

Economics 121
MIDTERM ANSWERS

Note that some of the answers given below delve more deeply than what would be expected on any exam. This portion is separated out and highlighted.

GENERAL INSTRUCTIONS: Write your name and your TA's name on the front cover of each of **TWO BLUE BOOKS**. The exam has 3 parts. Put Part I and Question II.1 in one blue book, and Questions II.2 and Part III in a second. The exam is worth a maximum of 100 points. Point assignments are given in the instructions for each part. You are encouraged to check your calculations on scratch paper but be certain to put all of your answers in the bluebooks.

I. TRUE or FALSE or UNCERTAIN and EXPLAIN: Choose just 4 of the following 7 statements, decide whether each is true or false or uncertain, and then explain the reasoning behind your answer in a few sentences; provide any assumptions you may think necessary to draw your conclusion. Each question is worth 7 points for a total of 28 points. Only the first 5 that appear in your bluebook will be graded.

1. For output greater than 1, the total cost function $C(Q) = \frac{1}{2} + Q + \frac{1}{2} Q^2$ has the property that $s > 1$.

FALSE, the exact opposite is true:

$$s = \frac{AC}{MC} = \frac{\frac{1}{2}(2Q) + 1 + \frac{1}{2}Q}{1 + Q} > 1 \Leftrightarrow \frac{1}{2Q} + 1 + \frac{Q}{2} > 1 + Q \Leftrightarrow \frac{1}{2Q} > \frac{Q}{2} \Leftrightarrow 1 > Q^2 \Leftrightarrow 1 > Q$$

2. If production of a good exhibits learning by doing, then a scope economy arises between the product produced at different points in time.

TRUE. Assume there are two periods and define q_1 and q_2 as output in the first and second periods, respectively. The cost of producing either output alone without the other would be the same, but when some of q_1 has been produced in the first period, then the cost of producing q_2 in the second period is lower than when q_2 is produced stand alone. To be formal, the cost of producing a positive amount q_2 in the second period compared to none at all is smaller if some of q_1 is produced, i.e., $C(0, q_2) - C(0, 0) > C(q_1, q_2) - C(q_1, 0)$. Rearranging gives $C(q_1, 0) + C(0, q_2) > C(q_1, q_2)$ which is the definition of scope economies. Note that the source of the scope economy here is not a shared input since production in the second period does not affect cost in the first, but rather a cost complementarity: more produced in the first period, the less the cost in the second.

3. A potential entrant may find it profitable to enter a Cournot oligopoly even when it has higher cost than all of the incumbent firms at every output level.

TRUE: In a Cournot equilibrium, oligopolists produce so that price is above marginal cost and also above average cost resulting in economic profits. This markup can be so large that price will be above the cost of an inefficient firm who has higher costs than all other firms. Recalling the result on duopoly with different costs that

was derived in lecture, in the book and also given in the handout “Duopoly Outcomes in a Linear World,” then inefficient firm 2 ($c_2 > c_1$) will make positive profits $(A - 2c_2 + c_1)^2 / 9B > 0$ provided it is not too inefficient: $2c_2 < c_1 + A$.

4. In a free-entry equilibrium, too many differentiated products will be supplied because each one will be produced in an amount less than its minimum efficient scale.

UNCERTAIN. This situation is modeled by Monopolistic Competition, in which free entry leads to firms continue to introduce brands as long as they can make a positive product. The result is that they produce where $p = AC$ and yet since they supply a differentiated product, $p > MC$. Consequently, they produce where $AC > MC$, i.e., below MES. However, the number of brands could be too small even though additional brands would not break even provided the additional brands generate consumer surplus sufficient to compensate the additional brands for their financial losses. The problem is that the pricing mechanism is unable to transfer all of the consumer surplus from additional brands to the firms.

5. In a Cournot oligopoly, if suddenly and unexpectedly the market demand became more price inelastic, then the industry Lerner Index will rise if the industry HHI does not change.

TRUE. Recall the expression derived for the industry Lerner Index in the textbook $L_I = \frac{HHI}{h}$ (and related to

what we called the “Fundamental Theorem of IO” in lecture: $\frac{\Pi}{PQ} = \frac{HHI}{h}$). If HHI does not change but h

decreases, then L_I must increase. In words, if the degree of concentration is held fixed, but demand for the product becomes more inelastic, then the mark up of prices over marginal costs will be higher since consumers are less willing and/or able to substitute away to other purchases.

