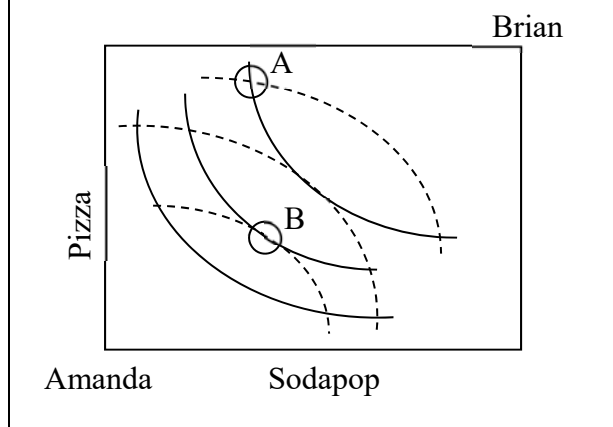


EXAMINATION #4 VERSION A
“General Equilibrium and Market Power”
November 23, 2021

INSTRUCTIONS: This exam is closed-book, closed-notes. Calculators, mobile phones, and wireless devices are NOT permitted. Point values for each question are noted in brackets.

I. MULTIPLE CHOICE: Circle the one best answer to each question. Feel free to use margins for scratch work [1 pt each—8 pts total].

The next two questions refer to the following Edgeworth box diagram for consumption. The solid curves are Amanda's indifference curves. The dashed curves are Brian's indifference curves.



(1) From allocation A, *both* consumers can enjoy greater utility if

- Amanda gives Brian some pizza, and Brian gives Amanda some sodapop.
- Amanda gives Brian some sodapop, and Brian gives Amanda some pizza.
- Amanda gives Brian some pizza and some sodapop.
- Brian gives Amanda some pizza and some sodapop.
- No trade will allow both consumers to enjoy greater utility.

(2) From allocation B, *both* consumers can enjoy greater utility if

- Amanda gives Brian some pizza, and Brian gives Amanda some sodapop.
- Amanda gives Brian some sodapop, and Brian gives Amanda some pizza.
- Amanda gives Brian some pizza and some sodapop.
- Brian gives Amanda some pizza and some sodapop.
- No trade will allow both consumers to enjoy greater utility.

(3) Walras's Law implies that

- only one market can be in disequilibrium at a time.
- it is impossible for only one market to be in disequilibrium.
- any random set of prices can produce general equilibrium.
- the quantity of excess demand must equal the quantity of excess supply.

(4) Suppose a flower vendor with market power is now selling 7 bouquets per hour at a price of \$10. If he cuts the price to \$9, he can sell one more bouquet per hour (that is, a total of 8 bouquets per hour). The vendor's marginal revenue for the eighth bouquet is therefore

- a. \$2.
- b. \$6.
- c. \$7.
- d. \$9.
- e. \$10.

(5) Suppose the elasticity of demand for concert tickets is -3 for customer group A, and -8 for customer group B. If the box office can charge a different price to each group, which group should get the higher price, to maximize profit?

- a. Both groups should get the same price because the marginal cost is the same for each.
- b. Group A should get the higher price.
- c. Group B should get the higher price.
- d. Cannot be determined from information given.

(6) Suppose all firms in an industry have the same marginal cost. According to the Cournot model of oligopoly, the equilibrium price will be higher,

- a. the more firms in the industry.
- b. the fewer firms in the industry.
- c. The price does not depend on the number of firms in the industry.

(7) Suppose all the firms in an industry reach an agreement to raise the product price above the competitive level and thereby maximize the sum of their profits. Then each firm has an incentive to cheat on the agreement by individually

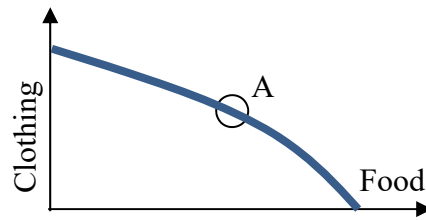
- a. increasing its price even further.
- b. decreasing its price.
- c. producing less output than its quota as specified in the agreement.
- d. all of the above.

