½$

If the firms discount the future by an amount greater than δ, and each of the firms play by the grim strategy mentioned earlier it is in the interest of the firms not to enter each other's markets.

2.Entrant from a Perfectly Competitive market

If a firm from the Perfectly Competitive market decides to stay in its own market then the present discounted profit stream it will get is

$$\Pi_0 + \delta\Pi_0 + \delta^2\Pi_0 + \delta^3\Pi_0 + \ldots = \Pi_0 / (1 - \delta) \qquad \text{(B.3)}$$

Instead if a firm enters and undercuts the incumbent of the Other Market in a period he gets

$$\Pi_m - \varepsilon$$

in that period and Π_0 from then onwards. So the discounted profit stream to the entrant is

$$\Pi_m + \Pi_0/(1-\delta) \qquad (B.4)$$

I ignore ε for convenience. Assume $\Pi_0 = 0$. If (B.4) is greater than (B.3), a firm is better off entering the Other Market.

i.e., $\Pi_m + \Pi_0/(1-\delta) > \Pi_0/(1-\delta)$

or, $\Pi_m > 0$

As long as the profit in the monopoly market is strictly positive the entrant from the Perfectly Competitive market would like to enter.

3.Entrant from an Oligopoly market

Suppose the maximum profit a firm can get in the Oligopoly market is Π_H. Let Π_L be the minimum profit possible there. So if a firm in the Oligopoly market remains in its own market the maximum it can get is

$$\Pi_H + \delta\Pi_H + \delta^2\Pi_H + \delta^3\Pi_H + \ldots = \Pi_H/(1-\delta) \qquad (B.5)$$

Instead if a firm enters and undercuts the incumbent of the Other Market in a period he gets

$$\Pi_m - \varepsilon$$

in that period and Π_L from then onwards. In this case once the firm enters the monopoly market, assume the incumbent in the monopoly market enters the Oligopoly market in all subsequent periods and chooses a price such that the profit level in the Oligopoly market is Π_L. In addition, he chooses a price P_0 in his own market. So the discounted profit stream to the entrant is

$$\Pi_m + \Pi_H + \delta\,\Pi_L/(1-\delta) \qquad (B.6)$$

If (B.6) is greater than (B.5), a firm is better off entering the Other Market. i.e.,

$$\Pi_m > \delta/(1-\delta)[\,\Pi_H - \Pi_L\,] \qquad (B.7)$$

Appendix B:

Introduction

Welcome to this market experiment. *You will be matched with another participant for the rest of the experiment.* You will get 5 U.S. dollars for participating in the experiment in addition to what you earn in experimental dollars during the experiment. Each experimental dollar is worth 0.01 U.S. dollar.

Instructions

There are two markets. You are the only seller in your home market. There is also one seller just like you in the other market. There are *multiple periods* of the experiment.

In each period there are two stages of decision making that you have to take.

Stage 1:

You choose a price between 4 and 11 in *your home market*. The other seller also chooses a price from the same set of prices in *his home market*.

Stage 2:

You are shown the price chosen by the other seller in *his home market*. Also the price you have chosen in *your home market* is shown to the other seller.

Then you decide whether to *enter* the other seller's home market or *not enter* his market. If you decide to enter you have to submit a price in that market. The other seller also decides whether to *enter* your market or *not enter* your market. If he chooses to enter then he submits a price in your market.

Once you and the other seller have taken the Stage 1 and Stage 2 decisions, *one period* is over. Your profit for that period is determined by the matrices attached at the end.

Notice the profit in your home market depends on what you choose in the first stage *and* what the other seller chooses in the second stage. Similarly, the profit in the other market depends on what the other seller chose in the first stage *and* what you choose in the second stage.

After every period, the computer program picks a number from 1 through 6 with equal chance. If either 5 or 6 comes up the experiment ends; otherwise, the experiment continues to another period. In other words, after every period you have $2/3^{rd}$ chance to move on to another period. NOTE: This is the same as rolling a six-sided die. If a 5 or a 6 turns up then the experiment ends; otherwise, the experiment continues to another period.

If you move on to another period, Stages 1 and 2 are repeated again.

At the end of the experiment your total profit from all periods will be converted to U.S. dollars in the mentioned exchanged rate and paid to you.

Introduction

Welcome to this market experiment. *You will be matched with another participant for the rest of the experiment.* You will get 5 U.S. dollars for participating in the experiment in addition to what you earn in experimental dollars during the experiment. Each experimental dollar is worth 0.01 US dollar.

Instructions

There are two markets. You are the only seller in your home market. You get 1 experimental dollar for being a seller in this market every period. There is another market which is the other seller's home market. There are *multiple periods* of the experiment.

In each period there are two stages.

Stage 1:

The other seller in *his home market* chooses a price between 4 and 11.

Stage 2:

You are shown the price chosen by the other seller in *his home market*. You have to decide whether to *enter* the other seller's market or *not enter* his market. If you decide to enter you have to submit a price in that market. The other seller also decides whether he wants to enter your market or not. If he chooses to enter he gets 1 experimental dollar for being in the market.

Once you and the other seller have taken the Stage 1 and Stage 2 decisions, *one period* is over. Your profit for that period, in the other seller's home market is determined by the matrix that is attached at the end.

Notice the payment in the other seller's home market depends on what the other seller chooses in the first stage *and* what you choose in the second stage. In addition, in your home market, you get 1 experimental dollar every period.

After every period, the computer program picks a number from 1 through 6 with equal chance. If either 5 or 6 comes up the experiment ends; otherwise, the experiment continues. In other words, after every period you have 2/3rd chance to move on to another period. NOTE: This is the same as rolling a six-sided die. If a 5 or a 6 turns up then the experiment ends; otherwise, the experiment continues to another next period.

If you move on to another period, Stage 1 and 2 are repeated again.

At the end of the experiment your total profit from all periods will be converted to U.S. dollars in the mentioned exchanged rate and paid to you.

The rest of the Instructions are not included for the sake of brevity and can be requested from the author.

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