Written Exam at the Department of Economics summer 2018

Industrial Organization

Final Exam

June 1, 2018

(3-hour closed book exam)

Answers only in English.

This exam paper consists of three pages in total, including this one

Be careful not to cheat at exams!

- You cheat at an exam, if during the exam, you:
- Make use of exam aids that are not allowed
- Communicate with or otherwise receive help from other people
- Copy other people's texts without making use of quotation marks and source referencing, so that it may appear to be your own text
- Use the ideas or thoughts of others without making use of source referencing, so it may appear to be your own idea or your thoughts
- Or if you otherwise violate the rules that apply to the exam

Attempt both questions.
Explain all the steps of your analysis and define any new notation that you use.
Show all the calculations that your analysis relies on.

Question 1: Vertically related firms and RPM

In a market there are two vertically related monopoly firms. The upstream firm (firm U) produces its good using a constant-returns-to-scale technology with marginal cost equal to zero. The firm chooses a linear wholesale price, denoted by w. The downstream firm (firm D) is a retailer and sells the good that the upstream firm produces to the final consumers. The demand of the final consumers is either "high", meaning that $Q(p) = 1 - p$ (where p denotes price), or "low", meaning that there is no demand at all. The probability that demand is high equals $\frac{e}{a+e}$, where $a \in (0, \frac{1}{4})$ is an exogenous parameter and $e \geq 0$ is an effort level chosen by firm D. The cost of exerting effort level e is equal to e. Firm D does not have any costs on top of the effort cost and the cost of buying the good from firm U at the (per-unit) wholesale price w. The firms try to maximize their expected profits.

The sequence of events is as follows. (i) Firm U chooses w. (ii) Knowing w, firm D chooses p and e. (iii) Demand is realized. If demand is low, there is no trade and D pays nothing to U (but incurs the effort cost e). If demand is high, D pays $(1 - p)w$ to U (and incurs the cost e).

Thus, the objective functions of D and U can be written as

$$\pi^D = (1 - p)(p - w)\frac{e}{a + e} - e$$

and

$$\pi^U = (1 - p)w\frac{e}{a + e},$$

respectively.

Answer the following questions:

(a) Solve for the subgame-perfect equilibrium values of p and e.

- You do not need to show that the second-order conditions are satisfied (and you will not get any credit if you nevertheless do that).

Suppose the firms integrate and become one single firm. One can show that then the subgame-perfect equilibrium values of the consumer price and the effort level are given by $p^I = 1/2$ and $e^I = \sqrt{a}\left(1 - 2\sqrt{a}\right)/2$, respectively.

(b) Are the values of p and e that you derived in part (a) larger or smaller than, or equal to, the corresponding values under integration stated above (i.e., p^I and e^I)? Explain the economic logic for why we have those relationships. Answer verbally only. Moreover, would you expect expected consumer surplus to be largest under integration or under non-integration? Spell out your reasons and the logic. Answer verbally only. *You are encouraged to attempt these questions even if you have not been able to solve part (a).*

Suppose now that, as under (a), the firms are not integrated. Moreover, the retail price p is now chosen *not* by firm D at stage 2, but by firm U at stage 1 (we can interpret this as resale price maintenance, RPM). Everything else in the model is unchanged. Denote the equilibrium values of the price and the effort level in this model by p^R and e^R, respectively.

(c) Derive an expression for p^R and relate this to p^I. Moreover, solve sufficiently much of the model in order to learn which one of the statements (i)-(iv) below is true.

- (i) $e^R < e^I$ for all $a \in (0, \frac{1}{4})$.
- (ii) $e^R > e^I$ for all $a \in (0, \frac{1}{4})$.

(iii) $e^R = e^I$ for all $a \in \left(0, \frac{1}{4}\right)$.

(iv) Whether e^R is smaller or larger than e^I depends on the value of a.

You do not need to show that the second-order conditions are satisfied (and you will not get any credit if you nevertheless do that).

Question 2: Strategic delegation

Consider a market in which there are two firms, firm 1 and firm 2. The firms produce identical products and they face the following indirect demand function: $p = 45 - 9(q_1 + q_2)$, where p is market price, q_1 is firm 1's output, and q_2 is firm 2's output. Both firms' marginal cost of producing the product is constant and equal to 9, and there are no fixed costs. Moreover, the firms compete in quantities. Firm i $(i = 1, 2)$ is owned by individual O_i and managed by some other individual M_i. Each owner O_i can give an instruction to his or her own manager M_i whether to try to maximize the firm's profits or its revenues. The sequence of events of the game is as follows:

1. O_1 and O_2 simultaneously choose whether to instruct its manager to maximize profits (P) or revenues (R).

2. M_1 and M_2 observe their own instruction and the other manager's instruction. Then they simultaneously choose their own firm's output, trying to maximize either the profits or the revenues (depending on the instruction they received).

The objective of each owner is to maximize their own firm's profits.

(a) Solve for all subgame-perfect Nash equilibria of the game described above.

(b) Interpret your results: What is the economic logic that explains why the owners make the choices they make in the equilibrium (or the equilibria) that you derived? Are the managers' choice variables strategic substitutes or strategic complements, and what is the significance of this? What is the significance of the assumption that each manager can observe also the other manager's instruction before making

the output decision? *[You are encouraged to attempt part (b) even if you have not been able to answer part (a).]*

End of Exam