6. If consumers take into account future sales of a good that experiences positive network externalities, the market will never face the “chicken-and-egg problem.”

FALSE. Each consumer will make their purchase decision based on the value they attach to the good but also on their expectation of how many other consumers will buy it. If each consumer expects no other consumer will purchase, then the good has no value to that consumer (assuming it has no stand alone value if no one else buys it), and so will not buy it. But then consumers’ expectations are fulfilled: no one buys because no one expects anyone to buy. Here consumers take into account of future sales and still face the chicken and egg problem, which is when no sales occur because no one will make a purchase, and no one will make a purchase because no sales occur.

7. A dominant firm’s residual demand curve becomes less price elastic as more firms enter the competitive fringe.

FALSE: As more firms enter the competitive fringe, the supply of the fringe increases, thereby decreasing the residual demand of the dominant firm. In the limit, the competitive fringe supply curve is flat at the shut down price. At that price, the dominant firm’s residual demand is also flat, or in other words, perfectly price elastic. In between, entry into the fringe makes dominant firms demand curve more elastic.

Formally, residual demand is $D_r(p) = D(p) - S_f(p)$. Differentiate by p and then multiply both sides by $-p/D_r(p)$ and we then have: $h_r = (D/D_r)h + (S_f/D_r)h_s$ where h_r is price elasticity of residual demand, h is price elasticity of market demand, and finally, h_s is the price elasticity of fringe supply. As a result, h_r is a weighted average of the other two elasticities, and as the number of fringe firms increase, the weight on the fringe supply elasticity increases while that elasticity does not.

II. MULTI-PART QUESTIONS: For each of the following two questions, answer all parts. The point assignment for each subpart is given in [square brackets]. Together, they are worth 50 points.

1. [18] Advertising is a key weapon in “the cola wars.” Suppose that Coke and Pepsi may choose a small (S), medium (M), or large (L) advertising budget. Their profits are given in the payoff matrix on the next page, where the lower left number in each cell is Coke's profit, and the upper right is Pepsi's.

- a) [3] Does Coke have any dominant strategies? Does Pepsi? Explain why they are dominant.

Neither Coke nor Pepsi has a dominant strategy. Recall that a dominant strategy is one which results in the highest payoff for each and every possible strategy that a rival could choose. Here, whether Coke chooses S, M or L, there is some action that Pepsi could choose for which Coke's chosen strategy does not yield highest payoff. The same goes for when Pepsi considers each of its three strategies.

- b) [5] Does Coke have any dominated strategies? Does Pepsi? If so, eliminate any and all of those *dominated* strategies, and decide if there are any more dominated strategies for either firm. Be sure to explain why they are dominated.

Coke does not have a dominated strategy. A dominated strategy is one which results in a payoff for each possible action chosen by Pepsi that is lower than if another strategy was chosen. For Pepsi, however, Strategy L is dominated by strategy M since: $3 > 2$, $4 > 1$, and $5 > 3$. Also, L is weakly dominated by strategy S. After eliminating strategy L for Pepsi, strategy L for Coke is then dominated by strategy M, since: $0 > -1$, and $1 > 0$. Note that no further elimination of dominated strategies is possible when the game is reduced to each firm choosing either S or M.

- c) [5] Find any and all Nash equilibria in advertising levels and for each one determine whether it is also Pareto efficient and explain why.

A Nash Equilibrium is a pair of actions, one each for Coke and Pepsi, such that neither firm could increase its profits by deviating from that strategy if the other firm did not. In this game, there are two Nash equilibria:

(S,S), since for Coke $\frac{1}{2} > 0 > -1$ and for Pepsi $4\frac{1}{2} > 3 > 2$, and

(M,M) since for Coke $1 > 0$ and for Pepsi $4 > 1$

Both are Pareto efficient since there are no other allocations which give more to at least one player without taking away from another, including the other Nash equilibrium.

