A Monopoly Classroom Experiment

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Abstract: The author uses a simple classroom experiment to develop the economic model of monopoly. As a pedagogical tool, the experiment introduces students to the nature of the monopoly problem and motivates them to think of the associated efficiency issues as a divergence between private benefits and social contributions. As a test of economic principles, the experiment highlights the role of information and fairness ideals in determining economic outcomes.

Key words: classroom experiment, fairness, information, monopoly
JEL codes: A22, C92, D42

In this article, I discuss a short and easily administered monopoly experiment conducted in several microeconomic principles courses. The purpose of the experiment was to introduce students to the economic analysis of monopoly and give them an intuitive way to think about the cause of inefficiency. The use of an experiment exposes students to concepts (such as marginal revenue) in a manner not typically available in a lecture format. In contrast to other monopoly experiments, the majority of students in these simplified experiments implemented the profit-maximizing equilibrium. Surprisingly, when the monopolist's cost information was public knowledge, consumer pressures led the monopolist to choose prices and quantities yielding a more equal division of the gains from trade.

OVERVIEW OF THE LITERATURE

There is a growing literature on the use of experiments in the classroom. As a pedagogical tool, experiments provide a means of empirically demonstrating abstract concepts, thereby making them more tangible to students. Furthermore, the versatility of classroom experiments permits them to be performed in computerized laboratories (Wells 1991; Williams and Walker 1993), directly in the classroom (Leuthold 1987), or by using data from animal and human experiments (Walker 1987). Although an in-depth review of the literature is beyond the scope of this article, the reader is referred to DeYoung (1993) and Williams and Walker (1993) for more complete analyses of the literature on classroom experiments.

More germane to this article are the experiments developed to expose students to the economic model of monopoly. Primarily, these experiments have been variants of the computer-based program MONOP (Wells 1991; Williams and Walker 1993). This program puts the student in the role of a price-searching

monopolist, where the computer provides information on consumer demand through repeated rounds of search. These computer-based experiments emphasize the importance of information and the complexity of the monopolist's problem when facing an uncertain demand. For example, Williams and Walker (1993) found that only a small percentage of the experimental monopolists earned at least 90 percent of the available profits. Wells (1991) concluded that the small proportion of individuals appropriating the available surplus was attributable to students not devising a search strategy emphasizing marginal principles.

In the experiment described here, I used a slightly different tactic to expose students to the monopoly problem. First, the experiment was conducted in a classroom setting, without the use of computers.[1] Second, the majority of students realized the textbook monopoly equilibrium in relatively few trials. This stands in sharp contrast to the MONOP experiments.

