Written Exam for the M.Sc. in Economics 2009-II

Advanced Industrial Organization

Final Exam
Short answers

August, 2009

(4-hour closed book exam)

Please note that the language used in your exam paper must correspond to the language of the title for which you registered during exam registration. I.e. if you registered for the English title of the course, you must write your exam paper in English. Likewise, if you registered for the Danish title of the course or if you registered for the English title which was followed by "eksamen på dansk" in brackets, you must write your exam paper in Danish.

If you are in doubt about which title you registered for, please see the print of your exam registration from the students' self-service system.

ALL QUESTIONS BELOW SHOULD BE ANSWERED

1. (a) *Both Green and Porter (1984) and Rotemberg and Saloner (1986) model collusion in repeated games. Compare and contrast the two models. Be sure to describe the information structure, as well as the role that exogeneous demand shocks play in each model.*

   A verbal answer is fine, but people are also welcome to use math. The basic set up should be explained, repeated games, collusion relying on trigger strategies and that they both concern tacit collusion in markets with fluctuating demand.

   It is important that the discussion clearly reflects taht the student understand the importance of the information structure. In Green - Porter, firms do NOT observe demand before having to make a choice and they do not observe each others' choice of strategic variable. Therefore they have an inference problem, a low price in the market may reflect that someone deviated from collusive play or it may reflect slack demand. For an implict cartel to collude, it is necessary that there are punishments for deviations. Since deviations cannot be observed, punishment phases must start when the price is very low. This gives rise to the so-called price wars triggered by slack demand.

   In Rotemberg Saloner on the other hand, firms observe the state of demand before choosing their strategic variable (and they observe each others' choice of strategic variable). When demand is high the gains from deviation are very high whereas the future is intermediate (RS assume that the shocks to demand are iid over time). Hence the temptation to deviate in good times is high. In order to deter deviations, it is necessary for the cartel to price below the monopoly price (or choose an output above the monopoly output) in good periodes. In periods of low demand this is not so. Hence the prediction is tat the price is below monopoly price when demand is high.

   (b) *How might you empirically distinguish these two models?* Using the predictions above. GP predict prices below the monopoly price following slumps, RS predict prices below monopoly prices in periods of high demand. *Describe the data you would like to have and intuitively how one could test which of the two models fit*

the data best? (think about the models' predictions). Price data and data on strength of demand.

2. *The Danish competition authority has published a chapter on trade assoications' dissemination of information in order to give guidance. The DCA summarizes the implications of the competition law as follows (my translation, CS):*

   Price Information

   i. Any form of advice on prices, discounts etc. from trade associations are prohibited.

   ii. Industry Associations' announcement of maximum prices are in most cases prohibited.

   iii. Trade associations' dissemination of information about future prices are in most cases prohibited.

   iv. Trade associations' dissemination of information on current prices is normally prohibited. An exception to this may be some forms of price portals for consumers.

   v. Industry Associations announcement of historical prices can be legal if the information is sufficiently old and aggregated.

   vi. When collecting individual price information associations should ensure full confidentiality of the information.

   Sales and marketing information

   vii. Trade associations' dissemination of information, revealing single corporate future sales and production, are generally prohibited.

   viii. Industry Associations' announcement of historical sales and production information can be legitimate if the information is sufficiently old and aggregated.

   ix. When collecting individual sales and marketing information, trade associations must ensure confidentiality of information.

   Cost Information

   x. Industry Associations' dissimination of cost information is prohibited if it in any way can be perceived as a price recommendation.

xi. Trade associations should normally not publish information on individual costs, unless there is demonstrable efficiency gains, and the information is made anonymous.

General criteria

xii. Recommendations on matters that may pose significant competition parameters will usually be prohibited.

xiii. Whether information is prohibited, depends in particular on the type and age of the information, aggregation and concentration of the market, and how information is disclosed and to whom.

Discuss whether these rules are sensible or not from a competition policy perspective. They are, cf the discussion in Motta 4.2.2. (and perhaps 4.2.3.) One could relate the discussion to the Green-Porter model discussed above.

