MOT1421
Economic Foundations
Week Three (November 2020)

November 23, 2020

OLIGOPOLY & CHOICE OF TECHNIQUE
SELF-TEST: Answers

The self-assessment consists of 10 Questions. Each Question has a weight of 1. Your maximum score therefore is 10. A score of 6 means that you have successfully passed the test.
This self-assessment is self-scoring.

Question 1

Calculate the Hirschman-Herfindahl Index for the following two markets:

	Market A	Market B
s_1 (biggest firm)	0.55	0.40
s_2	0.25	0.34
s_3	0.06	0.22
s_4	0.05	0.01
s_5	0.04	0.01
s_6	0.03	0.01
s_7 (smallest firm)	0.02	0.01
HHI	0.374	0.3244

Market concentration is higher in market A than in market B.

Question 2

We first define total revenue of firm 1. The demand function is $P = 400 – Q = 400 – Q_1 – Q_2$. Hence total revenue of firm 1 is: $TR_1 = 400\ Q_1 – (Q_1)^2 – Q_2\ Q_1$. Accordingly, marginal revenue of firm 1 is: $MR_1 = 400 – 2Q_1 – Q_2$. Marginal cost of firm 1 is: $MC_1 = 40$. Because $MR_1 = MC_1$ (the condition for maximum profits), we obtain the following reaction function for firm 1: $Q_1 = 180 – ½\ Q_2$.

The two firms are identical – and hence the reaction function for firm 2 must be as follows: $Q_2 = 180 – ½\ Q_1$.

Substitution of the reaction function of firm 2 into the reaction function of firm 1 gives: $Q_1 = 180 – ½\ (180 – ½\ Q_1) = 90 + ¼\ Q_1 \rightarrow Q_1 = Q_2 = 120$. The equilibrium price P = 160. Joint output Q = 240.

Profits of firm 1 = TR – TC = 120 x 160 – (40 x 120 +250) = 14150. Profits of firm 2 are also 14150. Joint profits in the non-cooperative Cournot equilibrium are 28300.

Question 3

Suppose the two firms in Question 2 form a cartel. The cartel works like a monopoly firm. Hence, we get total revenue $TR = P \times Q = 400Q – Q^2$. It follows that MR = 400 – 2Q. Marginal cost remains unchanged; MC =40. From the condition that MR = MC, we get: $400 – 2Q = 40 \rightarrow Q = 180$ (which is lower than the joint output of 240 in the non-cooperative situation in Question 2).

The equilibrium price P = 220. Total revenue TR = P x Q = 220 x 180 = 39600. Total cost TC = 40 Q + 500 = 40 x 180 + 500 = 7700. Cartel profits are 31900 – which is higher than the joint profits in the non-cooperative Cournot equilibrium of 28300. The two firms therefore have an incentive to create a cartel. Each firm earns a profit of 15950, which is more than 14150 in the non-cooperative situation of Question 2.

Question 4

Suppose that firm 1 violates the cartel agreement of Question 2 and maximises profits, assuming that firm 2 will stick to the cartel agreement and continue to produce 90 (= half of Q = 180).

The reaction function of firm 1 tells us that if firm 2 is producing 90, it will be profit-maximising for firm 1 to produce: $Q_1 = 180 – ½\, Q_2 = 180 – ½ \times 90 = 135$.

Total market supply Q will become 135 + 90 = 225. The market price will become 175.

Profits of firm 1 = TR – TC = 175 x 135 – 40 x 135 – 250 = 17975.

Profits of firm 2 = TR – TC = 175 x 90 – 40 x 90 – 250 = 11900.

Joint profits in this market are 29875. Joint profits are lower than in the cartel.

Note that firm 1 is making more profit here than in the cartel, while firm 2 is making less profit than in the cartel.

Question 5

Firm 2 / Firm 1	collude in a cartel	violate the cartel agreement
collude in a cartel	15950, 15950	11900, 17975
violate the cartel agreement	17975, 11900	14150, 14150

The dominant strategy of firm 1 is to violate the cartel agreement. In the scenario in which firm 2 sticks to the cartel agreement, firm 1 will make more profits if it breaks the agreement. In the scenario in which firm 2 breaks the agreement, firm 1 will make more profit if it breaks the agreement. Hence, irrespective of the decision made by firm 2, firm 1 is best off by violating the agreement. The same is true for firm 2. The market outcome is a Nash equilibrium (14150, 14150), in which joint profits are lowest.

Question 6

Consider the following production function: $x = 2\sqrt{K\,L}$.

The equation for the production isoquant is: $K = \frac{x^2}{4L}$

Question 7

The optimal capital-labour ratio is defined as: $\frac{K}{L} = \frac{\beta}{\alpha} \times \frac{W}{R}$. Hence, we get:

$\frac{K}{L} == \frac{\beta}{\alpha} \times \frac{W}{R} = \frac{0.5}{0.5} \times \frac{4}{8} = \frac{1}{2}$, or $K = \frac{1}{2}L$.

Total cost TC = 80. This means that $TC = 80 = 4L + 8K = 4L + 8 \times \frac{1}{2}L = 8L$, which gives *L* = 10 and *K* = 5. This is the profit-maximising combination of *L* and *K*.

Question 8

Consider the standard Cobb-Douglas production function: $x = a \times L^{\alpha} \times K^{\beta}$.

- Neutral technological progress will express itself in an increase in the efficiency parameter *a*.
- Labour-saving technological progress will express itself in an increase in the ratio $\frac{\beta}{\alpha}$.

Question 9

What is the difference between technical efficiency and economic efficiency?

Technical efficiency is efficiency in an engineering sense: a given level of output is produced with minimum levels of inputs of labour and capital; there is no slack in the production process; the production process operates in the best possible technical way. All combinations of labour and capital which lie on the same isoquant (and therefore yield the same level of output) are technically efficient – and therefore strictly comparable.

Economic efficiency refers to that unique combination of labour and capital, chosen out of a set of technically efficient combinations, which leads to maximum profits for the firm.

Question 10

What is the difference between static efficiency and dynamic efficiency?

A firm is statically efficient if it chooses the profit-maximising technique of production out of a set of technically efficient techniques of production. Profit maximisation ensures that the firm will be producing at minimum cost. Crucially, the production isoquant and the underlying production function are given – and don't change. The firm chooses the best option from a given set of options.

A firm is dynamically efficient if it attempts to change the production function and the isoquant by innovation and technological progress. By investing in R&D and process innovation, the firm can succeed in shifting the isoquant down (towards the origin), which means that the same level of output can be produced with fewer inputs of labour and/or capital.

End of self-test Week 3