The simple public-good experiments of Leuthold (1987) are perhaps closest in spirit to the experiments described here. In those experiments, students engaged in face-to-face bargaining over the provision of a public good. In this setting, students obtained the efficient public-goods equilibrium 75 percent of the time when costs were private information. This percentage rose to a striking 91 percent when cost information was public.
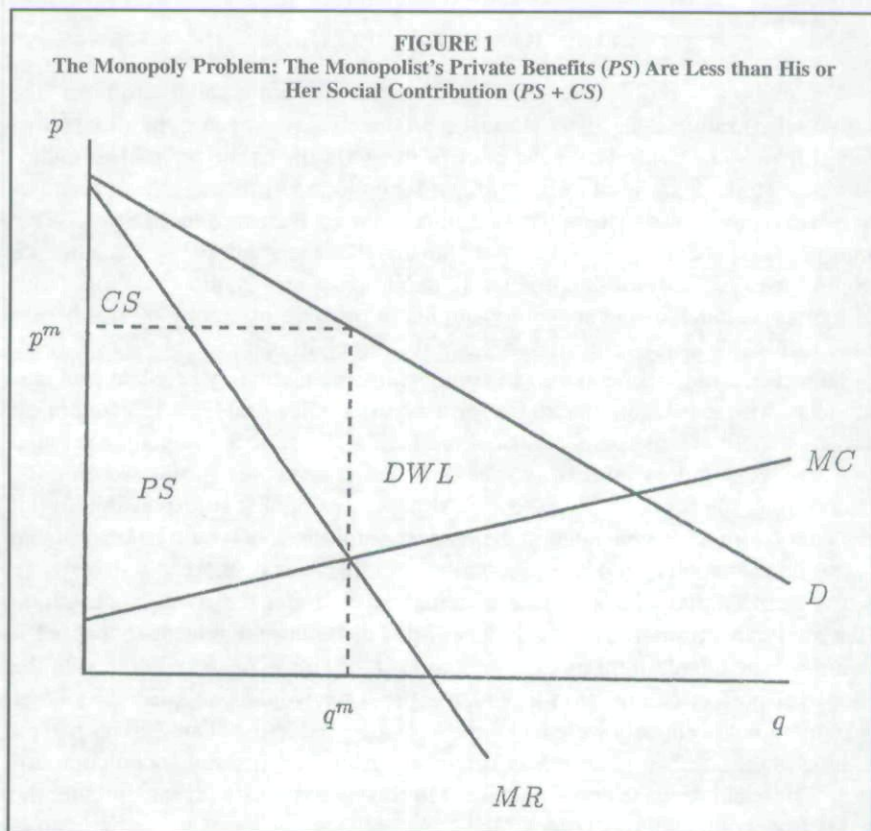
THE MONOPOLY PROBLEM

The monopoly problem arises when a market has but a single producer (the monopolist) rather than many atomistic producers.[2] As a result, the monopolist has at least some control over the price of the goods he or she sells. Most undergraduate students (at least initially) regard the monopolist as an evil in the marketplace whose presence prevents competition and creates inefficiency. This interpretation stems from students believing that the monopolist has ultimate control over the price of the product: In maximizing profits, the monopolist tries to extract as much of the consumer surplus as possible by setting a price higher than that which would prevail under perfect competition.

However, a more general way of approaching the monopoly problem provides students with a valuable paradigm for analyzing other problems in economics: private benefit versus social contribution. Unlike the perfect competitor facing a perfectly elastic demand relation, the monopolist generates surpluses he or she cannot fully appropriate. More specifically, the monopolist is responsible for all the gains from trade generated in the market, surpluses that would be unavailable were the monopolist to cease production. In other words, there is a divergence between the monopolist's private benefits (profits) and the social contribution (the total gains from trade). It is precisely this divergence that leads to the inefficiency of the laissez-faire monopoly equilibrium. This is in sharp contrast to the model of perfect competition in which a producer would be replaced by other inframarginal producers were he or she to cease production. Thus, under perfect competition, no divergence exists between private benefits and social contribution: Price taking makes profit maximization synonymous with maximizing the gains from trade.[3] In this context, the monopolist is not a menace in the market

but rather is constrained by the market demand curve and the information necessary to engage in perfect price discrimination.[4]

This distinction is easily shown using the textbook representation of monopoly. Because the monopolist faces the entire market demand curve, rather than a perfectly elastic demand curve, his or her private benefits from production are represented by the marginal revenue curve (Figure 1). Based on the diagram in Figure 1, it is easy for students to see that the price that maximizes profits does not maximize the gains from trade. The diagram also clearly illustrates the divergence between private incentives and socially efficient outcomes: The social contribution of the monopolist's production (producer plus consumer surplus) exceeds his or her private benefits (producer surplus). This divergence between individual and social incentives generates the inefficiency represented by the dead-weight loss in the figure. From the standpoint of maximizing the gains from trade, the perfectly competitive price is more efficient but yields lower profits to the monopolist. Because private and social incentives differ, it is not surprising that individually optimal and socially optimal allocations differ. Restoring efficiency in the market can be thought of as establishing institutions and mechanisms that bring private and social incentives in line with one another.

