

### Problem Set 6 – Competitive Firms and Markets

1. Draw a graph showing the average total, average variable, and marginal cost curves for a typical firm. Draw in three prices that result in the firm making positive profits, breaking even, and making negative profits that are less than fixed costs.
2. Suppose your firm is in a competitive industry in long-run equilibrium making substantial long-run profits (as in Figure 8.11 in your textbook). State specifically what will occur as the industry moves toward long-run equilibrium.
3. Suppose a perfectly competitive firm has the short-run cost function  $C = 125 + q^2$ . Use the derivative formula or marginal cost to determine the firm's output level and profit at prices of \$30 and \$20. At what price does the firm reach the shut-down point?
4. Suppose there are 25 firms in the sandals market, in which market demand elasticity is  $-1.5$ . The elasticity of supply is 1. A single firm in this industry decides that because there are only 24 competitors, it might be a good idea to increase prices by 1%. How much will quantity demanded fall by? If the number of firms goes up to 100 what happens?
5. If each competitive firm in an industry has the short-run cost function  $C = 50 + 5q + q^2$ , and the market price is \$35, what is the profit-maximizing output level for each firm? What is the total revenue? What are the profits?
6. Suppose, in Question 5, that fixed costs were \$250 instead of \$50. How does this change affect the firm's output decision and profits? Should the firm continue to operate?
7. Irina owns a coffee factory in Edinburgh. Her production function is:

$$F(K, L) = (K - 1)^{\frac{1}{4}} L^{\frac{1}{4}}$$

Consider the cost of capital to be  $r$  and the wage to be  $w$ . Both inputs are variable, and Sebastian faces no fixed costs.

- i) What is the MRTS of labor for capital?
- ii) What are Irina's input demands conditional on the quantity ( $q$ ) she wants to produce? [Hint: Treat  $w$  and  $r$  as parameters.]
- iii) Show that Irina's long run cost function is  $C(q) = r + 2(wr)^{0.5} q^2$
- iv) What is the supply function of Irina's firm?

Consider now that  $r = 4, w = 1$ , and that the market demand for coffee is  $Q_d = 20 - P$ . There are 7 other companies operating in this market, all with cost structures identical to Irina's company.

- v) What is the aggregate supply in this market?
  - vi) Calculate the equilibrium price, aggregate quantity sold, quantity sold by each firm, and economic profit of each firm.
  - vii) Can this be a long run equilibrium? Why? How will the supply side of the market adjust in the long run?
  - viii) What is going to be the price in the long run? How many firms will be present in this market in the long run? How much will each firm produce?
8. The long run average cost curve for a firm in the corn industry is

$$AC(q) = 40 - 6q + \frac{q^2}{3}$$

The market demand curve for corn is

$$D(P) = 2200 - 100P$$

What is the long run equilibrium price? How much does each firm produce? How many firms are in the corn market? What is price elasticity of demand facing each firm?

9. Suppose a firm's cost function is

$$C(q) = \frac{1}{2}q^2 + q$$

and the market demand curve is

$$D(P) = 310 - 10P$$

The government can limit the number of firms in the market by decree. If the government wants the equilibrium price to be \$21, how many firms should it let into the market? Do you think the government could achieve this goal?

10. Suppose the government imposes a tax on each unit of output produced of  $\tau$ . What is the firm's new profit maximizing level of output? Use comparative statics to determine how a change in tax affects output.

11. We have assumed that firms have no market power. That is, no matter how much a firm produces, the price will be the same. What happens to a firm's profit maximizing level of output if the market price is a function of how much an individual firm produces? Try to express it as a function of the price elasticity of demand facing a firm.