

Problem Set #6: MONOPOLY AND ALL THAT

Due: Tuesday, October 24th. [If you turn in your problem set by 2:00 PM on Friday, October 20th we will definitely return it to you in advance of the quiz on Friday, October 27th].

Reading Assignment:

- Chapter 6, Course Book (At Atticus and on electronic reserve) + GRAPHS
- *Economic Report of the President*, 1999, Ch 5: Regulation and Innovation (electronic reserve)
- Economics Annual Editions, 00/01: Readings #13, Corporate Governance, pp 48-52; #10, Price Discrimination, pp 40-41; #12, Market Concentration, pp 44-47; #14, Trustbusting, pp 53-54; #16, Deregulating Electricity, pp 58-61.

Errata: The chapter 5 Graphs handout contained some unfortunate errors:

On the 2nd line after equation 30, page 23, the exponents of the rhos should have been lambdas.

Table 5.3 and the related graphs were actually calculated with $K = 8$, $w = 20$ and $r = 5$. And the demand function for Figure 5.10 is $q = 30 - 1.2p$.

1. **Monopoly:** A firm facing the demand function

$$p(q) = 20 - 2q$$

has total cost function

$$C(q) = 20 + 4q + 0.6q^2.$$

- a. Determine the total revenue function $R(q) = q \cdot p(q)$ and the marginal revenue function $dR(q)/dq$ for our firm.
- b. Solve for the level of output and price yielding maximum profits

$$\pi = R(q) - C(q).$$
 What is total revenue, total costs, total profits, profits per unit of output, marginal cost, average total cost, and average variable cost at this level of output?
- c. Plot on a graph the demand function, the marginal revenue function, the marginal cost curve, and average total cost. [Hint: Check the cost function you analyzed for Part I of Problem Set #5] Then indicate on the graph the information you reported in b above. Also, calculate the amount of consumer surplus that is enjoyed under the monopoly.
- d. Is it true for this demand curve that at $q = 0$, marginal revenue equals price? Is it true that $dMR/dq = d^2R/dq^2 = 2 \cdot dp(q)/dq$ for this demand curve? Verify that these two properties hold for any linear demand curve $p = a - bq$, with $a > 0$ and $b > 0$.
- e. What is the elasticity of demand at the profit maximizing level of output. Recall: $\eta_p = - dq/dp \cdot p/q$
- f. Is it true that Marginal Revenue = $p(1 - 1/\eta_p)$ at any level of output? Explain.
- g. **REGULATION:** Suppose our monopoly produces electricity and that you sit on the Public Utility Control Commission. A consumer advocate recommends that the price be set so as to equate marginal cost with price (more precisely produce at the level where $p(q) = MC$). What price would this be? Compare the sum of consumer surplus plus profits at this level of output with that generated by the monopoly solution. If your responsibility is to regulate the monopoly in order to maximize Consumer Surplus plus Profits, what price and quantity would you establish?

- h. **TAX:** Suppose that the Public Utility Commission were abolished and that instead the government imposed a tax of \$2 per unit sold. How would the tax influence the price and quantity sold by the monopolist? Determine how the tax will affect consumer surplus and profits. Is the \$2.00 tax better than the public utility regulation solution in terms of maximizing the Net Social Gain = sum of consumer surplus plus profits = consumer surplus plus revenue - total costs? Discuss, considering both the efficiency and the equity issues raised by the tax .
- i. **POLLUTION:** Suppose that the Public Utility generates pollution costing the general public about \$2.00 per unit produced. Congressman Bullhorn suggests that a tax of \$2.00 per unit produced should be imposed in order to offset the social costs of pollution. How will the tax affect marginal cost and average cost? What will be the level of output produced by the monopolist if the tax is imposed. Should the government impose the tax? [Hint: You can suppose the objective is to maximize the Net Social Gain = Profits + Consumer Surplus - Pollution Costs = Consumer Surplus + Revenue - Production Costs - Pollution Cost].