FIGURE 1
The Monopoly Problem: The Monopolist's Private Benefits (*PS*) Are Less than His or
Her Social Contribution (*PS + CS*)

OUTLINE OF THE EXPERIMENT

The experiment was conducted in a classroom setting. I organized the students in groups of five and designated them as either consumers (A through D) or a producer (the monopolist). Each student received a personal information sheet indicating his or her willingness to pay for the goods (if a consumer) or for production costs (if a monopolist). The students had already been exposed to the perfectly competitive model, but as of the experiment had not been introduced to the standard model of monopoly.[5] Students were told they would be competing for surpluses (if designated a consumer) and profits (if designated a monopolist). This distinction highlighted the difference between the monopolist's private benefits (profits) and social contribution (profits plus consumer surpluses). Ten winners (the 2 monopolists with the highest profits and 8 consumers with the largest surpluses) would be awarded prizes at the next class meeting.[6] The rewards appear to have been enough of an incentive for students to compete seriously.

The small number of consumers in each group arose out of a desire to allow the largest number of students an opportunity to participate as monopolists. Clearly, a larger number of consumers would more closely approximate the situation facing a monopolist. From a practical perspective, the small groups allowed the experimental trials to run quickly and smoothly. Pedagogically, the small groups permitted many more students to experience the nature of the monopolist's problem. Given the enthusiasm and understanding the students derived from the experiment, I believe that the monopoly scenario was not significantly compromised by the small number of consumers.

Each group conducted eight trials of the experiment. In the first four trials, the monopolist's production costs were private information. In the last four trials, a new monopolist was chosen and production costs were public information. This change was introduced to explore how students would react when the profits of the monopolist could be easily determined. Although the consumers' willingness to pay was private information, the range of consumers' preferences was common knowledge.[7]

The experimental trials began with the monopolist choosing a price at which to sell goods and announcing it to the consumers. The consumers made a binding announcement of how many units they wished to purchase. The monopolist could then offer a second price in an attempt to sell additional units. After the second price offer, consumers could make another binding announcement regarding additional goods they wished to purchase. However, consumers could not alter their initial (first price) purchases in lieu of a lower second price from the monopolist. After each price offer, the participants signed an agreement regarding prices and quantities sold. (See appendix A for sample data and instructions for performing the experiment and appendix B for a sample sales agreement.) To maintain the privacy of production and preference information, the students did not calculate their gains on the sales agreement until each set of trials was completed. After the experiment, the nature of the monopoly problem was described to the students using the standard textbook model. A student earned extra credit for compiling the results for the entire class.

Instructor preparation time involved making copies of the appropriate information for each participant. If there are N students in the class, the experimenter will need $N/5$ copies of monopolist production costs and $4(N/5)$ copies of consumer preferences for the first set of trials. The second set of trials will require an additional $N/5$ copies of (different) monopolist production costs and $4(N/5)$ copies of consumer preferences that include information regarding production costs. $N/5$ copies of the sale agreement forms will also be required for each group in each of the eight trials (one form per group per trial).

RESULTS OF THE EXPERIMENT

A total of 128 students in two microeconomic principles courses participated in the experiment (22 groups of 5 and 3 groups of 6). The experiment took approximately 40 minutes, with the remainder of the 65-minute class used to explain the monopoly problem and present a preliminary analysis of the experiment. The next class period was used to conclude the discussion of the experiment and discuss ways to correct the inefficiencies that arose.

Students were evaluated based on the surpluses they appropriated in the fourth and eighth trials. This was done to give the monopolist an opportunity to develop estimates of the market demand and marginal revenue relations. Students were asked to complete sale agreement forms for the trials that were not evaluated (trials one through three and five through seven) to give them an incentive to take these trials seriously. The early trials also provided students with direct exposure to the marginal revenue problem faced by the monopolist. After the first trial, the monopolists quickly realized they could not offer a lower price and maintain the same level of profits on inframarginal units. Consumers, motivated by a larger surplus, bought only at the lowest price offered in the previous trial. Exposure to the concept in this way seemed to make students more aware of the problem and provided a strong foundation for the analytical models of monopoly and imperfect competition.

