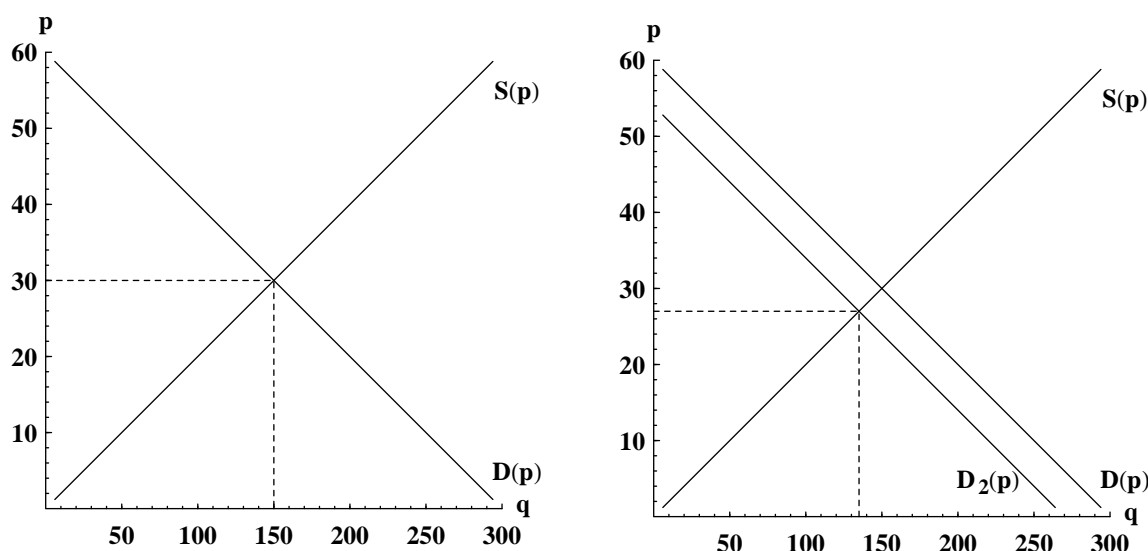


Economics 251
Homework #3
Due: Friday 1 June

The first problem in this assignment is based on the lecture notes on long-run equilibrium. The problems progress through steps similar to those taken in the lecture and the lecture notes, but with firm contraction in response to a tax on consumers, rather than firm entry or expansion due to a demand increase. Each part of problem 1 is worth 1 point. Problem 2 is worth 4 points.

1. Suppose that originally the demand in a market is $D_1(p) = 300 - 5p$ and the supply in the market is $S_1(p) = 5p$. The supply and demand are shown on the left side of the figure below.



Suppose that in this market a sales tax of \$6 per unit is placed on the buyers. Demand of the buyers then shifts to

$$\begin{aligned} D_2(p) &= 300 - 5(p + 6) \\ &= 270 - 5p \end{aligned}$$

as shown on the right side of the figure above.

(a) Assume that the production function is the same one that we worked with in the lecture notes: $q = f(K, L) = \bar{K}^{1/2} L^{1/2}$. Assume that the factor prices are $r = 9$ and $w = 25$. Find the cost function for each of ten firms if their capital stock is fixed in the short-run at $\bar{K} = 25$. Recall that the cost function is

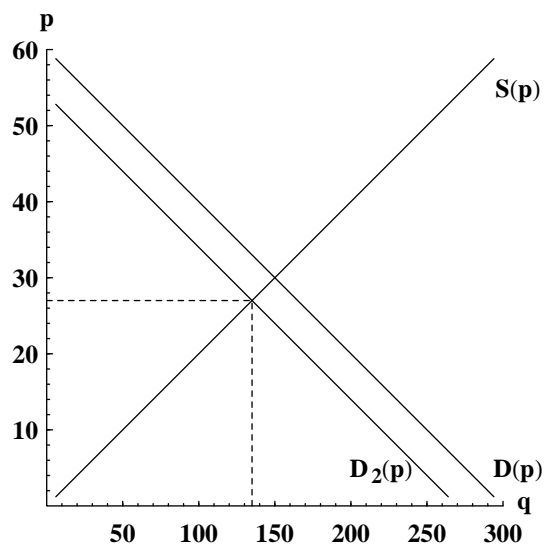
$$\begin{aligned} C(q) &= r \bar{K} + w L(q) \\ &= r \bar{K} + w q^2 / \bar{K}. \end{aligned}$$

(b) Find the marginal cost function for the firm, using the equation $MC(q) = \frac{1}{\delta} (C(q) - C(q - \delta))$.

