

Fall 2018 14.01 Problem Set 4

Problem 1: True or False (24 points)

1. (4 points) In the short and long run, a profit-maximizing firm will choose its input mix based on $MRTS = -\frac{w}{r}$.
2. (4 points) Long-run marginal costs can be lower or higher than short-run marginal costs, while long-run average costs can't be higher than the short-run average costs.
3. (4 points) In a perfectly competitive market with identical firms, a permanent positive demand shock leads to a permanent increase in the price in the long run.
4. (4 points) In a perfectly competitive industry, a profit-maximizing firm sets its price equal to its marginal cost in a range where the marginal cost is decreasing.
5. (4 points) Adding up the individual supply curves $P = 5 + Q_1$ and $P = 3 + Q_2$ will lead to the market supply curve $P = 8 + 2Q$.
6. (4 points) In 1998, the Kenyan government confiscated and burnt 12 tons of elephant ivory in a gesture to persuade the world to halt ivory trade. The equilibrium quantity in the market for ivory will surely decrease, while the effect on price is ambiguous: it may decrease if this gesture is effective in convincing consumers to stop buying ivory, and will increase otherwise.

Problem 2: Short-run and Long-run equilibrium (26 points)

Consider a market for skateboards that is in a long-run equilibrium. In this equilibrium, each firm's short-run and long-run total cost functions are given by:

$$SRTC(q) = q^3 - 3q^2 + 3q + 4$$

$$LRTC(q) = 3q$$

The market demand for skateboards is given by $Q_D(P) = 27 - P$.

1. (4 points) What is the equilibrium price in the initial long-run equilibrium?
2. (4 points) Knowing that cost curves are defined by the above functions, explain why you can infer the number of skateboards each firm produces in long run equilibrium. Calculate the quantity. [Hint: If the market is in a long-run equilibrium, it is also in a short-run equilibrium.]
3. (4 points) What is the equilibrium market quantity in the initial long-run equilibrium? How many firms are in the market?
4. (6 points) Derive each firm's short-run supply curve (expressing it as q as a function of p). Derive the short-run market supply curve.
5. (4 points) The skateboards suddenly come into vogue, and the market demand shifts to $Q'_D(P) = 57 - 3P$. What are the equilibrium price and quantity in the short run?
6. (4 points) If the market demand stays at Q'_D thereafter, how will the market adjust? How many firms will there be in the long run?

Problem 3: Long-run equilibrium with heterogeneous firms (34 points)

Consider the market for bicycles. There are two technologies used by firms in this industry: Technology 1 uses solar power, and has a cost function $C^1(q) = q + 4q^2 + 32$ for $q > 0$. Technology 2 uses electricity from the grid and is more efficient, with a cost function $C^2(q) = q + 2q^2 + 32$ for $q > 0$. Assume that we are in the long run, so firms using both technologies can shut down and leave the market at 0 cost, so that $C(0) = 0$ for both technologies.

1. (4 points) What are the marginal and average cost curves for each of these two technologies? In the long-run, assuming that firms can choose their technology, will any firms choose the solar technology (technology 1)? Why or why not?

2. (6 points) Find the individual supply curve of a firm operating Technology 2.
3. (4 points) Suppose that market demand for bicycles is given by $D(p) = 820 - 40p$. What will be the long-run price in the market? How much will each firm produce at this price? What will the total number of firms be?
4. (6 points) Now, suppose that the government offers solar subsidies to 10 bicycle manufacturers. These subsidies are for \$28 and the manufacturers receive these subsidies as long as they produce a positive quantity of bikes with the solar technology (i.e. technology 1). What are new AC, MC, and supply curve for the solar technology with the subsidy?
5. (6 points) What will be the long run price now that there are the 10 bicycle manufacturers using technology 1 (assuming that there is still free entry for firms using technology 2)? What quantity will be produced by firms using technology 1 and 2? In equilibrium, how many firms using technology 2 will there be in the market?
6. (4 points) Will either type of firm make any profit in equilibrium? If so, how much will they make? If your results differ by firm, explain the intuition for why firms using some technologies make profits while others do not.
7. (4 points) Now suppose that the government increases the number of solar bike manufacturing subsidies it will give from 10 to 500. What is the new long-run price? How much will be produced by firms of each type? How many firms will there be of each type? Do any firms make profits?

Problem 4: Consumer and Producer Surplus (16 points)

Suppose the demand for apples is $Q^D = 550 - 50P$ and the industry supply curve is $Q^S = -12.5 + 62.5P$.

1. (4 points) Calculate the equilibrium price and quantity.
2. (6 points) Compute the consumer, producer, and total surplus for this market.
3. (6 points) Suppose that the government gives producers a subsidy of \$2 per bushel of apples sold. Draw the effect on the demand and supply curves, with quantity on the horizontal axis and the price paid by consumers on the vertical axis. Compute the new equilibrium price and quantity, the consumer and producer surplus, and the government expenditure on the subsidy. Compare the government expenditure with the increase in consumer and producer surplus.

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