The monopolist's option to offer a second price was intended to give students direct experience with the concept of marginal revenue. Because consumers purchased goods only at the lowest price offered in the previous trial, the monopolist had direct evidence of the conflict between profits earned on inframarginal units and selling additional units at a lower price. However, given the monopolist's uncertainty regarding the distribution of preferences, the second price offer did provide information. Whereas this information could have been used by the monopolist to engage in price discrimination, no evidence of price discrimination appeared during the experiment. Given the results, it appears that the option of offering a second price was used only to obtain a better estimate of the relation between the monopolist's market price and profits (i.e., the marginal profit curve).

A profit-maximizing monopolist might be expected to discriminate among consumers as information on preferences was revealed in each trial. The absence of discrimination was probably due to the students being unfamiliar with the topic and the small number of trials. However, the experiment lends itself nicely to the study of price discrimination.[8] With repeated trials and the ability to con-

tract with individual consumers, discrimination might arise where the monopolist offers different price-quantity contracts to different consumers.

In the first set of trials (those in which production costs were private information), 92 percent of the groups reached the textbook monopoly equilibrium. However, in the second set of trials (in which production costs were public information), only 34 percent of the groups achieved the monopoly equilibrium. Surprisingly, although not achieving the efficient solution, students tended to select equilibria with more equal divisions of the gains from trade. On several occasions, consumers chose not to purchase an individually optimal amount given the monopolist's price. Reasons cited for this were the consumers' belief that they were "being taken advantage of" and the monopolist was earning "unreasonable" profits.[9] The monopolist typically responded by offering a price where the gains from trade were more evenly distributed between the producer and consumers. On the other hand, when cost information was public, some consumers argued that the monopolist should not be driven to zero profits (which marginal cost pricing with the given cost structure would entail). These students argued that marginal cost pricing would be "unfair" as the monopolist should be compensated for being the sole provider of goods in the market.[10] This position demonstrates that consumers recognized the dependence of their gains on the monopolist's production. Thus, the threat of consumer action (or more appropriately, inaction) and recognition of the social benefits created by the monopolist encouraged producers to choose prices that, although not necessarily efficient, resulted in more efficient equilibria.

The presence of fairness concerns appears consistent with other experiments in which one individual gains disproportionately over another. In experiments with the ultimatum game, norms of fairness typically arise and preclude the realization of the Nash equilibrium (Prasnikar and Roth 1992; Thaler 1988). Here, if we consider the textbook monopoly equilibrium as the Nash equilibrium between consumers and a monopolist who does not discriminate on price, we have a similar result: The monopolist chooses a more equitable distribution of the gains from trade than the Nash equilibrium would predict. What is intriguing in these experiments is that fairness norms are efficiency enhancing. To not be perceived as unfair or greedy, the monopolists moved toward more efficient equilibria in which more units of the good were brought to market.[11]

CONCLUSION

The experiment achieved several goals. First, it motivated students to think about market imperfections in an intuitive way, namely, through the divergence of private and social contributions to the gains from trade. The difference between private and social incentives was used throughout the term in discussing why, in the presence of externalities and public goods, the laissez-faire market may be inefficient. Discussions of policies focused on means of re-aligning private and social incentives. Second, the experiment provided students with a welcome break from the standard lecture format and an opportunity to look more closely at the problem through direct involvement. Students not only seemed

excited by the variety the experiment introduced into the course but were also quick to understand and analyze how a given economic question can be solved through policies that alter private incentives. The intimacy provided by the experiment also exposed students to the role of bargaining and information in reaching an efficient solution. From this, discussions of trade and consumer unions were spawned.

