Amherst College
Department of Economics
Economics 58
Fall 2009

Name________________

Third Hour Test

SOLUTIONS

There are three questions on this 50 minute examination. Each is of equal weight in grading.

Question 1 One of the most important illustrations of microeconomic theory is in the study of taxes. In what follows you are to use verbal and graphical arguments to explain the following results of this theory.

a. Why are long-run supply curves generally believed to be more elastic than short-run supply curves? If this is the case, how does the short-run incidence of a tax differ from the long-run incidence.

Two things make supply more elastic in the long run: (1) The ability to change inputs that are fixed in the short run; and (2) Entry and exit in the marketplace. Because supply is more elastic in the long run, producers should pay a smaller share of any tax in the long run than they do in the short run.

b. How does the analysis of the producer's share of a tax differ between the short and long-run? Who pays the "producer's share" of a tax in the short-run? Who pays the producer's share in the long-run? Explain carefully.

In the short run the producers share will reflect both reduced profits of existing firms and (possibly) some changes in input prices. In the long run all of the producers share is paid by some input from changes in its price.

c. Define the "excess burden" of a tax? Would you expect the excess burden of a tax to be greater in the short-run or in the long-run?

The excess burden of a tax is the reduction in consumer and producer surplus that is not collected in tax revenues. It is a deadweight loss of welfare.

d. Describe one important observation about tax incidence theory that can be derived from general equilibrium analysis that is not apparent in partial equilibrium analysis.

All tax incidence ultimately falls on some set of households. To understand the complete incidence question one must also consider how the tax revenues are used.

<u>Question 2</u> A "process innovation" is a technological improvement that reduces the cost of producing a good. Assume that a good is produced at a constant average and marginal cost of c and that a process innovation reduces this cost to c' ($c' < c$). Suppose also that the demand for this good is given by $q = D(p) \qquad D'(p) < 0$.

a. What is the social value of this cost reduction? Illustrate this value both with a graph and with a definite integral showing the gain in welfare for consumers. (Hint: Assume the good is produced under perfect competition and that all firms have the same costs).

The social value of the cost reduction is given by the increase in consumer surplus which can be represented as $\int_{c'}^{c} D(p)dp$.

b. Suppose instead that this good is produced by a monopoly. Profits of this monopoly are given by $pD(p) - cD(p)$. Explain why for this monopoly $\frac{d\pi}{dc} = -D(p^m)$ (where p^m is the <u>monopolist's profit-maximizing price</u>). (Note: An answer to this question requires more than just differentiating the profit equation)

This is a result of the envelope theorem since profits are a maximized function. Applying that theorem yields:

$$\frac{d\pi}{dc} = \frac{\partial \pi}{\partial c}(at\ p = p^m) = -D(p^m) \text{ where } p^m = \frac{ce}{1+e} \text{ (}e\text{ is the price elasticity of demand)}$$

c. Use the results from part b together with the Fundamental Theorem of Calculus to show mathematically the profits gained by the monopolist as marginal costs fall. (Your answer should be a definite integral similar to that in part a) Also show your results with a graph.

Because of part b, the fundamental theorem of calculus says:

$$\pi(c') - \pi(c) = -\int_{c}^{c'} -D(p^m)dp = \int_{c'}^{c} D(p^m)dp\ .$$

d. Explain why the integral calculated in part c is smaller than that in part a. What does this say about the incentive for a monopolist to invest in process innovations relative to the socially optimal incentive?

Because $p^m > c \quad D(c) > D(p^m)$, the integral in part c is smaller than the integral in part a. This shows that a monopoly has less incentive to innovate than is socially optimal.

<u>Question 3</u>: Two firms, A and B, produce slightly different products and compete in a price-setting game. The demand for firm A's product is given by $q_A = 1 - p_A + p_B$ and the demand for firm B's product is given by $q_B = 1 - p_B + p_A$ where p_A, p_B are the prices charged by firm A and firm B, respectively. Both firms have the same (constant) marginal cost of production, *c*.

a. Calculate firm A's profit maximizing best response function. [Hint: This should result in $p_A = f(p_B, c)$]

$\pi_A = p_A q_A - c q_A = p_A - p_A^2 + p_A p_B - c + c p_A - c p_B$ and the first order condition for a maximum is $1 - 2p_A + p_B + c = 0 \quad or \quad p_A = \dfrac{1 + p_B + c}{2}$

b. Because the firms in this problem are symmetric, B's Best Response function will have the same general form as A's. Write down firm B's best response function. Then graph both Best Response Functions on a single graph.

$p_B = \dfrac{1 + p_A + c}{2}$. Both of these best response functions are positively sloped. (see Figure 15.4)

c. Calculate the Nash Equilibrium in this price-setting game. Discuss briefly the efficiency of this equilibrium.

Using the condition that $p_A = p_B$ yields $p_A = 1 + c = p_B$. This equilibrium is inefficient because both prices are greater than marginal cost.

d. Without making any calculations, use your graph from part b to describe how the Nash Equilibrium would change in this problem if firm A's marginal costs increased. Provide some intuition for the resulting change in the Nash Equilibrium because of the cost increase.

This would shift A's best response function to the right with its slope unchanged. The resulting Nash Equilibrium would have both prices higher. This shows that prices are strategic complements in this price-setting game.