Practice Set 5 – KEY

Strategic Competition

This set contains problems for your own practice. It is highly recommended to work on the problems on your own. Do not just read the provided solutions. Instead, try to solve the problems and use the solutions only when you cannot continue on your own. Reading problems that someone else has solved has the same value for your preparation like watching someone else running a marathon on TV and then expecting to be able to run it, too. If you have questions on this set, please ask your section's teaching assistant.

1. Firm 1 and firm 2 compete by setting quantities. Market demand is $p = 14 - Q$. Each firm has zero fixed costs and constant $MC = 2$.

   (a) Calculate the Cournot reaction functions for the two firms.

   Firm 1 sees the demand as $p = 14 - q_1 - q_2$ or $p = (14 - q_2) - q_1$. Marginal revenue will be: $MR = 14 - q_2 - 2q_1$ (same intercept – double slope only for q_1 that firm controls). $MR = MC$ implies that $14 - q_2 - 2q_1 = 2$ or $q_1 = (12 - q_2)/2$, which is the reaction function for firm 1. Because the firms are identical and symmetric (they face the same demand and cost), the reaction function for firm 2 will be the symmetrical: $q_2 = (12 - q_1)/2$.

   (b) Find the Cournot equilibrium quantities and price.

   Here we can use a "shortcut" to solve for the quantities directly. Since both firms are identical and symmetric, we already know that in the end it will be $q_1 = q_2$. Substituting q_1 for q_2 in firm's 1 reaction function yields: $q_1 = (12 - q_1)/2$ or $q_1 = q_2 = 4$. From the demand, we can calculate the price consumers are willing to pay for 8 total units of output as: $p = 14 - 8$ or $p = 6$.

   (c) Find the profit for the two firms under Cournot competition.

   Since MC is constant and FC is zero, we can figure that AC = MC (each additional unit has the same cost as the previous unit, thus each unit's cost is the same). Profit for firm 1 can be calculated as $\Pi_1 = (p - AC) \cdot q_1$ or $\Pi_1 = (6 - 2)4$ or $\Pi_1 = 16$. Because firms are symmetric, $\Pi_2 = 16$.

   (d) Find the quantities and price if the two firms collude.

   If firms collude, the demand for the cartel will be $p = 14 - Q$, where Q is the total quantity. Marginal revenue will be $MR = 14 - 2Q$. $MR = MC$ implies $14 - 2Q = 2$ or $Q = 6$. That is, $q_1 = q_2 = 3$. From the demand curve, the price can be calculated as $p = 14 - 6$ or $p = 8$.

   (e) Find the profit for the two firms under collusion.

   Profit for firm 1 can be calculated as $\Pi_1 = (p - AC) \cdot q_1$ or $\Pi_1 = (8 - 2)3$ or $\Pi_1 = 18$. Because firms are symmetric, $\Pi_2 = 18$.

   (f) If firm 1 produces its collusion quantity, what is the quantity that maximizes firm's 2 profit?

   Firm's 2 optimal reaction function is $q_2 = (12 - q_1)/2$. If $q_1 = 3$, then $q_2 = (12 - 3)/2$ or $q_2 = 4.5$.

   (g) What will be the price, if firm 2 cheats?

   If firm 2 cheats, it will produce $q_2 = 4.5$. The total quantity will be $Q = q_1 + q_2$ or $Q = 3 + 4.5$ or $Q = 7.5$. Demand yields the price at which 7.5 units can be absorbed in the market $p = 14 - 7.5$ or $p = 6.5$.

   (h) What will be the profit for each firm, if firm 1 colludes and firm 2 cheats?

   Profit for firm 1 is $\Pi_1 = (p - AC) \cdot q_1$ or $\Pi_1 = (6.5 - 2)3$ or $\Pi_1 = 13.5$.
   Profit for firm 2 is $\Pi_2 = (p - AC) \cdot q_2$ or $\Pi_2 = (6.5 - 2)4.5$ or $\Pi_2 = 20.25$.

