Exam ECON4820 spring 2023

Instructions: This exam consists of two essay questions and two mathematical problems. They are all weighted equally towards the final grade on the exam. Please answer all questions. Show all your work for the mathematical problems, as partial credit may be awarded. You have three hours to complete this exam.

Question 1 – Essay

Describe the practice of competition authorities and their role in regulating the economy. Discuss the key principles they follow as well as the tools they use to analyze and enforce competition laws.

Answer

Key principles followed by competition authorities

- Consumer welfare: Focus on promoting consumer benefits through lower prices, better quality, and increased choices. Maybe contrast this with the total welfare criterion.
- Market efficiency: Encourage efficient resource allocation and productive efficiency
- Fair competition: Prevent anti-competitive behavior and maintain a level playing field for all market participants

In class we have primarily discussed two roles:

- Merger screening and enforcing the merger rules
- Investigating and policing illegal cooperation between firms (cartels and collusion)

In addition, policing the abuse of market power is important, but we haven't discussed it that much in class.

Tools that we have discussed

- Economic analysis: Applying economic theories and models to assess the impact of business practices on competition
- Market investigations: Gathering information about market structure, conduct, and performance to identify competition problems
- Legal enforcement: Imposing fines, sanctions, or remedies to correct anti-competitive behavior

Question 2 – Essay

Compare and contrast the Cournot (quantity) and Bertrand (price) models of competition. Discuss their underlying assumptions, key differences, and the implications of these differences for market outcomes.

Answer

First, they should

- Briefly introduce the Cournot and Bertrand models of competition

- Explain the focus of each model (quantity competition in Cournot, price competition in Bertrand)

The assumptions they should include, are

- Cournot
    - Firms choose output levels simultaneously
    - Goods are perfect substitutes
    - Firms take competitors' output levels as given
    - Prices are determined endogenously in the model ("by a hidden auctioneer")
- Bertrand
    - Firms choose prices simultaneously
    - Goods are perfect substitutes, and consumers buy from the cheapest supplier
    - Firms take competitors' prices as given
    - Consumers determine how much each firm sells (or produces)

Key differences between Cournot and Bertrand models

- Strategic variable: Quantity in Cournot, price in Bertrand
- Reaction functions: Cournot firms react to changes in competitors' output, Bertrand firms react to changes in competitors' prices
- Actions are strategic substitutes in Cournot, strategic complements in Bertrand
- Equilibrium outcomes: Cournot model results in higher prices and lower quantities compared to Bertrand model
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Implications for market outcomes

- Market efficiency: Bertrand competition tends to result in more competitive prices, driving firms closer to marginal cost pricing and increasing allocative efficiency
- Profitability: Firms in a Cournot equilibrium earn higher profits than those in a Bertrand equilibrium

Rule of thumb: The least flexible variable should be thought of as the strategic one; package holiday industry competes in quantity (book planes and hotels long in advance) while the mail order business competes in prices (determine prices, prints them on paper and mails them out long in advance)

Question 3 – Model-based, sequential moves

Consider a market where two firms, Firm L and Firm F, produce differentiated goods. The demand functions for both firms are given by:

$$\begin{aligned} q_L &= a - p_L + bp_F \\ q_F &= a - p_F + bp_L \end{aligned}$$

where q_L and q_F are the quantities produced by Firm L and Firm F, respectively, and p_L and p_F are the prices they charge.

Moves are made sequentially, not simultaneously. Firm L moves first and acts as the leader, and Firm F is the follower. Both firms have a constant marginal cost of production, given by 0. Assume throughout that $a = 1$ and $b = \frac{1}{2}$.

a) Determine the reaction functions for Firm L and Firm F. Even if you are unable to solve the problem mathematically, you get partial credit for stating the problems, explaining how you would solve them and what you expect to find.

Answer:

Here, the problem was not sufficiently clear, but we assume that firms maximize profits with respect to prices.

The follower solves $\max_{p_F} p_F(a - p_F + bp_L) \Rightarrow p_F^* = \frac{a}{2} + \frac{b}{2}p_L$

The leader solves $\max_{p_L} p_L(a - p_L + bp_F^*) = \max_{p_L} p_L(a - p_L + b\left(\frac{a}{2} + \frac{b}{2}p_L\right)) \Rightarrow p_L^* = \frac{a(2+b)}{2(2-b^2)}$

b) Calculate the equilibrium prices, quantities, and profits for both firms with sequential moves. Even if you are unable to solve the problem mathematically, you get partial credit for stating the problem, explaining how you would solve it and what you expect to find.

