

Industrial Organization - Exercises Chapter 4

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Exercise 1. Socially Excessive R&D in Patent Race

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 engages in R&D is successful (it obtains a patent) with probability ρ . A firm that choose not to engage in R&D, or is unsuccessful in R&D, stays inactive (it generates no profit and no consumer surplus). 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.

1) 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 ?

2) 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 ?

3) 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 ?

4) 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?

5) 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.

6) 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?

7) Same question under Cournot competition.

Exercise 2. R&D cooperation

Consider an industry of two symmetric firms which compete in a two-stage game. Initially, both firms have the same marginal cost $c > 0$.

At the first stage, firms choose research and development (R&D) to maximize joint profits. More precisely, at the first stage, each firm $i \in 1, 2$ chooses an amount x_i by which it reduces his marginal cost. $c_i(x_1, x_2) = c - x_i - \beta x_j$, where $\beta \in [0; 1]$ is the spillover coefficient. The associated expenditure $r(x_i)$ does not need to be specified for solving this exercise.

At the second stage, firms compete in quantity. The inverse demand is given by $p = a - q_i - q_j$.

1) Does the second-stage competition yield strategic complement or substitute? Draw the resulting second-stage reaction functions when the two firms engage in R&D according to the pair (x_1, x_2) .

2) What are the duopoly quantities q_1^C and q_2^C when the two firms engage in R&D according to the pair (x_1, x_2) ? What are the resulting aggregate output Q^C , price p^C , and firm's profits π_1^C and π_2^C ?

3) Assume firm i increases x_i by one unit, having the effect of switching from the Cournot equilibrium C to a new Cournot equilibrium denoted as E in the figure of question 1). Give the coordinates of points C , D , and E , where D denote the intermediate point situated at the intersection of the new firm i 's reaction curve and the old firm j 's reaction curve. Under which condition on the spillover coefficient $\beta \in [0; 1]$ is point E situated above of point C ? Give an economic interpretation.