University of Minnesota
Department of Economics
Ph.D. Preliminary Examination
INDUSTRIAL ORGANIZATION
Spring 2013

May 23, 2013
10:00 a.m.-2:00 p.m.

Answer any three of the following four questions. The answers will be equally weighted in the examination grade. Your copy of the exam should have 6 pages including this cover page.

Analytic solutions can be derived for some of the problems this examination contains. If the algebra involved proves too cumbersome, however, essentially full credit will be given for careful explanations of the steps that could be followed to derive analytic solutions. If you feel that additional assumptions are required before a unique solution to the problem can be found, specify what they are and why you need them.

Please indicate clearly which questions and which part of the question you are answering. Note also that irrelevant material, even if correct, will receive no credit.


Question 1

Perfect Price Discrimination. There are \( n \) firms indexed by \( j \) and an “outside good” labeled by 0. Each firm \( j \geq 1 \) has constant marginal cost equal to \( c_j \). There is a unit measure consumers. Let \( i \) index an individual consumer and suppose the utility of consumer \( i \) from purchasing good \( j \) and paying price \( p_{i,j} \) has utility

\[
U_{i,j} = \xi_j - \alpha p_{i,j} + \varepsilon_{i,j} \quad \text{for} \quad j = 1, 2, \ldots, n
\]

\[
= \varepsilon_{i,0} \quad \text{for} \quad \text{good } 0.
\]

A consumer is therefore summarized by his or her vector of draws \( \varepsilon_i = (\varepsilon_{i,0}, \varepsilon_{i,1}, \ldots, \varepsilon_{i,n}) \) since consumers are otherwise the same. Assume the \( \varepsilon_{i,j} \) are drawn type 1 extreme value which delivers the logit choice probabilities.

We allow for perfect price discrimination. Each firm observes the entire vector of draws \( \varepsilon_i \) for each consumer \( i \) and can set prices contingent on \( \varepsilon_i \) (i.e. can set a price \( p_{i,j} \) specific to individual \( i \)). The \( n \) firms compete in a Bertrand fashion for each individual consumer.

1. Take as given the \( n \) firms in the industry and calculate the equilibrium of price competition when perfect price discrimination is feasible. Derive formulas for the market shares of each firm.

2. A potential entrant is considering entry into this industry. If it comes in, it will be firm \( j = n + 1 \), and consumers will all get a new logit draw \( \varepsilon_{i,n+1} \) for this firm. The firm has given values of \( \xi_{n+1} \) and \( c_{n+1} \). If the firm enters, it pays a fixed cost \( \phi_{n+1} \). Derive a condition determining whether the firm enters. Discuss the connection between the private incentive for firm \( n + 1 \) and the social incentive. That is, how does the total of producers and consumers surplus change if the firm enters?

3. Discuss how your answer to part (2) would change if firms were required to set a uniform price instead of being able to practice perfect price discrimination. Connect your discussion about the efficiency of entry to a paper in the literature, for example, Mankiw and Whinston (1986).
Question 2

Suppose the inverse demand in an industry is \( P(Q_t) = A - Q_t \). There are two firms. Let \( q^t_j \) denote the output of firm \( j \) in time \( t \) so that \( Q^t = q^t_1 + q^t_2 \). Marginal cost is zero. However, there is a fixed cost \( \phi > 0 \) that must be incurred when output is positive. When a firm moves and picks output, the output choice is fixed for two periods. Assume the fixed cost \( \phi \) is paid in first of the two periods when the firm sets a positive output level. Firms alternate in moves, with firm 1 picking in odd periods and firm 2 picking in even periods.

1. Suppose there are two periods, \( t = 1, 2 \). In period 1, firm 1 sets \( q^1_1 = q^1_2 \) and firm 2’s output is initially fixed at \( q^1_2 = 0 \). In period 2, firm 2 picks \( q^2_2 \). Let \( \beta \) denote the discount factor. Characterize the subgame perfect equilibrium of this game. Determine how the equilibrium sequence of outputs varies with the parameter \( \beta \) and the fixed cost \( \phi \). Explain the intuition for why the equilibrium sequence of outputs varies with \( \beta \) and \( \phi \).

