Problem Set #6

Due November 14, 2001

1. Tirole ex. 7.3 p. 284. Also, use an example to show that if integer constraints on $n$ are taken into account in the model there can be too little entry.

2. In the following question we will refer to "Entry and Competition in Concentrated Markets" by Bresnahan and Reiss (JPE 91) as BR.

(a) In BR the authors define an entry threshold $S_k$ as the level of demand (population) necessary for the $k$th firm to enter a market. They use the ratios of entry thresholds to infer the extent of competition in the markets they study, a series of geographically isolated markets for services, mostly. What assumptions about the firms' costs must the authors make? Let $s_k = S_k/k$. What can one infer if all of these ratios are equal, i.e. $s_1 = s_2$, $s_2 = s_3$, etc.? What was their basic finding about the change in firm conduct as the number of firms increases? Would you expect the empirical results to be similar for markets where the goods are more differentiated than the ones they studied?

(b) In a later paper, using panel data on the location of rural dentists' practices, Bresnahan and Reiss find that exit thresholds are well below entry thresholds. What does this finding imply about the costs faced by rural dentists? In BR the authors only observe population and number of firms in a cross section (and, in particular, do not observe population at the time when entry occurred). What bias might this cause in estimating $S_1$? How could it affect our interpretation of BR?

3. Consider a standard model of horizontal differentiation involving two firms and consumers who are uniformly distributed on $[0, 1]$ with the consumer at location $x$ receiving utility $v_0 - tx - p_0$ if he purchases from the firm at location 0, $v_1 - t(1 - x) - p_1$ if he purchases from the firm at location 1 and zero if he purchases from neither firm.
    (a) Suppose we model advertising by firm 1 as raising $v_1$. Does advertising make firm 1 tough or soft?
    (b) Suppose instead we model advertising as increasing the degree of differentiation in the market without affecting the consumers' rankings of the goods, *i.e.* suppose it increases t. Does advertising make firm 1 tough or soft?
    (c) Suppose instead that customers initially do not necessarily know of the existence of both products (say each potential customer is informed about each product only with probability $p$ and that these probabilities are independent so that a consumer knows about both products with probability $p^2$) and can not purchase a product they do not know about. In this model suppose the effect of advertising by firm 1 is to increase the probability with which customers know of the existence of firm 1. Does advertising now make firm 1 tough or soft?

4. Consider an incumbent monopolist facing a threat of entry by a potential entrant. In the

first period, the incumbent can lobby the government to require extensive testing of the output, which boosts marginal cost to both the incumbent and the entrant. When the incumbent spends $L$ on lobbying the regulations which get passed result in profit functions of the form $\pi_i(x_I, x_E) = (x_i - cL)(1 - 2x_i + \text{Min}\{x_{-i}, 1\})$, where $i = I, E$ refers to the incumbent or entrant and $x_i$ is the price firm $i$ chooses in the second stage. Suppose also that after observing $L$ the entrant decides whether or not to enter the market and pay a fixed cost of $E$.

For what values of $E$ is entry accomodated/deterred? What level of $L$ is chosen in each case?

5. Consider the following model of brand proliferation. A continuum of consumers (of mass 1) are located around a circle of radius one. In the first period, firm 1 has the opportunity to introduce any number $N$ of brands and position them anywhere it likes around the circle. The cost of doing this is $NE_1$. Firm 2 then chooses whether to enter, in which case it introduces and positions a single brand at a cost of $E_2$. If firm 2 enters, assume that there is differentiated product price competitions with consumers having value $v - td$ for a product located at a distance $d$ from them.

(a) If firm 1 introduces two brands at points which are opposite each other on the circle, and firm 2 introduces a single brand half way between two of these show that the equilibrium prices and profits are $p_1 = 7t/12$, $p_2 = 5t/12$, $\pi_1 = 49t/144 - 2E_1$, $\pi_2 = 25t/144 - E_2$. Explain intuitively why firm 1 chooses a higher price than firm 2.

(b) Find values of $v$, $t$, $E_1$, and $E_2$ for which firm 1 would choose $N = 1$ if entry were not possible, but "overinvests" in brand proliferation and chooses $N = 2$ in this model to deter entry.

(c) Suppose we added a third stage to this game where firm 1 could withdraw any of its brands if it desired before price competition occurs (but not get back the sunk costs of introducing the brands). Given the parameter values from part (b) show that if firm 2 were to introduce a brand located in exactly the same place as one of firm 1's brands, then firm 1 would in equilibrium withdraw that brand. What does this imply about the feasibility of entry deterrence through brand proliferation?

6. (a) Consider a game in which two firms simultaneously choose actions $a_1$ and $a_2$ to maximize their profit functions $\pi_1(a_1, a_2)$ and $\pi_2(a_1, a_2)$. Suppose that $\pi_i(a_i, a_{-i})$ is concave in $a_i$ and that the game has an unique interior Nash equilibrium. Show that the game has strategic complements if $\frac{\partial^2 \pi_i}{\partial a_i \partial a_j} > 0$ and strategic substitutes if $\frac{\partial^2 \pi_i}{\partial a_i \partial a_j} < 0$.

(b) Use the result above to show that Cournot competition with linear demand has strategic substitutes. (If you're curious try using the result above to find a demand curve for which this isn't true.)

(c) Consider a model of differentiated product price competition where two firms with a constant marginal cost of $c$ compete by simultaneously setting prices $p_1$ and $p_2$ and firm $i$'s demand is $D_i(p_i, p_j) = A - bp_i^2 + dp_j$. When is this a game with strategic complements and when is it a game with strategic substitutes?