# UNIVERSITY OF DELHI

## M.A. Economics: Summer Semester 2019-2020

## Course 801: Industrial Organization

**Maximum marks: 70** **Time: 2 ½ hours**

**Instructions:** Check that this question paper has 3 pages, with questions numbered 1 to 4. Answer Question 1 and any ***two*** other questions. Read the questions carefully before answering. Keep your answers short and precise, *taking care to explain the relevance of the assumptions wherever appropriate in your mathematical derivations*.

1. (COMPULSORY) *Note that parts (a), (b) and (c) are independent of each other.*

(a) A mass of $M$ identical consumers, each having inelastic unit demand with willingness to pay $v$ are uniformly distributed on a line segment of unit length. Two firms with identical and constant marginal cost $c < v$ are located at the extremes of the line segment. A consumer located at distance $d$ from a firm can buy its product by paying the price plus *quadratic* 'transport costs' of $td^2$. Assume that $v$ is high enough to rule out the possibility of non-purchase by any consumer. In this context,

i) Determine whether prices are strategic substitutes or complements.

ii) Derive the prices and the value of the Hirschman-Herfindahl index in a Bertrand-Nash equilibrium.

(b) Two identical firms produce a homogenous product and compete in prices. They compete in every period over an infinite horizon, with identical discount factors given by $\delta$. The Nash equilibrium of the stage game is the Bertrand Paradox. Both firms operate in two markets (A and B) which are identical in demand, but in Market A prices are observed with no lag, whereas in Market B prices are observed after a lag of one period. That is, any deviation from a collusive price in period 1 can be punished in one or both markets with effect from period 2 if the deviation occurs in Market A, but only from period 3 if it occurs in Market B. Derive the critical minimum discount factors that can sustain tacit collusion with equal sharing of monopoly profits, using grim trigger strategies with Nash reversion, in the following cases:

i) The firms treat the two markets as independent.

ii) The firms use cross-market retaliation to exploit multimarket contact. Show that this increases the likelihood of collusion in Market B, but not in market A.

(The following approximations may be helpful in solving for the roots of the quadratic equations that may arise in the course of your derivations: $\sqrt{½} = 0.71$, and $\sqrt{17} = 4.12$)

(c) A monopolist manufacturer produces a product with marginal cost $c < 1$ and sells it at a wholesale price $w$ to a monopolist retailer, who then resells it to consumers at a retail price $p$, without incurring any retail costs. Final demand is given by $D(p) = 1 - p$. Derive the equilibrium values of $w$ and $p$. Then show that vertical integration of the manufacturer and retailer will reduce the price for consumers. Finally, if the firms do not integrate, specify in term of the parameter $c$ how the vertically integrated outcome can be implemented by: (i) a two-part tariff and (ii) resale price maintenance

(10 each)

2. Two firms play an infinitely repeated game, with discount factor $\delta$. In any period, they can either collude, earning $\pi^c$ each, or compete, earning the Nash equilibrium profit $\pi^n$ each. Deviation from collusion earns $\pi^d$ for the deviating firm, but it is punished by a grim trigger strategy with Nash reversion from the next period. Collusion requires communication, which creates evidence which lasts for that period only. There is an antitrust agency that audits the industry and finds the evidence with probability $\rho < 1$. This results in a fine $F$ on each firm, including a deviating firm. However, $\pi^c - \rho F > \pi^n$, so auditing by itself is not sufficient to deter collusion. The firms start colluding again from the next period even after a successful audit, but evidence is generated again for that period, which can be discovered by audit with the same probability. In this setting, answer the following questions:

(a) Set up and explain the incentive-compatibility condition that will sustain collusion in equilibrium. Then derive the critical minimum value of the discount factor $\delta^*$ required to sustain collusion. Show that either a higher fine $F$, or a higher probability of a successful audit $\rho$, can reduce but not eliminate the range of discount factors that can sustain collusion.

(b) Suppose the antitrust agency offers a reward $R$ to a firm that reports the evidence. (Note that $-\rho F < R \leq 0$ implies a reduced fine, while $R > 0$ implies positive reward.) The firms use Nash reversion to deter such reporting. Set up and explain the new incentive-compatibility condition that will sustain collusion in equilibrium. Then show that higher rewards can reduce the range of discount factors that can sustain collusion. Hence calculate the minimum value of the reward that will eliminate it completely.

(c) Discuss the credibility issues that the agency might face in implementing the reward scheme, if the minimum reward in part (b) is large and positive?

(8, 8, 4)

3. An incumbent monopolist 'I' with constant marginal cost $c_I \in (0, 1]$ is faced with a potential entrant 'E' who can produce exactly the same product with constant marginal cost $c_E < c_I$ and fixed entry cost *e*. Both firms sell to one or two buyers, who have *identical inelastic unit demands with willingness to pay equal to 1*. Before the entrant makes its entry decision, the incumbent can offer buyers an exclusive dealing contract with some compensation *m*, but no damages for breaking the contract. If entry occurs, there is Bertrand competition in homogenous products between I and E, otherwise the incumbent remains a monopolist. All cost and demand parameters are common knowledge. In this context, examine the validity of (i) the 'Chicago critique', according to which exclusive dealing contracts can never be anti-competitive (assume only one buyer); (ii) the Segal and Whinston 'divide and conquer' strategy, according to which an exclusive dealing contract offered to a single buyer can be anti-competitive (assume two buyers, and the entrant has to be able to sell to both of them to cover its entry costs). (NOTE: You can make any diagrams or additional assumptions required to derive the results, *but no marks will be given for solutions based on price-elastic demand*.)

(10, 10)

4. Firm 1 is a monopolist producer of good A. It can launch a different good B, which is already being produced by firm 2. Goods A and B are independent in demand, but the versions of good B produced by firms 1 and 2 are perfect substitutes for each other. Both A and B are characterized by inelastic unit demands with consumers' valuations $r_a$ and $r_b$ respectively, which are uniformly and independently distributed on the interval [0, 1]. All goods have zero marginal cost, but good B requires a fixed cost $f > 0$ to be paid by any firm that produces it. All cost and demand parameters are common knowledge.

(a) Will firm 1 launch good B if it can only be sold independently of good A? Give reasons for your answer.

(b) Suppose firm 1 can offer consumers a bundle comprising one unit each of A and B, at a combined price of $p_{ab}$. Firm 2 can offer only B at price $p_2$. With the help of a suitable diagram, derive the demand functions of the two firms in terms of $p_{ab}$ and $p_2$.

(c) Use the demand functions from part (b) to derive each firm's best response function in ($p_{ab}$, $p_2$) space. Calculate the slope of *either one* of these functions to determine whether these prices are strategic substitutes or strategic complements.

(4, 8, 8)