If firm 1 believes that firm 2 is going to cheat, what quantity maximizes firm's 1 profit and what would the price be?

Firm's 1 reaction function is $q_1 = (12 - q_2)/2$. *If firm 1 suspects that* $q_2 = 4.5$, *it will set quantity* $q_1 = (12 - 4.5)/2$ *or* $q_1 = 3.75$. *Total quantity will be* $Q = q_1 + q_2$ *or* $Q = 3.75 + 4.5$ *or* $Q = 8.25$. *From the demand curve:* $p = 14 - 8.25$ *or* $p = 5.75$.

(i) What will be the profit for each firm if firm 2 cheats, while it believes that firm 1 will not cheat; and firm 1 cheats, while it believes that firm 2 will cheat?

Profit for firm 1 is $\Pi_1 = (p - AC) \cdot q_1$ *or* $\Pi_1 = (5.75 - 2)3.75$ *or* $\Pi_1 = 14.0625$.
Profit for firm 2 is $\Pi_2 = (p - AC) \cdot q_2$ *or* $\Pi_2 = (5.75 - 2)4.5$ *or* $\Pi_2 = 16.875$.

(j) Order all possible outcomes of competition, collusion, and cheating starting from the one that yields the highest profit to firm 1. Include Bertrand competition in the comparison.

i. *Firm 1 and firm 2 collude but firm 1 (alone) cheats* $[\Pi_1 = 20.25]$.
ii. *Firm 1 and firm 2 collude* $[\Pi_1 = 18]$.
iii. *Firm 1 and firm 2 collude, firm 1 cheats but firm 2 suspects it and adjusts its quantity accordingly* $[\Pi_1 = 16.875]$.
iv. *Firm 1 and firm 2 compete in a Cournot way* $[\Pi_1 = 16]$.
v. *Firm 1 and firm 2 collude, firm 2 cheats but firm 1 suspects it and adjusts its quantity accordingly* $[\Pi_1 = 14.0625]$.
vi. *Firm 1 and firm 2 collude but firm 2 (alone) cheats* $[\Pi_1 = 13.5]$.
vii. *Firm 1 and firm 2 compete in a Bertrand way* $[\Pi_1 = 0]$.

2. Firm 1 and firm 2 compete by setting *prices*. Market demand is $p = 14 - 2Q$. Each firm has zero fixed costs and constant $MC = 2$. Find the price, the profit maximizing quantities, and the profits for the two firms.

If firms compete in a Bertrand way, $p = MC = 2$. *We can use the demand curve to calculate what quantity will be sold in the market at* $p = 2$ *as* $2 = 14 - 2Q$ *or* $Q = 6$ *or* $q_1 = q_2 = 3$. *Profit for firm 1 will be* $\Pi_1 = (p - AC) \cdot q_1$ *or* $\Pi_1 = (2 - 2)3$ *or* $\Pi_1 = 0$. *Firm 2 will earn zero-profit as well.*

3. Explain what it means that "a Monopolistically Competitive firm exhibits *excess capacity* at the L-R equilibrium" and that "Monopolistic Competition allows for more firms than optimal to survive in the L-R".

The optimal scale for any firm is the one that LAC is minimized at the L-R equilibrium quantity. This occurs in PC markets because the demand for the firm is horizontal. As entry makes the demand for the firm to slide down, it always becomes tangent to LAC at the quantity q_c^*, *where LAC is at its minimum (point E). Minimum LAC means that the firm utilizes its technology at the optimal level –not too little to not take complete advantage of the economies of scale; not too much for diseconomies of scale to kick in.*