2. Suppose there is an infinite horizon. The two firms alternate moves, firm 1 picking its location in odd periods, firm 2 in even periods, so the decisions are fixed for two periods. Suppose the fixed cost \( \phi \) for a positive output choice that must be paid by the firm whose turn it is to move is a random variable drawn i.i.d. each period from a continuous distribution \( F(\phi) \) with support \([0, \infty)\). Define a Markov-perfect equilibrium for this game.

3. Completely work out the solution for the problem of part 2 under the assumption that \( \beta = 0 \). Next discuss how allowing for \( \beta > 0 \) changes the nature of the solution. In particular, when \( \beta > 0 \), what additional things need to be taken account in the firm’s decision problem?
Question 3

One formulation of the compensating variation measure of a new good’s value to society is written as the difference in the consumers’ expenditure function $e(\cdot)$ before and after the introduction of the good, holding utility constant at the post-introduction level $u_1$. Denoting the new good as $N$ we have:

$$CV = e(p_0, p_N^*(p_0), P, u_1) - e(p_1, p_N, P, u_1)$$

(1)

where $p_0$ and $p_1$ are the vectors of pre- and post-introduction prices of the $N-1$ competing products, $p_N$ is the post-introduction price of the new product, and $P$ is a vector of prices of products outside the industry (which are assumed to be unaffected by the introduction). $p_N^*(\cdot)$ is a function of all existing $N-1$ goods prices and is evaluated above at the pre-introduction prices.

1. How high must $p_N^*(p_0)$ be for the above definition to be equal to compensating variation?

2. Assume CV is differentiable in prices. Provide an integral equation representation of the CV expression above that is based on demand functions.

3. Would the use of $u_0$ instead of $u_1$ destroy the economic content of the measure?

4. It is possible to decompose the total benefit to consumers from the introduction of a new good into two parts:

$$CV = [e(p_1, p_N^*(p_1), P, u_1) - e(p_1, p_N, P, u_1)] + [e(p_0, p_N^*(p_0), P, u_1) - e(p_1, p_N^*(p_1), P, u_1)]$$

Describe what each of the two bracketed components measure intuitively. Hint: You may find the characterization from 2. useful here.

5. Suppose you were operating in the simple discrete choice demand setting similar to problem one but with no price discrimination:

$$U_{i,j} = \xi_j - \alpha p_j + \varepsilon_{i,j} \text{ for } j = 1, 2, \ldots N$$
$$= \varepsilon_{i,0} \text{ for good } 0.$$
Suppose good $N$ is the new good. Suppose a given individual, that is, a fixed set of tastes $\varepsilon_i = (\varepsilon_{i,0}, \varepsilon_{i,1}, \ldots, \varepsilon_{i,N})$, purchases the new good. Derive the formula for compensating variation for this individual $i$ due to the presence of the new good $N$. Your answer should be in terms of $\varepsilon_i, \alpha, (\xi_j, p_{0j}, p_{1j}) j = 1, 2, \ldots, n$. Note that unlike prices $\xi_j$ is not indexed by the new good/no new good regime.

6. Repeat 5 for a consumer who does not buy the new good. Interpret.
Question 4

Consider an industry with the single input labor in which there are \( N \) producers that differ in their elasticities of output with respect to labor:

\[
Q_i = \omega l^{\beta_i},
\]

with \( \beta_i < 1 \) \( i = 1, \ldots, N \). The consumption good price is always fixed (normalized) to 1 and labor is supplied at constant wage \( w \).

1. Solve for the optimal level of employment for each \( i \) as a function of \( (\beta_i, \omega, w) \). What is the value of the marginal product for each firm evaluated at their optimal labor level?

2. In equilibrium do plants that have higher \( \beta_i \) use more or less labor? In equilibrium do they have higher efficiency as measured by higher output-per-labor ratios?

3. Introduce taxes or subsidies \( \tau_i \neq 0 \) \( i = 1, \ldots, N \) on the output of each plant so the effective price received per unit of output is \( 1 + \tau_i \) (versus 1 above). What is the new output level for every firm \( i \) in terms of the model primitives and taxes?

4. What is the value of the marginal product at any firm \( i \) in this equilibrium with taxes/subsidies?

5. What is the change in aggregate welfare? How is the change in aggregate welfare related to the values of firms’ marginal products?

6. What fraction of this change in welfare arises because firms have become better or worse at producing output holding inputs constant?

7. What fraction of this change in welfare is due to inputs reallocating to some firms (being hired) and from other firms (being fired) in response to the introduction of the taxes/subsidies?