A third Nash Equilibrium would come from a mixed strategy of Coke and Pepsi randomizing independently over S and M. Let p_{Coke} be the probability that Coke chooses S and p_{Pepsi} be the probability that Pepsi chooses S. Then these probabilities must satisfy the following equations

(Pepsi indifferent between S and M)

$$p_{Coke} \cdot 4\frac{1}{2} + (1 - p_{Coke}) \cdot 1 = p_{Coke} \cdot 3 + (1 - p_{Coke}) \cdot 4 \Rightarrow p_{Coke} \cdot 1\frac{1}{2} = (1 - p_{Coke}) \cdot 3 \Rightarrow p_{Coke} \cdot 4\frac{1}{2} = 3 \Rightarrow p_{Coke} = \frac{2}{3}$$

(Coke indifferent between S and M)

$$p_{Pepsi} \cdot \frac{1}{2} + (1 - p_{Pepsi}) \cdot 0 = p_{Pepsi} \cdot 0 + (1 - p_{Pepsi}) \cdot 1 \Rightarrow p_{Pepsi} \cdot \frac{1}{2} = (1 - p_{Pepsi}) \cdot 1 \Rightarrow p_{Pepsi} \cdot 1\frac{1}{2} = 1 \Rightarrow p_{Pepsi} = \frac{2}{3}$$

Therefore the *third* Nash equilibrium (remember there should always be an even number) is that each play S with probability $\frac{2}{3}$

So the average payoff for Coke would be: $\frac{4}{9} \cdot \frac{1}{2} + \frac{2}{9} \cdot 0 + \frac{2}{9} \cdot 0 + \frac{1}{9} \cdot 1 = \frac{2}{9} + 0 + 0 + \frac{1}{9} = \frac{3}{9} = \frac{1}{3}$ and the average payoff for Pepsi would be: $\frac{4}{9} \cdot 4\frac{1}{2} + \frac{2}{9} \cdot 3 + \frac{2}{9} \cdot 1 + \frac{1}{9} \cdot 4 = 2 + \frac{6}{9} + \frac{2}{9} + \frac{4}{9} = 2\frac{12}{9} = 3\frac{1}{3}$. This Nash equilibrium is dominated by (S,S) since $\frac{1}{2} > \frac{1}{3}$ and $4\frac{1}{2} > 3\frac{1}{3}$, as well as other outcomes, and so it is not Pareto efficient.

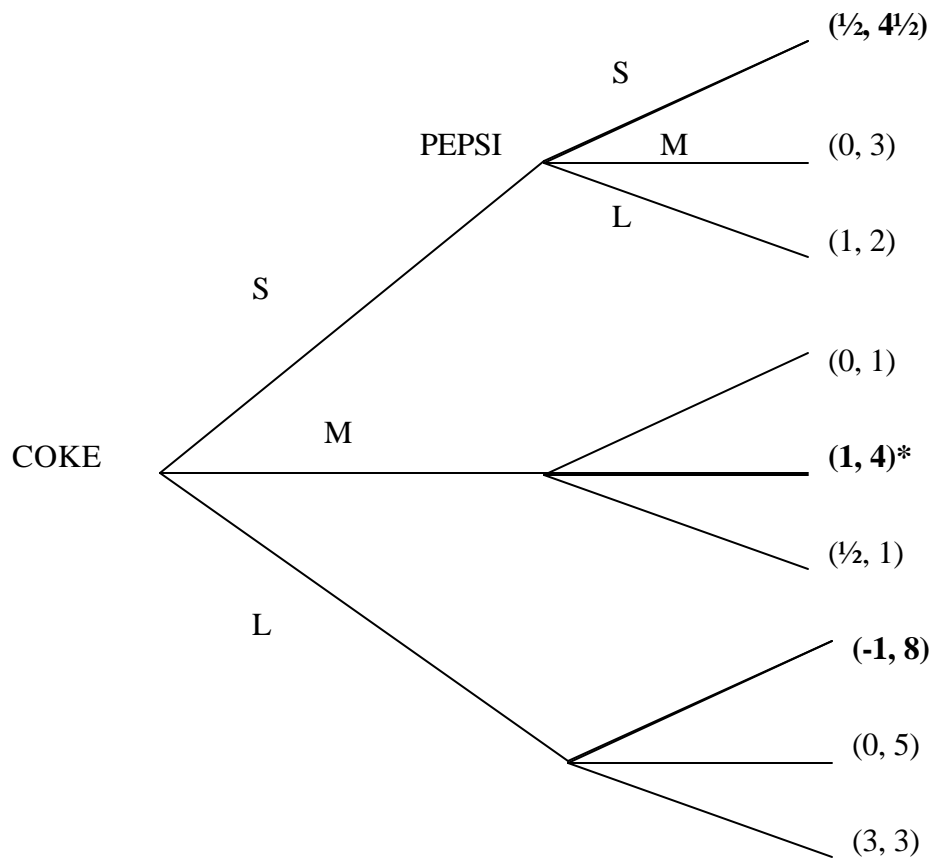
- d) [5] Suppose that Coke chooses its advertising budget first, and Pepsi follows. What is the new equilibrium? Is Pepsi harmed by assuming the role of the follower? Explain.