(8) The term "differentiated products" means, in economics,

- a. the derivative of a firm's output.
- b. the derivative of a firm's revenue with respect to its output.
- c. products that are not perfect substitutes.
- d. products that a firm sells to different customers at different prices.
- e. products for which different consumers have different elasticities of demand.

II. SHORT ANSWER: Please write your answers in the boxes on this question sheet. Use margins for scratch work.

(1) [General equilibrium: 8 pts] Consider the graph at right of an economy's production-possibility curve. Assume this economy is in general competitive equilibrium at point A, where the slope of the production-possibility curve is $-1/2$.



- What is the opportunity cost of a unit of food? In other words, how many units of clothing must be given up in order to produce one more unit of food?
- What is the opportunity cost of a unit of clothing? In other words, how many units of food must be given up in order to produce one more unit of clothing?
- Consider the typical consumer's budget line with clothing on the vertical axis and food on the horizontal axis. What must be the slope of every consumer's budget line in this economy?
- If the price of a unit of clothing is \$ 6, then what must be the price of a unit of food?

| | |
|----|-------------------|
| | units of clothing |
| | units of food |
| | |
| \$ | |

(2) [Lerner index of market power: 6 pts] The Lerner index of market power is defined as the fraction of price that represents a markup over marginal cost: $L = (P-MC)/P$. Suppose the market for mobile phone service has a price elasticity of demand of -2.

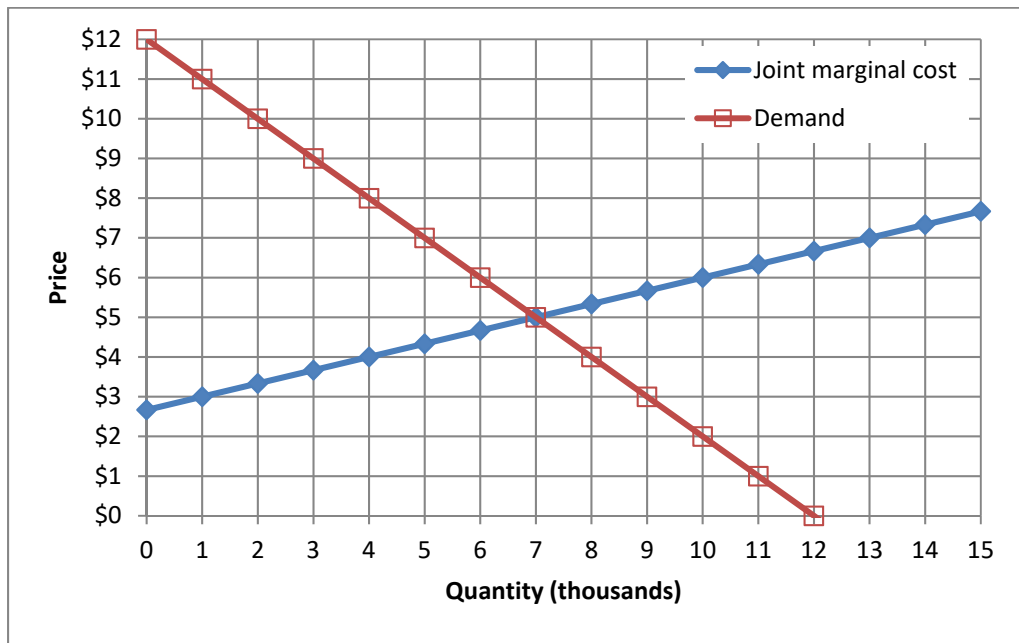
- Compute the Lerner index if this market is a symmetric Cournot oligopoly of ten firms.
- Compute the Lerner index if this market is a symmetric Cournot oligopoly of three firms.
- Compute the Lerner index if this market is a monopoly.