2. Product Differentiation and Price Discrimination:

Sellers at times market essentially the same commodity in different markets at different prices. For example, stores may sell to the "careful shopper" market at reduced prices on bargain days; spur of the moment shoppers pay the regular price. It is said that Japanese steel is "dumped" in the American market at less than cost. And the United States sells subsidized wheat abroad at a price much below what it sells for in the United States.

- a. Suppose that a firm sells its product in two differentiated markets with demand functions

$$p_1 = 10 - q_1/2$$

and

$$p_2 = 20 - q_2/4;$$

Production costs are $C(q_1, q_2) = 2(q_1 + q_2)$

Find the profit maximizing level of output and prices.

3. Monopolistic Competition:

As explained in section 5 of "Market Structure," the EYEth Company sells its product in a monopolistic competitive market with demand function

$$q_i = 10(11 - p_i + 0.75\bar{p})/n^{0.5},$$

where p_i is the price it charges, \bar{p} is the average price charged by all the firms in the industry, q_i is annual sales, and n is the number of firms in the industry. There is free entry and exit from the industry. Production costs for each firm in the industry are given by the function $C = 64 + 4q_i$; i.e., there are fixed costs of \$64 and marginal cost = average variable costs = \$4.

The newly elected governor has imposed a licensing fee of \$64 on each firm. Subsequently the number of firms declines to 25.

- If all the other competing firms are charging $\bar{p} = \$12$, what is the best price for the EYEth company to charge in order to maximize its profits? With this price will the EYEth company make positive after-tax profits after paying the licensing fee?
- Would the EYEth company be better off if every firm in the industry charged \$18.00? Explain. Hint calculate the resulting quantities and profits if every firm charges \$18.00. If all the other firms are charging \$18.00, what is the best price for the EYEth company to charge?
- Would this industry be in long run monopolistic competitive equilibrium with $p_i = \bar{p} = \$18$ and $n = 25$? Would this industry be in long run monopolistic competitive equilibrium with $p_i = \bar{p} = \$12$ and $n = 25$? Explain.

4. Game Theory

Congratulations, you have been promoted to President of the Ajax manufacturing company. Ajax sells in a duopolistic market in competition with the Bjax company. Duopolists Ajax and Bjax are both considering an expansion of their capacity. The following payoff matrix shows how their profits (in millions of dollars) depend on their decisions (The first number of each pair is the profit of Ajax; the second *number* is the profit of Bjax):

	<i>Bjax has low capacity</i>	<i>Bjax has large capacity</i>
<i>Ajax has low capacity</i>	\$8, \$5	\$5, \$4
<i>Ajax has large capacity</i>	\$6, \$4	\$14, \$3

- Does the Ajax company have a dominant strategy? Does the Bjax company have a dominant strategy. Explain.
- Is there a Nash equilibrium for this game? Explain.
- Will you expand your plant capacity, Mr. President? Explain your decision.

DISCUSSION QUESTIONS:

- Discriminatory Pricing:** The Connecticut Electric Light and Power Company charges its residential customers \$9.50 per month plus 0.09125 KWH, where KWH is the number of kilowatt hours consumed during the month. Thus if a frugal customer uses a 100 KWH the monthly bill is $\$9.50 + \$9.125 = \$18.6225$ or an average price of 18.6 cents per KWH. In contrast, a customer using 1000 KWH has a bill of $\$9.50 + \$91.25 = \$100.75$ or 10.075 cents per KWH. Why would a public utility follow this pricing procedure? Is it equitable? May it contribute to an efficient allocation of resources?
- Imperfect Competition:** Mrs. Joan Robinson, in her book on *Economics of Imperfect Competition* [1932], objected that the market mechanism tends to generate too much product variety, leading to excessive production costs and distribution expense. Does the solution described above suffer from this problem? That is to say, if you were a central planner could you find a more efficient way of supplying the same total output to consumers at a lower price? Edward Chamberlin, in *The Theory of Monopolistic Competition* [1933], argued that the Monopolistic Competitive Solution is optimal.

[Hint: The firms in this industry are not operating at minimum average cost. Indeed the entire output of the industry could be produced by one factory.]

HONORS OPTION: Construct a simple numerical example showing that the prohibition of discriminatory pricing might under certain circumstances lead to a reduction in Consumer Surplus.