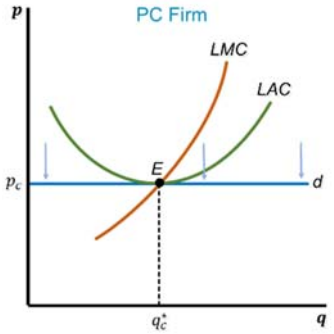

Figure 5.1

In monopolistic competition, however, the demand for the firm is somewhat negatively sloped. Thus, as entry makes D slide down in the L-R, D will not become tangent to LAC at q_c^* *(point E) but at the lower quantity* q_{LR}^* *(point B). That is, at the L-R equilibrium, each firm tends to produce less than what would minimize their LAC. So, the monopolistically competitive firm uses less than its optimal capacity* q_c^* *or in other words, it has "excess capacity" (stays at B instead of being able to produce at E).*

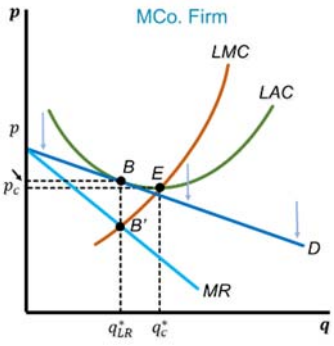

Figure 5.2

The reason why each firm ends up producing q_{LR}^* less than q_c^* is that too many firms have entered the industry in the L-R. You can view figure 5.3 as a stage before the final L-R equilibrium of figure 5.2. If less firms had entered, the demand for each firm would not have slided down all the way to meet LAC at B. If entry had stopped earlier so that $MR = MC$ occurs at point E, each firm would want to produce its optimal quantity q_c^*. At that stage of entry, however, profit is not yet zero, thus, more firms would want to enter till the firm's demand becomes tangent to LAC at B (figure 5.2). The entry of more firms will drop the profit maximizing quantity for each firm from q_c^* to q_{LR}^*. Hence, we can say that Monopolistic Competition by nature allows a higher number of firms than optimal to survive in the market in the L-R.

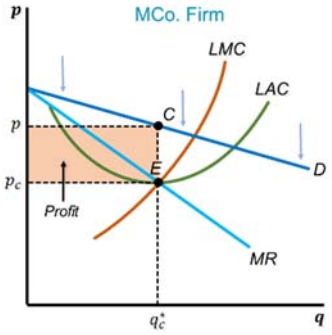

Figure 5.3

4. In the kinked-demand model, if a $1 price decrease from the prevailing price causes an increase in quantity demanded equal to 100 units, what should you expect for a $1 price increase over the prevailing price?

   In the kinked-demand model, demand is more elastic above the prevailing price and less elastic below the prevailing price. This means that a $1 increase in price causes a higher loss in sales than the gain in sales from a $1 decrease in price. Therefore, we should expect the $1 increase in price will cause quantity demanded to decrease by more than 100 units.

5. A radio commercial includes the message: "*Buy now before prices go up in October!*". Explain how this message could facilitate collusion.

   The message gives the heads up to other sellers that the seller who sends the message is intending and committing to increase prices. Other sellers may take this as an invitation to all together increase prices in October.

6. A radio commercial includes the message: "*If you find a better price, we will pay you back double the difference*". Explain how this message could facilitate collusion.

   With this message the firm commits that it will start a price war in case another firm cuts prices. Competitors will hear the message and will not want to cut their prices. If they do, they will have to deal with an even bigger price cut from the firm who published the message. The advertisement serves as a threat to a price war. Moreover, the threat is also credible because the seller has committed to all customers that will indeed answer a price cut with an even bigger price cut.

7. A radio commercial includes the message: "*We will give you the same price that we give to our own employees, no one gets a lower price than you!*". Explain how can this message facilitate collusion.

   The firm commits to rivals that it does not secretly cut prices. If this firm now offers a secret price cut to some customer and gets caught, based on this clause, it will have to compensate all other customers who got higher prices. This would cause massive damages to the firm. By broadcasting this commitment to all customers, the firm effectively self-commits that it will not cut prices.

You are kindly requested to report any *typos, mistakes* or *proposals* for the improvement of this practice set key at kmarinakis@smu.edu.sg.