| |
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(3) [Comparison of models: 6 pts] In long-run equilibrium, which models predict that price equals each firm's marginal cost, and which models predict that price equals each firm's average cost? Write YES or NO in each box.

| | P = AC | P = MC |
|------------------------------|--------|--------|
| a. Monopoly. | | |
| b. Perfect competition. | | |
| c. Monopolistic competition. | | |

(4) [Collusion/joint profit maximization: 16 pts] Three firms produce vitamins. Market demand and the three firms' joint marginal cost are shown in the graph below.



First, suppose these firms engage in price competition.

- Compute competitive equilibrium market price.
- Compute competitive equilibrium market quantity.
- Compute the amount of deadweight loss.

| | |
|----|----------|
| \$ | |
| | thousand |
| \$ | thousand |

Now suppose these firms form a cartel to maximize jointly the sum of their profits. The equation for demand is $P = 12 - Q$, where $Q =$ quantity in thousands.

- Find the equation for the cartel's marginal revenue.

MR =

e. Carefully plot and label the cartel's marginal revenue curve in the graph above.

- What price will the firms jointly set?
- How much output will the firms produce, in total?
- Compute the amount of deadweight loss.

| | |
|----|----------|
| \$ | |
| | thousand |
| \$ | thousand |

(5) [Game theory: 12 pts] High-tech firms Pear and Giggle are choosing technical standards for a new handheld device. Pear prefers the “red” standard and Giggle prefers the “blue” standard. However, if they choose different standards, their products cannot interconnect and they both lose many customers. Their situation is expressed by the following game in normal form.

| | | | |
|------|------|---|---|
| | | Giggle | |
| | | Red | Blue |
| Pear | Red | Pear gets \$10 million. Giggle gets \$5 million. | Pear gets \$1 million. Giggle gets \$1 million. |
| | Blue | Pear gets \$1 million. Giggle gets \$1 million. | Pear gets \$5 million. Giggle gets \$10 million. |

- a. Which outcomes of this game (if any) are Pareto-optimal¹? Answer “YES” or “NO.”

| | |
|---|--|
| Pear plays “Red” and Giggle plays “Red” | |
| Pear plays “Red” and Giggle plays “Blue” | |
| Pear plays “Blue” and Giggle plays “Red” | |
| Pear plays “Blue” and Giggle plays “Blue” | |

- b. Which outcomes of this game (if any) are dominant-strategy equilibria²? Answer “YES” or “NO.”

| | |
|---|--|
| Pear plays “Red” and Giggle plays “Red” | |
| Pear plays “Red” and Giggle plays “Blue” | |
| Pear plays “Blue” and Giggle plays “Red” | |
| Pear plays “Blue” and Giggle plays “Blue” | |

- c. Which outcomes of this game (if any) are Nash equilibria in pure strategies? Answer “YES” or “NO.”

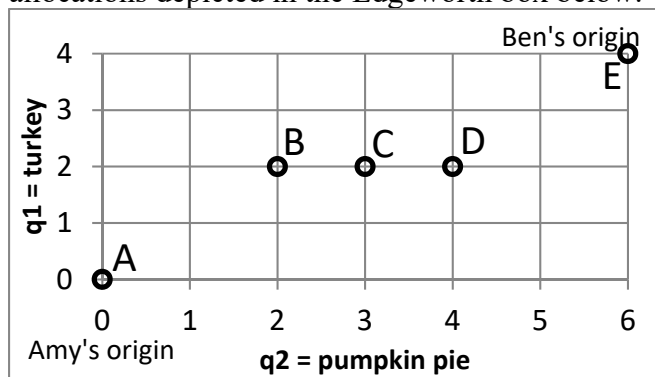
| | |
|---|--|
| Pear plays “Red” and Giggle plays “Red” | |
| Pear plays “Red” and Giggle plays “Blue” | |
| Pear plays “Blue” and Giggle plays “Red” | |
| Pear plays “Blue” and Giggle plays “Blue” | |

¹ Ignore the welfare of consumers.