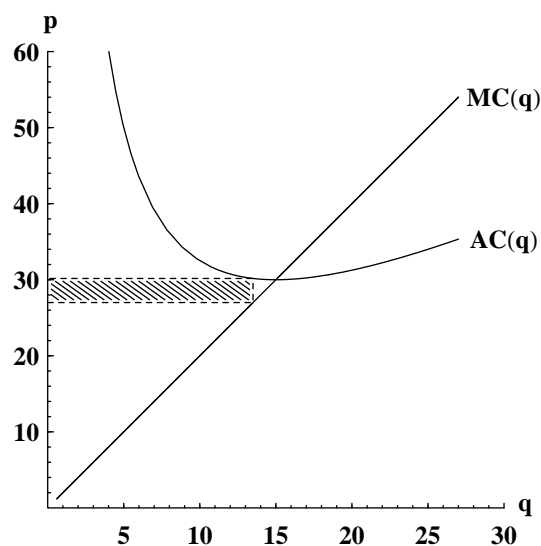
(c) Use the marginal cost function that you've found (dropping the δ from $MC(q)$ if you haven't already done so) and the profit maximization condition $p = MC(q)$ to find the supply function for a firm in this market.

(d) Find the average cost function for the firm, using the equation $AC(q) = C(q)/q$.

(e) The graph on the right side of the figure below shows the marginal cost and average cost for a typical firm in this market. Check the marginal cost and average cost functions that you've found in parts (b) and (d) by comparing your equations to the functions shown in the graph.



(a) Market conditions



(b) Firm conditions

(f) Calculate the economic profit for each firm in this market at the original equilibrium price p_1^* and at the equilibrium price p_2^* for the market after the demand shifts due to the introduction of the sales tax.

(g) Calculate the accounting profit (or producer's surplus for an individual firm at each of these two equilibrium prices) and subtract the total capital cost ($r\bar{K}$) from the accounting profit. How does economic profit compare to accounting profit minus capital cost?

(h) Suppose that in response to the economic losses that result from the decrease to demand the firms in the market begin to reduce their capital investment. Suppose that each firm reduces its capital stock to $\bar{K} = 20$. Find the new cost function for the firm.

(i) Find the marginal cost function for the firm. Use the marginal cost function to determine the supply for a firm with its reduced level of capital. Find the new market supply $S_3(p)$ by adding together the supply functions of the individual firms.

(j) Find the equilibrium price p_3^* in the market with the demand after the tax is imposed and the supply after the firms have reduced their capital in response to the economic losses. What is the output for a typical firm at this new equilibrium price?

(k) What is the average cost for a typical firm at the level of output that you found in part (j)? Find the difference between the equilibrium price p_3^* and the average cost for the typical firm at this level of output.

(l) Economic profit for each firm is the difference between price and average cost times the number of units sold. Calculate the economic profit.

(m) Should firms continue to reduce their capital investment? Briefly explain why or not. (One to two sentences should be enough to explain this.)

(n) What is the accounting profit for the typical firm in this new equilibrium?

(o) How does accounting profit for the typical firm compare to the capital costs of the firm? (The capital cost is the rental rate of capital r times the amount \bar{K} of capital utilized, which is $r \bar{K} = 9 \cdot 20$ after the capital level of the firms declines.)

(p) How does the difference between accounting profit and capital cost (your answer to part (o)) compare to the economic profit (your answer to part (l))? Give a one or two sentence description of the relationship between these three measures.

2. Suppose that a monopolist faces the demand curve $q = D(p) = a - bp$.

(a) (1 point) Find the inverse demand function $p = D^{-1}(q)$ for the monopolist and substitute this into the monopolist's revenue function $R(q) = pq$ to get the revenue as a function of output.

(b) (1 point) Find the level of output q^* that maximizes the monopolist's revenue. Also, substitute the profit maximizing price into the inverse demand equation $p = D^{-1}(q)$ to find the price charged by the monopolist.

(c) (2 points) Calculate the elasticity of demand for the monopolist at the output that maximizes revenue for the monopolist. In the elasticity formula take $p_0 = p^*$ and $q_0 = q^*$. (To get q_1 and p_0 you can take q_1 slightly larger than q_0 and use the inverse demand function to find p_1 .)