We solve this problem by looking at what Pepsi will do given Coke's choices.]:

If Coke chooses S, Pepsi will choose S and Coke will get $\frac{1}{2}$;
 if Coke chooses M, Pepsi will choose M and Coke will get 1; and
 if Coke chooses L, Pepsi will choose S and Coke will get -1.

Therefore Coke will choose M to maximize its payoff, and Pepsi will respond by playing M. Pepsi is only harmed by assuming the role of follower relative to the Nash equilibrium (S,S).

Finally, it is helpful to view the game in extensive form to see this result:

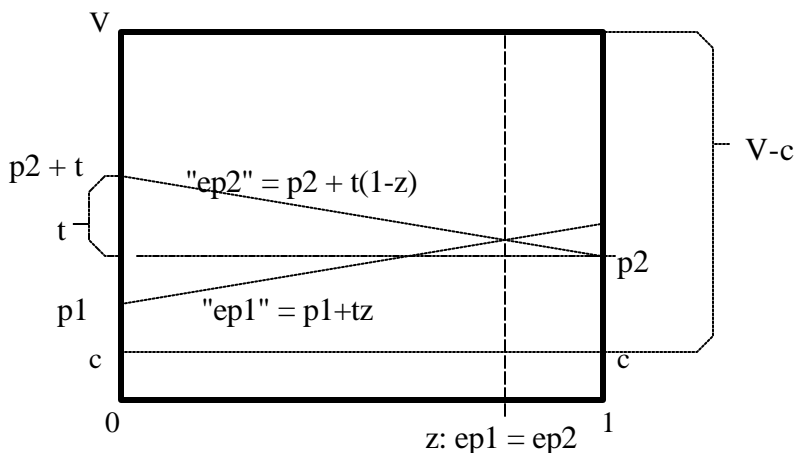


		PEPSI		
		S	M	L
COKE	S	$\frac{1}{2}$ $4\frac{1}{2}$	0 3	1 2
	M	0 1	1 4	$\frac{1}{2}$ 1
	L	-1 8	0 5	3 3

+++++ Start Your Second Blue Book +++++

2. [28] Consider the simple Hotelling model on the interval in which a monopolist owns two stores, one at each of the endpoints of Main Street, *i.e.*, at $z_1 = 0$ and $z_2 = 1$. Suppose, to begin with, that the cost of the product sold at the two stores is the same, $c_1 = c_2 = c > 0$, but that the monopolist may set different prices, p_1 and p_2 . Assume throughout that $t < \frac{1}{3}(V - c)$.

- a) [5] Draw a diagram illustrating the Hotelling town being sure to label all points and lines. In your diagram, be sure to indicate the “effective” (or “delivered”) prices for both stores (as seen by the various customers located along the line) and give algebraic expressions for those prices.



To the left is the correct drawing of the effective prices (“ep”) paid for each consumer located at some point z . The effective price is simply the sum of the list price p_1 or p_2 and the travel cost tz or $t(1-z)$, for stores 1 and 2, respectively. In other words

$$ep_1 = p_1 + tz$$

$$ep_2 = p_2 + t(1-z)$$

The drawing to the left shows one particular example where the two effective price lines cross below V which will be helpful in imagining part b). Note that while the intercepts of the effective prices at their respective origin need not be the same, the absolute value slopes of the slopes should be equal.

- b) [3] Derive the location of the “marginal consumer” as: $z = (p_2 - p_1 + t)/2t$, assuming V is large enough and p_1 , p_2 and t are small enough so that everyone in town makes a purchase.

Notice that our notation for z switches from *any* consumer to specifically the *marginal* consumer.

