

cover page for a written examination/test

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Students are expected to conduct themselves properly during examinations and to obey any instructions given to them by examiners and invigilators. Firm action will be taken in the event that academic fraud is discovered.

Each question should be answered on TU exampaper, each furnished with the candidate's name and ANR number. If candidates are unable or unwilling to answer a question, they must nevertheless submit a sheet of paper containing details of their name and ANR, together with the number of the question concerned. The 6 digit ANR number is printed on the TU card.

- Candidates are allowed to use a calculator, but no books or notes.
- This exam consists of 3 questions.
- Candidates must write clearly.
- Candidates must convince us that they understand the material of this course. Motivate your answers!
- There is no reason to panic! If you feel that you miss relevant information to answer a question, state this explicitly and assume the information that you need. Then we can see whether we can give points for this.
- If you don't write anything, we cannot give you any points!

Question 1 (50 points)

Consider a market with two social networks, 1 and 2, each giving away for free to users their social network services and selling advertising slots to advertisers. The two publishers know that demand for advertising depends not only on the price charged for it but also on the number of users of their social services, since an ad in a social network which is used more is more likely to lead to higher sales for an advertiser.

Assume demand for advertising on social network 1 is given by:

$$(1) q_1^a = -p_1^a + 2q_1^u$$

while demand for advertising on social network 2 is given by:

$$(2) q_2^a = -p_2^a + 2q_2^u$$

where p_1^a and p_2^a are advertising prices on social network 1 and 2 respectively, q_1^a and q_2^a are advertising quantities while q_1^u and q_2^u are the number of users of each social network.

The owners of the two social networks also know that people who use social networks value them more if they include fewer ads.

Assume demand for use of social network 1 is given by:

$$(3) q_1^u = 20 - \frac{1}{2}q_1^a + \frac{1}{4}q_2^a$$

while demand for use of social network 2 is given by:

$$(4) q_2^u = 20 - \frac{1}{2}q_2^a + \frac{1}{4}q_1^a$$

Further assume that the main strategic choice owners make is about the price of advertising. Also assume that the marginal cost of serving a user or an advertiser is constant and equal to zero for both firms.

- (a) (5 points) Using equations (1)-(4) show that demands for advertising (q_1^a and q_2^a) and usage (q_1^u and q_2^u) as functions of p_1^a and p_2^a can be written as:

$$q_1^a = 80/3 - 8/15 * p_1^a - 2/15 * p_2^a$$

$$q_2^a = 80/3 - 2/15 * p_1^a - 8/15 * p_2^a$$

$$q_1^u = 7/30 * p_1^a - 1/15 * p_2^a + 40/3$$

$$q_2^u = 7/30 * p_2^a - 1/15 * p_1^a + 40/3$$

- (b) (5 points) Are the two social networks substitutes, complements or independent products for advertisers? And for users? Why?
- (c) (5 points) Using the equations obtained in (a) write down the profit functions and the first order condition for profit maximization for each of the owners of the two social networks and calculate the equilibrium prices and quantities.

Now suppose the two owners want to merge their business. First, consider a merger which maintains open the two social networks but centralizes decisions.

- (d) (5 points) Using the equations obtained in (a) write down the profit function and the first-order conditions for profit maximization for the monopolist and calculate the equilibrium prices and quantities.
- (e) (5 points) Would the price of an ad increase or decrease with the merger? Why? Would consumers benefit from the merger?

Then, consider a merger which results in the closing down of one of the two social networks, leading to a demand for use of the surviving social network equal to:

$$(5) q^u = 40 - \frac{1}{2}q^a$$

and a demand for advertising on that social network equal to

$$(6) q^a = -2p^a + 4q^u$$

- (f) (5 points) Using equations (5)-(6) derive demands for advertising q^a and usage q^u as functions of p^a only.
- (g) (5 points) Using the equations obtained in (f) write down the profit function and the first-order condition for profit maximization for the monopolist and calculate the equilibrium price and quantity.
- (h) (5 points) Would the price of an ad increase or decrease with such a merger compared to the pre-merger situation and compared to the merger which would maintain both? Would consumers benefit from the merger? Why? What type of market is this?
- (i) (5 points) Suppose the EU antitrust authority (i.e. DG-Competition at the Commission) claimed that, since users do not pay for using social networks, there is only one relevant market to be defined, i.e. the one for advertising, and one should thus look at the likelihood of unilateral effects for advertisers only. Would you agree? Why?
- (j) (5 points) DG-Competition is currently investigating the merger between Facebook and What's App. What does the exercise above say about the way one should investigate such a merger? How would you change the exercise to make it better fit such a real merger?

Question 2 (35 points)

Consider an industry with 3 firms. Industry demand is of the form $p = 6 - Q$ where $Q = \sum_{i=1}^3 q_i$ denotes total output. Firms produce a homogeneous good with zero marginal costs and zero fixed costs. If the firms do not collude, they compete in prices (Bertrand competition).

- (a) (5 points) Show that the monopoly price in this industry equals 3 and the monopoly profit 9.

Let $\delta \in \langle 0, 1 \rangle$ denote the firms' discount factor. Firms try to form a cartel which charges the monopoly price from now on.

- (b) (5 points) Show that the discounted profit of sticking to the cartel equals $\frac{3}{1-\delta}$. Why is this increasing in δ ? [hint: we want the intuition here, not a derivative]
- (c) (5 points) Show that a tit-for-tat strategy can sustain the cartel if $\delta \geq \frac{2}{3}$.

From now on assume that $\delta = \frac{2}{3}$. Further, instead of facing constant demand, we consider the case where the firms face industry demand that varies over time. There are two demand states. In the high demand state, demand is of the form $p = 8 - Q$. In the low demand state, it is of the form $p = 4 - Q$. The probability of the high demand state is $1/2$ and demand states are independently drawn over time. Hence the expected demand intercept equals $\frac{1}{2}8 + \frac{1}{2}4 = 6$ which is the demand intercept we considered above. Firms first observe this period's demand state and then they set their prices for this period. When setting the price for this period, firms do not know the demand realization for next period (nor for periods thereafter).

- (d) (5 points) Show that monopoly profits in the industry are either 16 or 4, depending on the realization of the demand state.
- (e) (5 points) Derive the following two incentive compatibility constraints to sustain collusion in this industry.

$$\frac{16}{3} + \frac{\delta}{1-\delta} \frac{10}{3} \geq 16$$

$$\frac{4}{3} + \frac{\delta}{1-\delta} \frac{10}{3} \geq 4$$

- (f) (5 points) Show that with $\delta = \frac{2}{3}$ it is not possible to sustain collusion in this case.
- (g) (5 points) In which demand state does collusion break down? Explain why.

Question 3 (15 points)

Here we consider the use of exclusive contracts by an upstream incumbent to keep out an upstream entrant. In particular, assume that the upstream firm offers a contract to a downstream firm specifying a price p_{+1} at which the downstream firm has to buy next period (if this firm accepts the contract). As the entrant cannot sell to a downstream firm that accepted this contract, entry becomes harder.

- (a) (5 points) Explain the Chicago argument why such contracts cannot be used by the incumbent to prevent a more efficient entrant from coming into the market next period. Be clear about the assumptions that you need to make this argument.
- (b) (5 points) Suppose that there is one incumbent and one downstream firm. At the moment that the incumbent makes its offer to the downstream firm, the cost level of the entrant is not yet known. Outline a model where the incumbent can use exclusionary contracts to make it harder for the entrant to enter. Explain the difference with (a).
- (c) (5 points) Suppose that there are two downstream firms. Is exclusion of a more efficient entrant possible in this case? Explain why (not).