Several extensions of this experiment can be considered. For example, the use of larger groups or computers in lieu of face-to-face bargaining would avoid some of the consumer organization occurring in the latter trials. This experiment and the intuition behind it can be easily extended to other topics in economics. In this respect, the experiment provides a simple, quick, and effective pedagogical tool.

APPENDIX A

Sample Data and Instructions

This appendix contains sample data on production costs and consumer preferences as well as brief instructions for use by the instructor. Complete information is available from the author.

Sample Data From the Experiment

Sample One

The monopolist's marginal cost of production is $2 per unit. The consumers' willingness to pay for each unit is as follows:

Consumer	First unit	Second unit	Third unit
A	7	5	3
B	7	4	2
C	6	5	2
D	6	4	3

These values correspond to an aggregate demand curve with $q = 16 - 2p$.

Sample Two

The monopolist's marginal cost of production is $4 per unit. The consumers' willingness to pay for each unit is as follows:

Consumer	First unit	Second unit	Third unit
A	18	10	6
B	14	8	4
C	16	7	3
D	13	11	1

These values approximate a linear aggregate demand curve with $q = 10 - p/2$.

Instructions for Performing the Experiment

1. It is recommended that the instructor expedite the distribution of materials by preparing packets for each group prior to the class. Each group's packet should contain personal information sheets for the monopolist and consumers and eight copies of the sales agreement form.

2. Students should be divided into groups of five and each given a personal information sheet indicating their willingness to pay for the good (if a consumer) or production costs (if a monopolist). Remind the students that they will use this information to compete in the experiment and that the information should be kept private.

3. Brief explanation to students of the trading rules:

    a. Students should purchase/sell goods in order to obtain the highest level of surplus/profits.

    b. The monopolist can offer only one price at a time and two prices per trial. After each price is offered, consumers are to indicate the number of units they wish to purchase Once such an announcement is made, it is considered binding. That is, during each trial a consumer cannot renege on his or her purchase if the monopolist's second price offer is lower

    c. After each trial, a sales agreement should be completed documenting the prices and quantities of all sales. Please wait until the end of the session before completing the profit and surplus information.

4. Four trials of trading should be conducted in each session. In the second session, the personal information sheets of all participants should include the monopolist's cost information.

APPENDIX B
Sample Sales Agreement Form

Trial number
Consumer A agrees to purchase   units at   per unit.
                                           units at   per unit.
Consumer B agrees to purchase   units at   per unit.
                                           units at   per unit.
Consumer C agrees to purchase   units at   per unit.
                                           units at   per unit.
Consumer D agrees to purchase   units at   per unit.
                                           units at   per unit.
Name of Consumer A:
Name of Consumer B:
Name of Consumer C:
Name of Consumer D:
Name of Monopolist:

Surplus accruing to Consumer A:
Surplus accruing to Consumer B:
Surplus accruing to Consumer C:
Surplus accruing to Consumer D:
Profits accruing to Monopolist:

NOTES

1. This was done not only out of necessity but also to give the students more direct contact with the relevant principles.
2. The existence of a monopolist is typically attributable to barriers to entry. Because the experiment created ersatz barriers to enter, a discussion of the causes of monopoly is not provided.
3. This follows the concept of full appropriation as developed by Makowski and Ostroy (forthcoming).
4. That is, the monopolist would provide additional goods were he or she able to discriminate perfectly among consumers.
5. The students had participated in a double-auction experiment earlier in the term and were familiar with the mechanics of a classroom experiment.
6. Twenty dollar gift certificates from a local record store were used as prizes.
7. Agents did not know the full distribution of consumers' willingness to pay but rather only the maximum and minimum values.
8. I thank an anonymous refereee for bringing this to my attention.
9. The ability of consumers to develop this type of strategy most likely resulted from the small size of the groups.
10. Although not part of the experiment, some students argued against marginal-cost pricing based on compensating the monopolist for previously incurred fixed costs.
11. This is similar to the public-good experiments of Leuthold (1987), in which public information pertaining to production costs yielded more efficient outcomes.

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