Answer:

p_L^E is the same as p_L^* above. Insert to get $p_L^E = \frac{1\left(2+\frac{1}{2}\right)}{2\left(2-\frac{1}{4}\right)} = \frac{20}{28}$. Then insert into p_F^* to get $p_F^E = \frac{1}{2} + \frac{1}{4}P_L^E = \frac{1}{2} + \frac{5}{28} = \frac{19}{28} < p_L^E$. (Here, it is possible to reason that $\frac{1}{2} + \frac{1}{4}p_L^E$ is smaller than p_L^E even if one can't compute it. Anyways, $p_L^E > p_F^E$.

Quantities can be readily inserted:

$$q_L^E = 1 - p_L^E + bp_F^E = 1 - \frac{20}{28} + \frac{1}{2} * \frac{19}{28} = \frac{35}{56}$$
$$q_F^E = 1 - p_F^E + bp_L^E = 1 - \frac{29}{28} + \frac{1}{2} * \frac{20}{28} = \frac{38}{56}$$

So $q_F^E > q_L^E$.

Finally, profits are computed as follows:

$$\pi_L = p_L^E q_L^E = \frac{19}{28} * \frac{35}{56} = \frac{665}{1568}$$
$$\pi_F = p_F^E q_F^E = \frac{20}{28} * \frac{38}{56} = \frac{760}{1568}$$

So, the follower makes higher profits.

c) Explain the strategic advantage of being the leader. Who sets the higher price? Who sells the most units? Who makes the highest profits?

See above. When competing in prices, there is a second-mover advantage since the follower can undercut. The leader will set a price above what he would have set under simultaneous moves. The follower slightly undercuts him, sells more units and makes higher profits.

Question 4 – Model-based, network effects

In this problem we consider a market in which there are network effects. This means that (part of) the utility a consumer derives from consuming a good, depends on how many other consumers consume that same good. The network effect is, however, not equally important to all consumers. Assume that consumer i derives net utility $u_i = a + b_i n^e - p$ when the good is for sale at price p and he expects n^e consumers to buy. The parameter b_i measures the importance of the network effect to consumer i. Assume $b_i \sim U[0,1]$. In total there are $\mathrm{N} = 1$ consumers. Each consumer buys if and only if $u_i \geq 0$. Assume that the consumers all share the same expectations, n^e. Let n denote the share of consumers who actually choose to buy the good at price p and with an ex ante expectation that n^e consumers would buy it.

a) Derive the parameter b of the indifferent consumer and demonstrate that the inverse demand curve is given by $p = a + n^e - nn^e$.

Answer:

- The indifferent consumer has $u_i = 0 \Leftrightarrow a + \hat{b}n^e = p$, or $\hat{b} = \frac{p-a}{n^e}$
- All consumers with $b \geq \hat{b}$ will buy $\Rightarrow n = 1 - \hat{b}$

$$n = 1 - \frac{p-a}{n^e}$$
$$\frac{p-a}{n^e} = 1 - n$$
$$p = a + n^e - nn^e$$

b) Derive the profit-maximizing price the producer of this network good would set when he has a fixed expectation n^e.

Answer:

- Invert inverse demand to get $n(p) \;=\; 1 - \frac{p-a}{n^e}$
- Solves $max\ (p-c)n(p)$
- $p = \frac{a+c+n^e}{2}$

c) Compute the producer's optimal price for the parameters $a = \frac{1}{4}, n^e = \frac{1}{2}, c = \frac{1}{8}$.

This gives us $p = \frac{\frac{1}{4}+\frac{1}{2}+\frac{1}{8}}{2} = \frac{7}{16}$

d) Explain the concept of self-fulfilling equilibria.

Answer:

Here, the problem should have been clearer that we mean the "fulfilled expectations-equilibrium" discussed in the book and in the lecture.

- Since expectations matter, these have to be taken into account in forming the equilibrium.
- One option is to assume that ex ante expectations have to be correct.
- If we assume that n^e is equal to the realized n, no matter what, then we get the self-fulfilling expectations equilibrium.

e) Derive the equilibrium number of consumers (in terms of n) when the consumers expectations are self-fulfilling, for the fixed price derived in answer a). Discuss how it relates to the producer's initial expectations.

Answer:

- $n(p) = 1 - \frac{p-a}{n^e}$
- Set $n^e = n$ and solve for n to get $n^2 - n + (p - a) = 0$
- The quadratic formula is $n = \frac{1 \pm \sqrt{1-4(p-a)}}{2}$, where $p - a = \frac{3}{16}$
- This gives us $n = \frac{1}{2} \pm \frac{1}{4}$, or $n = \frac{1}{4}$ and $n = \frac{3}{4}$.

When the producer expects $\frac{1}{2}$ to buy, he sets the price $p = \frac{7}{16}$. But at that price, either fewer or more consumers end up buying. The price is too high to support $n = \frac{1}{2}$ if the consumers' expectations are low (leading to $n = \frac{1}{4}$) or too low to restrain demand at $n = \frac{1}{2}$ if the consumers' expectations are high (leading to $n = \frac{3}{4}$).