Industrial Organization - Exercises Chapter 2

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Exercise 1. Market transparency and product differentiation (C. Schultz, Economics Letters, 2004)

We consider a Hotelling market with a continuum of consumers. Consumer x is located at $x \in [0, 1]$. A consumer buys exactly one unit of the good. There are two firms, A and B. First firms simultaneously choose locations, a and $1 - b$, on the unit interval, w.l.o.g. $a \leq 1 - b$. Second firms simultaneously compete in price. We want to adapt the model to markets where product characteristics as well as prices are not obvious to all consumers, for instance because the good is an experience good, or because the good's characteristic and the pricing are "complicated" as is the case with insurance policies, internet access or mobile phones. Hence we assume some consumers are uninformed about the firms' locations, and only learn these when buying. There are two different types of consumers: a fraction φ are informed about both firms' prices and locations, while a fraction $1 - \varphi$ are uninformed. The variable φ is our measure of market transparency, the higher is φ, the more transparent is the market. Both information types are uniformly distributed on locations. We will concentrate on symmetric equilibria where half of the uninformed consumers consume from firm A. A parameter $t > 0$ measures the "intensity" of product differentiation, we denote it the transportation cost and we assume that it is quadratic. We assume both firms' costs are equal to zero. Denote p_i the firm i's price and D the firm A's demand.

1) *Give the location x of the informed consumer who is indifferent between buying from firm A and B.*

2) *Write the firms' demands.*

3) *Write the firms' maximization programs at the competing stage.*

4) *Show that the price that maximizes firm A's program satisfies:*

$$D + \varphi p_a \frac{\partial x}{\partial p_a} = 0$$

5) *Using the previous equation and its analogous for firm B, show that*

$$p_a^*(a, b, p_b) = \frac{2t(1 - a - b)}{\varphi} - p_b$$

(Hint: Do not expand D)

6) *Give a system of equations (without solving it) that yields the Nash equilibrium in price.*

In the following, we use that the Nash equilibrium in price is given by

$$p_a^*(a, b) = \frac{(1 - a - b)(\varphi(1 + a - b) + 2 + (1 - \varphi))}{3\varphi} t$$

$$p_b^*(a, b) = \frac{(1 - a - b)(4 + \varphi(b - a - 1) + (\varphi - 1))}{3\varphi} t$$

Also, we assume the functions

$$f(a) = \frac{\partial x}{\partial a} + \frac{\partial x}{\partial p_b} \frac{\partial p_b}{\partial a} \quad ; and \quad g(b) = \frac{\partial (1-x)}{\partial b} + \frac{\partial (1-x)}{\partial p_a} \frac{\partial p_a}{\partial b}$$

are both equal to zero when $a = b = \frac{7\varphi-9}{8\varphi}$ and positive (resp. negative) for lower (resp. higher) values of a and b.

7) *What is the location at equilibrium ?*

Now we assume firms can locate outside the city and can choose their location on the whole real line.

8) *What is the location at equilibrium ?*

9) *What is the effect of increasing market transparency on product differentiation, prices and profits ?*

Exercise 2. Product differentiation : Transparency in Circular City (C. Schultz, Economics Letters, 2009)

We consider a differentiated market à la Salop (1979) where a continuum of consumers are located on a circle with circumference one, and firms compete in two stages. First, firms simultaneously choose whether or not to enter in the market. Second, they simultaneously choose their prices given their location. Finally, the consumers choose from which firm to buy one unit of the good.

A large number of firms with outside opportunity zero can enter the market at a cost of f. Maximum differentiation is exogenously imposed. The firms that choose to enter are (exogenously and automatically) located equidistant from one another on the circle. With n firms in the market, the distance between two neighboring firms is $1/n$. Marginal costs are constant and normalized to zero.

A consumer buys at most one unit of the (differentiated) good. If she buys at the price p from a firm, located x away from her, her utility is

$$V = u - p - tx$$

where $u > 0$ is the reservation price, and $t > 0$ is the transportation cost, reflecting the consumer's "pickiness". For simplicity, we assume transportation cost t is sufficiently high so that at least two firms enter the market and the firms' price strategies are pure.

1) *(1 pt) Characterize the distance $x \in (0, (1/n))$ from which the located consumer is indifferent between purchasing from firm i, who charges price p_i, and purchasing from i's closest neighbor, who charges price p_j.*

To reflect the lack of market transparency, we assume all consumers know firms' locations, but only a fraction, $\varphi \in (0, 1]$, is informed about the firms' prices. Both information types are uniformly distributed on the circle. We assume that the market is covered. An uninformed consumer buys from the nearest firm, whatever its price. Each firm will get the demand from half of the uninformed consumers located in between it and its neighbors.

We solve the model backwards. We assume n firms have entered in the first period. We focus on symmetric equilibria of the second period, where all firms charge the same price.

2) *Give firm i's total demand when it charges price p_i and the two firms neighboring firm i charge the same price p. We denote it as $D(p_i, p, \varphi, n)$.*

3) *Give firm i's second stage profit (the entry cost is sunk), when it charges price p_i and other firms charge the same price p. We denote it as $\pi(p_i, p, \varphi, n)$.*

4) *(Give firm i's optimal price when other firms charge the same price p. We denote it as$p_i^*(p, \varphi, n)$.*

5) *Give the symmetric equilibrium in price and the corresponding profit, denoted as $p^*(\varphi, n)$ and $\pi^*(\varphi, n)$. How do they vary with the measure of transparency φ, and the number of firms n ?*

We now solve for the firms' entry choice in the first period.

6) *How many firms will enter the market at equilibrium ? We denote it as* $n^*(\varphi)$. *How does it vary with the measure of transparency* φ *?*

7) *What is the equilibrium price at the equilibrium number of firms* $n^*(\varphi)$, *denoted as* $p^*(\varphi)$ *? How does it vary with the measure of transparency* φ *?*

8) *What is the net effect of an increase in transparency on consumers' average utility, V ? Give an interpretation.*

9) *Which number of firms would choose a social planner, denoted as* n^{FB} *? Compare this number to the competitive solution. Which level of transparency would choose the social planner, denoted as* φ^{FB} *?*

10) *Can we conclude that an increase in transparency with respect to the competitive solution leads to a Pareto improvement ?*