Industrial Organization - Final Exam

Paris Dauphine University - Master Industries de Réseau et Economie Numérique (IREN), December 2024

Jérôme MATHIS (LEDa)

Duration: 105 mn. No document, no calculator allowed.

Exercise 1. Stackelberg Competition in the Telecommunications Industry (10 pts).

Two firms, Firm A and Firm B, are competing in the market for providing broadband internet services. These firms must decide how much they will invest in building the necessary infrastructure to offer high-speed internet to consumers. The market demand for internet services is given by the following inverse demand function:

$$P(Q) = 100 - Q$$

where P is the price of the internet service and Q is the total quantity of internet services provided to consumers, which is the sum of the quantities provided by both firms, $Q = q_A + q_B$. Firm A is the leader and makes its decision about how much infrastructure to build (quantity q_A) first. Firm B, which benefits from a competitive advantage on costs, but as a new entrant is a follower, observes Firm A's decision and then decides its own investment level (quantity q_B). The cost functions for the firms are as follows:

Firm A (leader): $C_A(q_A) = 20q_A + 10$.

Firm B (follower): $C_B(q_B) = \frac{C_A(q_B)}{2}$.

a) **(2 pts)** *Derive the reaction function of Firm B.*

b) **(2 pts)** *Determine Firm A's best response.*

c) **(2 pts)** *Determine the equilibrium quantities for both firms.*

d) **(2 pts)** *Calculate the market price and the profit for each firm.*

e) **(2 pts)** *Compute the total consumer surplus and total social welfare in this Stackelberg competition.*

Exercise 2. Product differentiation (10 pts).

Consider the two stages game in which two players, firm 1 and firm 2, compete in quality and price as follows:

Stage 1: Both firms simultaneously choose a quality $\theta \in [\underline{\theta}, \bar{\theta}]$;

Stage 2: Both firms simultaneously choose a price.

Firm i, $i \in 1, 2$, produces a good of quality θ_i, and charges a price p_i. The unit cost of production is c. Let us order the firms such that if $\theta_1 \neq \theta_2$ then $\theta_1 < \theta_2$. For a given pair of qualities (θ_1, θ_2) where $\theta_1 < \theta_2$, the reaction and residual demand functions are given by:

$$p_1(p_2, \theta_1, \theta_2) = \frac{p_2 + c}{2}$$

$$p_2(p_1, \theta_1, \theta_2) = \frac{1 + c + \theta_2 - \theta_1}{2}$$

$$D_1(p_1, p_2, \theta_1, \theta_2) = \min\{1; \frac{p_2 - p_1}{\theta_2 - \theta_1}\}$$

$$D_1(p_1, p_2, \theta_1, \theta_2) + D_2(p_1, p_2, \theta_1, \theta_2) = 1$$

1) (1 pt) *Give the pure strategy Nash equilibrium of the price competition (for a given pair of qualities (θ_1, θ_2) where $\theta_1 < \theta_2$).*

2) (1 pt) *To which situation would correpond the price equilibrium resulting from identical qualities?*

3) (1 pt) *Give a graphical representation of this price equilibrium in the (p_1, p_2) space.*

4) (1 pt) *Graphically illustrate how the price equilibrium would move with an increase in quality differentiation.*

5) (1 pt) *What are the corresponding residual demands and profits?*

6) (1 pt) *Assume the quality is costless. Give a pure strategy Nash equilibrium of the quality choice.*

7) (1 pt) *Give the two-stage game equilibrium and corresponding profits. Does this equilibrium exhibits minimal or maximal differentiation?*

8) (1 pt) *Is this equilibrium unique? Explain.*

9) (1 pt) *Is the whole equilibrium subgame perfect? Explain.*

10) (1 pt) *Why do firms use product differentiation?*