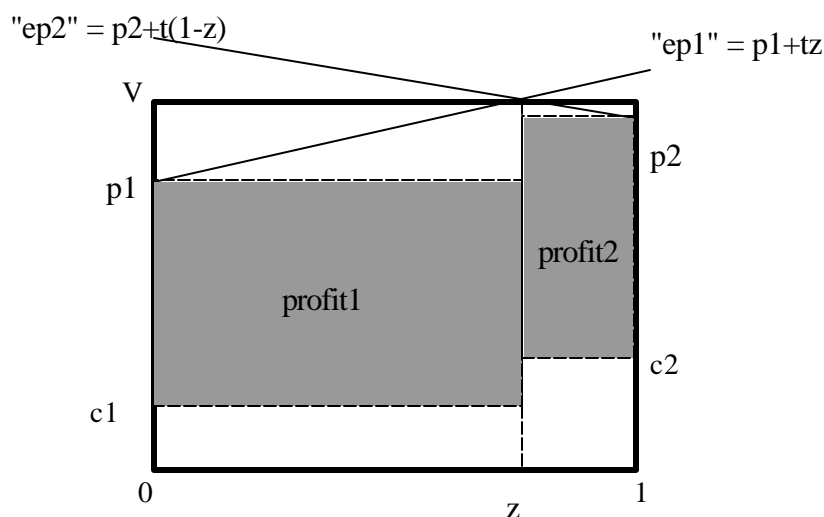
$$ep_1 = ep_2 \Rightarrow p_1 + tz = p_2 + t(1-z) \Rightarrow tz - t(1-z) = p_2 - p_1 \Rightarrow 2tz - t = p_2 - p_1 \Rightarrow 2tz = p_2 - p_1 + t$$

Simplifying, we can write: $\bar{z} = \frac{p_2 - p_1 + t}{2t}$.

- c) [6] Now let costs at the two stores differ: $c_1 < c_2$, $t < \frac{1}{3}(V - c_2) < \frac{1}{3}(V - c_1)$ Draw the Hotelling diagram again for this case, showing effective prices which will maximize the monopolist’s profits from the two stores. (Hint: choose $z = \frac{1}{2} + (c_2 - c_1)/4t$) Indicate in your diagram the profit derived from each of the two stores.

As long as everyone purchases, the monopolist will raise prices at the two stores to their maximum—any higher and the marginal consumer would decline to purchase from either store. Consequently, the marginal consumer has all of their surplus extracted: $V - p_1 - \bar{z}t = 0 = V - p_2 - (1 - \bar{z})t$. Therefore,

$V - p_1 - \bar{z}t = 0 \Rightarrow \bar{z} = (V - p_1)/t$. Substituting into the condition on p_2 , namely, $V - p_2 - t(1 - \bar{z}) = 0$, we then have: $p_2 = V - t(1 - \bar{z}) = V - t(1 - (V - p_1)/t) = 2V - t - p_1$. In that case, we can find the marginal consumer from (b): $z = (p_2 - p_1 + t)/2t = (2V - t - 2p_1)/2t = (V - p_1)/t - 1/2$. The picture looks like the one below:



Derivation of the optimal z can be found in Appendix B to Chapter 4 of the textbook. There is also shown that all consumers will make a purchase at the profit-maximizing solution when $V > t + (c_1 + c_2) / 2$.

- d) [6] Continue to assume that costs differ at the two stores, but let transportation cost t fall to zero. What happens to the monopoly prices? Does the monopolist fall victim to the “Bertrand Paradox” when setting these two prices? Explain why or why not. Would your answer change if the two stores were owned by different firms, i.e., duopolists? Explain.

Imagine that t becomes smaller; then both prices will rise which differs from the Bertrand paradox in which prices fall as differentiation between duopolists’ products diminish. In the present case, eventually the price of the low cost store will fall below the cost at the high cost store, at which point the monopolist will shut down the high cost store.

In the case of duopolists we would expect the Bertrand Paradox to occur if costs were the same, but here we have assumed $c_2 > c_1$, so we will have $p_1 \rightarrow c_2$ i.e., low cost firm sets prices at high cost firm’s cost (provided that this price level is still lower than the low cost firm’s monopoly price). Since firm 1 makes positive profits, we do not have the strict Bertrand Paradox even in the case of two firms.