3. *An incumbent monopolist has private information about his marginal cost. His marginal cost is high, $c_H = 4$, with probability $1/2$ and low, $c_L = 1$, with probability $1/2$. A potential entrant does not know the marginal cost of the incumbent. In the first period the monopolist is alone in the market. He faces the inverse demand curve*

$$p = 10 - q$$

where q is sales and p the price. The monopolist chooses a production in the first period. This and the price is observed by the entrant, who then decides whether to enter the market. The entrant has cost $c_E = 4$. If the entrant enters the market, Cournot competition prevails and both firms set quantities. For simplicity we assume there is no discounting, so the monopolist weighs profits in the first and second periods equally high. ($\delta = 1$ if you want). The time line is as follows. In the first period, the incumbent chooses production. This is obeserved by the entrant, who then decides whether to enter or not. If he enters, he pays an entry cost equal to 2 and there is a Cournot doupoly in the market in the second period. If he does not enter, there is no entry cost paid, and the incumbent contunues as monopolist in the second period.

   (a) *Find the monopoly profits to the incumbent if he just maximizes period 1 profit, not thinking about potential entry consequences.*

Call the profit level for the high (low) cost monopolist π_H^m , π_L^m.

$$\max_q (10 - c - q) q$$

$$q^m = \frac{10-c}{2}; \pi^m = \left(\frac{10-c}{2}\right)^2$$

so that

$$\begin{aligned} q_H^m &= \frac{10-c_H}{2} = 3, q_L^m = \frac{10-c_L}{2} = \frac{9}{2} \\ \pi_H^m &= \left(\frac{10-4}{2}\right)^2 = 9; \pi_L^m = \left(\frac{10-1}{2}\right)^2 = \frac{81}{4} = 20\frac{1}{4} \end{aligned}$$

(b) *Assume that the entrant has entered the market, and has learned the incumbent's cost and solve for the Cournot equilibrium both when the incumbent has high cost and when he has low cost. Find the profits of the firms in both cases. (Hint, to avoid making essentially the same calculations twice call the cost levels c_1 and c_2, solve for the Cournot eq and insert the values $c_{1H} = 4$ and $c_{1L} = 2$ respectively and c_2 =4.). Please use the notation π_{1H} and π_{1L} for the incumbent's profits when he has high and low profits respectively and π_{2H} and π_{2L} for the entrant's profits when he faces a high cost incumbent and low cost incumbent respectively.*

$$\begin{aligned} & \max_{q_1} (10 - q_1 - q_{21} - c) q_1 \\ 10 - 2q_1 - q_2 - c_1 &= 0 \\ q_1 &= \frac{10 - q_2 - c_1}{2} \end{aligned}$$

similarly

$$q_2 = \frac{10 - q_1 - c_2}{2}$$

so in eq

$$\begin{aligned} q_1 &= \frac{10 - q_2 - c_1}{2} \\ q_2 &= \frac{10 - q_1 - c_2}{2} \end{aligned}$$

the solution is:

$$q_1 = \frac{10 - 2c_1 + c_2}{3}; q_2 = \frac{10 - 2c_2 + c_1}{3}$$

and profits are

$$\begin{aligned}\pi_1 &= \left(10 - \frac{10 - 2c_1 + c_2}{3} - \frac{10 - 2c_2 + c_1}{3} - c_1\right)\frac{10 - 2c_1 + c_2}{3} \\ &= \left(\frac{10 - 2c_1 + c_2}{3}\right)^2\end{aligned}$$

and

$$\pi_2 = \left(\frac{10 - 2c_2 + c_1}{3}\right)^2$$

so that

$$\begin{aligned}\pi_{1H} &= \left(\frac{10 - 2c_{1H} + c_2}{3}\right)^2 = \left(\frac{10 - 8 + 4}{3}\right)^2 = 4 \\ \pi_{1L} &= \left(\frac{10 - 2c_{1L} + c_2}{3}\right)^2 = \left(\frac{10 - 2 + 4}{3}\right)^2 = 16\end{aligned}$$

while

$$\pi_{2H} = \left(\frac{10 - 2c_2 + c_{1H}}{3}\right)^2 = \left(\frac{10 - 8 + 4}{3}\right)^2 = 4$$

and

$$\pi_{2L} = \left(\frac{10 - 2c_2 + c_{1L}}{3}\right)^2 = \left(\frac{10 - 8 + 1}{3}\right)^2 = 1$$

