Industrial Organization - Final Exam

Paris Dauphine University - Master Quantitative Economics, April 2024

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22 pts = 20 pts + 2 bonus pts

Duration: 90 mn. No document, no calculator allowed.

Exercise A. Repeated Monopolistic Competition (9 pts)

Three firms are in monopolistic competition for producing goods that are imperfect substitutes. They choose their prices simultaneously. Consumers' demand for the firm i, with $i = 1, 2,$ and 3, is written as $q_i = 100 - 3p_i + \sum_{j \neq i} p_j$, where p_i denotes firm i's price. We assume production costs are zero.

A.1) (2 pts) *What is firm i's optimal price p_i^* given its pair of competitor prices? Solve the Nash equilibrium of the stage game. (Hint: Begin by summing the optimal prices chosen by each firm $p_1^* + p_2^* + p_3^*$.) What are the associated profits?*

A.2) (2 pts) *Find the strategies and profits associated with the "cooperative" solution that would maximize the total profit. (Hint:It suffices to solve for a symmetric price p.)*

A.3) (2 pts) *Consider now the corresponding infinitely repeated game. Let δ_i denote firm i's discount factor. Define a trigger strategy that may sustain cooperation at equilibrium.*

A.4) (3 pts) *Show that there are values of δ_i $(i = 1, 2, 3)$ such that cooperating at every stage sustain a subgame perfect Nash equilibrium. Give the corresponding strategies and value for δ_i $(i = 1, 2, 3)$.*

Exercise B. Socially Excessive R&D in Patent Race (13 pts)

Consider two firms in competition that can engage in a R&D patent race for new product development. Suppose the marginal cost of production is zero. Firms choose simultaneously on whether to engage in R&D. The fixed R&D cost is $f \geq 0$. A firm that choose not to engage in R&D makes zero profit. A firm that engages in R&D successfully obtains a patent with probability ρ. The inverse demand function for a good that results from a successful R&D innovation is $p(Q) = 1 - Q$, where Q denote the aggregate output.

B.1) (2 pts) *What are the monopoly price p^m, quantity q^m, and profit π^m of a firm that successfully engages in R&D while its rival does not? What is the resulting consumer surplus CS^m?*

B.2) (2 pts) *Under Bertrand competition, what are the duopoly price p^B and profit π^B of a firm that successfully engages in R&D as its rival? What is the resulting aggregate output Q^B? What is the resulting consumer surplus CS^B?*

B.3) (2 pts) *Under Cournot competition, what are the duopoly quantity q^C of a firm that successfully engages in R&D as its rival? What are the resulting aggregate output Q^C, price p^C, and firm's profit π^C? What is the resulting consumer surplus CS^C?*

B.4) (1 pt) *Under Bertrand competition, what is the threshold on the R&D cost, f_2^B, below which both firms conducting R&D is a Nash equilibrium?*

B.5) (2 pts) *Under Cournot competition, what is the threshold on the R&D cost, f_2^C, below which both firms conducting R&D is a Nash equilibrium? Is this condition less or more demanding than the one obtained under Bertrand competition? Explain.*

B.6) (2 pts) *From society's point of view, when is it optimal to have one research division (i.e., only one firm conducting R&D) rather than two under Bertrand competition? Are there levels of R&D cost f and probability ρ that lead firms to over-invest in R&D compared to what is socially optimal?*

B.7) (2 pts) *Same question under Cournot competition.*