² "Equilibria" is the plural form of "equilibrium."

III. PROBLEMS: Please write your answers in the boxes on this question sheet. Show your work and circle your final answers.

(1) [Exchange efficiency: 12 pts] Amy and Ben both like turkey (q_1) and pumpkin pie (q_2). Amy's utility function is $U_A = q_1 q_2^2$. Ben's utility function is $U_B = q_1 q_2$. A total of 4 servings of turkey and 6 slices of pumpkin pie must be divided between them. Consider the allocations depicted in the Edgeworth box below.



a. Is allocation A Pareto-efficient? Why or why not?

b. Is allocation B Pareto-efficient? Why or why not?

c. Is allocation C Pareto-efficient? Why or why not?

d. Is allocation D Pareto-efficient? Why or why not?

e. Is allocation E Pareto-efficient? Why or why not?

f. **Sketch and label the contract curve** in the Edgeworth box above.

(2) [Monopoly, profit maximization: 14 pts] Suppose a monopolist has total cost function given by $TC(Q) = Q + (Q^2/20)$. This monopolist faces a demand curve given by $P = 13 - (Q/20)$. Note: question continues on next page. Use graph at bottom of next page for scratch work.

- a. Find the monopolist's marginal cost function.

- b. Find the monopolist's average cost function.

- c. Find the monopolist's marginal revenue function.

- d. Compute the monopolist's profit-maximizing level of output Q_M .

- e. Compute the monopolist's profit-maximizing price P_M .

f. Compute the monopolist's profit.

g. Compute the social deadweight loss caused by the monopolist. (You may use the graph for scratch work.)



(3) [Cournot duopoly: 14 pts] Suppose two makers of a consumer good form a symmetric Cournot duopoly, each firm setting its own quantity while taking the other firm's quantity as given. Let q_1 = firm #1's quantity and q_2 = firm #2's quantity, so that total market quantity $Q = q_1 + q_2$. The market demand curve is $P = 15 - (Q/10)$. Each firm has constant marginal and average cost equal to \$3. Note: question continues on next page. Use graph at bottom of next page for scratch work.

- a. Find an expression for firm #1's revenue, as a function of its own quantity and the quantity produced by the other firm: $TR_1(q_1, q_2)$.

- b. Find an expression for firm #1's marginal revenue, as a function of its own quantity and the quantity produced by the other firm: $MR_1(q_1, q_2)$.

- c. Find an expression for firm #1's reaction function, showing how much firm #1 will produce for any given quantity set by the other firm: $q_1^* = f(q_2)$.

- d. Assume the equilibrium is symmetric (that is, assume $q_1^* = q_2^*$) and compute firm #1's equilibrium quantity q_1^* .

e. Compute total market quantity Q^* and the equilibrium price P^* .

f. Compute the combined total profit of both firms.

g. Compute the social deadweight loss.



IV. CRITICAL THINKING: Answer just *one* of the questions below (your choice). [4 pts]

(1) Reconsider the monopoly in problem (2) above. Suppose the firm is capable of setting a separate price for every unit sold, engaging in perfect price discrimination. Compute the firm's profit maximizing quantity, its revenue, and its profit. Show your work and circle your final answers. (You may use the graph for scratch work.)

(2) Reconsider the duopoly in problem (3) above. Suppose each firm maximizes its own profit while taking the other firm's *price* as given. Compute the equilibrium market quantity, the equilibrium price, and the combined total profit of both firms. Show your work and circle your final answers. (You may use the graph for scratch work.)

Circle the question you are answering and write your answer below. Full credit requires good grammar, legible writing, accurate spelling, and correct reasoning.



[end of exam]