(c) *Now consider the first period, where the incumbent thinks about the possible entry conditions. Explain either in words or formally, what a separating equilibrium is. Is there a separating equilibrium where the low cost incumbent chooses the one period optimal production,* $q_L^m = 9/2$?.

It is appropriate to define a separating eq.

It consists of production for the incumbent of both types q_L, q_H, a belief fctn for the entant $\rho(q)$, mapping first period production

into belief about incumbent's type, $\rho = 1$, meaning that the entrant believes the incumbent has high cost with prob 1, $\rho = 0$ that the belief is that the incumbent is of type H with probability 0, and finally an entry strategy for the entrant $R(\rho)$, where $R(\rho) = 1$ means that the entrant enters, and $R(\rho) = 0$, that he does not.

We need to check whether the high cost incumbent would want to mimick this choice. If he would then there is not a separating equilibrium of this type.

The gain from mimiciking the choice is that the entrant would believe he is a low cost incumbent. The entrant will then only expect to earn a profit of 1 when entering. Since the entry cost is 2, he would then stay out of the market, incumbent would be alone in the next period and earn monopoly profits rather than Cournot-doupoly profits. The gain is

$$\pi_H^m - \pi_{1H} = 9 - 4 = 5$$

If the high cost incumbent chooses $q_L^m = 9/2$, the first period profit is

$$\left(10 - \frac{9}{2} - 4\right)\frac{9}{2} = \frac{27}{4}$$

hence the first period loss from choosing $q_L^m = 9/2$: rather than the one period optimal, $q_H^m = 3$ is

$$\pi_H^m - \frac{27}{4} = 9 - \frac{27}{4} = \frac{9}{4}$$

The gain outweighs the loss as

$$5 - \frac{9}{4} = \frac{11}{4} > 0$$

Hence, there is not a separating equilibrium, where the low cost incumbent chooses the one period optimal production.

(d) *Show that there is separating equilibium. Find the one, which is best for the low cost incumbent.*

(A little service information: When comparing profits, you are welcome to use the approximation $\sqrt{5} \approx 2.2$*)*

The low cost incumbent distorts production so high that the high cost incumbent will not mimick. First period production should be so high that it gives the high cost incumbent a loss equal to 5 compared with choosing hte one period optimal production. Hence the low cost incumbent's production solves

$$9 - (10 - q - 4)\, q = 5$$

$$q = \sqrt{5} + 3 \approx 5.2$$

We shall check that the low cost incumbent finds this worthwhile. The gain is that he forestalls entry in the next period, which gives a gain equal to

$$20\frac{1}{4} - 16 = 4\frac{1}{4}$$

the cost is that he does not choose the first period optimal, giving a first period loss equal to : 19.76

$$\left(10 - \left(\sqrt{5} + 3\right) - 1\right)\left(\sqrt{5} + 3\right) = 13 + 3\sqrt{5} \approx 19.7$$

Those using the suggested approximation get

$$(10 - 5.2 - 1)\, 5.2 \approx 19.8$$

Hence the first period loss is

$$\frac{81}{4} - \left(13 + 3\sqrt{5}\right) = \frac{29}{4} - 3\sqrt{5} \approx 0.5$$

Using the suggested approximation, one gets the first period loss

$$\frac{81}{4} - 19.8 \approx 0.5$$

We see that the loss is smaller than the gain, hence the low cost incumbent is willing to choose q in order to forestall entry. We conclude there is a separating eq.

There are other sep eq, where the low cost incumbent distorts his production even higher. But they give less profit, since the production deviates more from the monopoly production and the profit function is strictly concave.