- e) [4] Suppose, finally, that the location of the two stores could change. Discuss the profit incentives of moving one or both stores away from the extreme end of the Hotelling line when a monopolist owns both stores, and compare to the case when they are separately owned.

As shown lecture and derived in the textbook, the ideal position for a monopolist to locate two stores under the conditions that prevail here would be at $z_1 = 1/4$ and $z_2 = 3/4$. These locations minimize the distance the marginal consumer’s travel costs, allowing for the monopolist to charge the highest price. Therefore, the monopolist will move its stores away from the extreme endpoints, but not all the way to the middle of Main Street.

In a duopoly ownership of the two stores, each firm will also move away from the end points. They will continue to move toward their rival in an attempt to capture a larger share of the contested consumers that live between the two stores. This holds for a range of values of t . Were t to be very large, however, there would be no incentive to move toward one’s rival because then the gain in stealing customers will be more than offset by the drop off in otherwise captive customers on the other side.

III. INDUSTRY STUDIES: Answer each of the following questions about the three industries in the first half of the course, i.e., the beer, auto and breakfast cereals industries in the U.S. Point assignment is given in square brackets. This section has a total of 30 points.

1. [10] Briefly compare the time pattern of concentration in the beer and the breakfast cereal industries over the 20th century, i.e., through the 1900s.
 - Beer industry experienced steady upward trend in concentration throughout the 20th century, beginning with many, small, regional brewers and ending with a few large national brewers, with Anheuser Busch and Miller together representing two thirds of sales in the U.S. It is still the case that there are many small brewers that have limited geographic market but these are niche firms such as microbreweries. The national brewers have plants distributed throughout the country.
 - Cereal industry displayed persistently high levels of concentration throughout this century, for both the four firm and eight firm concentration ratios, with some but little turnover in the identities of the largest cereal makers. The number of plants fell steadily throughout this time.
2. [10] Choose *either* the beer or the auto industry (but not both!), describe empirical evidence of scale economies in production and indicate two likely sources of scale economies.
 - Beer: a new brewery should have capacity that is somewhat larger than about 4 million barrels per year. Several plants would be necessary to take advantage of multiplant economies that are realized by reduction in transportation costs. Distribution throughout the country enables a brewer to take advantage of the significant scale economies that derive from national television advertising. Dimensional economies from the brewing and storage of beer is one source of scale economies, along with the fixed costs (and low marginal costs) of bottling and canning facilities.
 - Autos: an efficient assembly plant would produce about 250,000 vehicles per year and would cost about \$350 million. Estimates demonstrate for General Motors that $s = 1.23$ indicating scale economies. Scale economies in auto production derive from significant fixed costs of production with a good example being the design of a new product, construction of the plant and assembly lines to produce the cars and certain equipment specific to the model (e.g., stamping presses for parts).
3. [10] Now, choose *either* the auto or the breakfast cereal industry (but not both!), and give one example of a *significant competitive entry threat* into that industry. Describe how the incumbents responded to this threat and the success of the entrants and incumbents strategies.
 - Autos: perhaps the most significant entry threat in recent years was the Japanese imports that began in the 1960s and 1970s. These were reliable, small, fuel efficient vehicles which were effective in stealing sales from the big three U.S. auto makers which had large, gas guzzlers with a record for poor quality. Detroit responded at first by seeking a variety of import controls on the Japanese imports, succeeding in persuading Washington in some cases or eliciting voluntary restraints from Japan. With time, Detroit built smaller, more fuel efficient cars, and with much more time, improved the quality record. (An entry threat still on the horizon is the alternative fuel vehicle whether it is a gas-electric hybrid, or powered by hydrogen or fuel cells.)

- Cereals: health cereal challenged the major U.S. cereal makers beginning in the 1960s. These cereals were made by small, new entrants into the cereal business, and most of them were domestic. The major cereal makers responded principally by fashioning their own version of health cereal. Very few of these brands have survived until today. They also created versions of existing brands to meet the competition, and added vitamins and minerals across all their product line to deflect the challenge. Private label cereals (or store brands) represented another competitive entry threat. In most cases the majors simply refused to make cereal for the private labels, with the exception of Ralston. In the case of Kelloggs, it created a brand (Crispix) to attack Ralston's core brands (Chex), apparently attempting to punish it for facilitating private label products.