Written Exam for the B.Sc. in Economics summer 2011

Industrial Organization

Final Exam

August 15, 2011

(3-hour closed book exam)

Please note that the language used in your exam paper must correspond to the language of the title for which you registered during exam registration. I.e. if you registered for the English title of the course, you must write your exam paper in English. Likewise, if you registered for the Danish title of the course or if you registered for the English title which was followed by “eksamen på dansk” in brackets, you must write your exam paper in Danish.

If you are in doubt about which title you registered for, please see the print of your exam registration from the students’ self-service system.

Attempt both questions

Question 1

In a market there are two firms that produce a homogeneous good and compete in prices. Firm i's ($i = 1, 2$) price is denoted p_i. Demand in the market is given by $D(p) = 1 - p$, where $p = \min\{p_1, p_2\}$. Firm i's marginal cost is constant and equal to $c \in \left[0, \frac{1}{2}\right)$. Hence, Firm 1's demand is

$$D_1(p_1, p_2) = \begin{cases} 1 - p_1 & \text{if } p_1 < p_2 \\ \frac{1}{2}(1 - p_1) & \text{if } p_1 = p_2 \\ 0 & \text{if } p_1 > p_2, \end{cases}$$

and analogously for Firm 2. The firms' profit functions are therefore

$$\Pi^1(p_1, p_2) = (p_1 - c) D_1(p_1, p_2) \qquad \text{and} \qquad \Pi^2(p_1, p_2) = (p_2 - c) D_2(p_1, p_2).$$

The game is one-shot (i.e., it is played only once), and the firms choose their prices simultaneously.

a) Solve for the Nash equilibria of the model described above.

b) Now modify the model described above as follows. Assume that the firms are *capacity constrained*: firm i's marginal cost is constant and equal to c up to the production level $\overline{q}_i$; however, any quantity larger than $\overline{q}_i$ is impossible to produce. The capacities do not exceed one-third:

$$\overline{q}_1 \in \left(0, \frac{1}{3}\right] \qquad \text{and} \qquad \overline{q}_2 \in \left(0, \frac{1}{3}\right].$$

Assume efficient rationing and that $c = 0$ (exactly as we did in the lecture and as Tirole does). Prove that both firms charging the price

$$p^* = 1 - \overline{q}_1 - \overline{q}_2$$

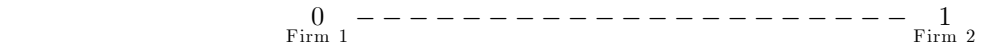
is a Nash equilibrium.

c) Explain (i) what kind of model Kreps and Sheinkman (Bell Journal of Economics, 1983) studied and (ii) what result they could show. Also, (iii) discuss the limitations and implications of their analysis and result.

Question 2

The following is a model of informative advertising. It is similar to the one that we studied in the course, but here it is assumed that a consumer learns about the existence of *both* firms if seeing an ad from only one of the firms.

There are two firms that are exogenously located at each end of Hotelling's linear city (as illustrated below).



The consumers are uniformly distributed on the line. They have so-called unit demand, meaning that they want to consume at most one unit of the good that the firms sell. Their preferences are modelled exactly as in Tirole's version of the model. A consumer has the option to buy from firm i if and only if she has been reached by an ad that informs her about the existence of that firm (details to be explained below). The firms have a constant marginal cost of production, denoted by c; their cost of advertising equals $\frac{a}{2}\Phi_i^2$; and their objective is to maximize their profits.

The timing of events is as follows.

1. Each firm i chooses its price, p_i, and how much to advertise, Φ_i. The choices of p_1, p_2, Φ_1 and Φ_2 are made simultaneously.

2. The consumers observe the stage 1 choices and then make their consumption decisions.

Assume that the parameters are such that the market is covered. Then one can verify (as we did in the course) that the *full information* demand that firm 1 faces equals

$$\overline{\theta} = \frac{p_2 - p_1 + t}{2t},$$

while firm 2's full information demand equals $1 - \overline{\theta}$. As in the model in the course, Φ_i equals the fraction of consumers who are reached by firm i's ad. However, here it is assumed that firm i's ad informs the consumer about the existence of *both* firms. As a consequence, a consumer will either know about both firms or about no firm, and the fraction of consumers who are reached by the ad from at least one of the firms equals

$$1 - (1 - \Phi_1)(1 - \Phi_2) = \Phi_1 + \Phi_2 - \Phi_1\Phi_2.$$

Firm i's profit can therefore be written as

$$\Pi^i = (p_1 - c) D_i(p_1, p_2, \Phi_1, \Phi_2) - \frac{a}{2}\Phi_i^2,$$

where $D_i(p_1, p_2, \Phi_1, \Phi_2)$ is firm i's *actual* demand (as opposed to its full information demand), i.e., the number of consumers who actually choose to buy from firm i.

a) Write down the expressions for each firm's actual demand (as a function of $\overline{\theta}$, Φ_1 and Φ_2).

b) Solve for the equilibrium prices and advertising levels.

c) In Tirole's version of the model, which we studied in the course, the equilibrium profit levels are

$$\Pi_1 = \Pi_2 = \Pi = \frac{2a}{\left[1 + \sqrt{\frac{2a}{t}}\right]^2}.$$

We have $\frac{\partial \Pi}{\partial a} > 0$; that is, a firm's equilibrium profits go up if advertising becomes more costly. Discuss this comparative statics result and, in particular, explain the logic behind it.

END OF EXAM