

Friday, September 3 2010

UCLA  
Department of Economics  
Ph.D. Preliminary Exam  
Industrial Organization Field Exam  
(Fall 2010)

**Instructions:**

- You have 4 hours for the exam.
- Answer any 5 out of 6 questions. All questions are weighted equally. Answering fewer than 5 questions is not advisable, so do not spend too much time on any one question. DO NOT answer all questions.
- Use SEPARATE booklets to answer each question
- Calculators and other electronic devices are not allowed.

1. Consider a Lucas span of control model with the following features. There are 2 alternative technologies that can be used by any firm. Technology one has production function  $sf(n)$ , where  $s$  represents span of control and  $n$  employment. Technology two has production function  $\theta sf(n)$  where  $\theta > 1$  but requires in addition an addition  $f$  workers (as fixed cost.) The distributon of span of control  $s$  in the population is given by a *cdf*  $G(s)$ .
  - (a) Define a competitive equilibrium.
  - (b) Explain why in equilibrium there might be complete specialization in any of the two technologies. Describe the equilibrium allocations when in equilibrium both technologies are used.
  - (c) Suppose  $f(n) = n^\alpha$  and the fixed cost to operate the good technology depends on  $s$  as follows  $f(s) = f \cdot s^{\frac{1}{1-\alpha}}$  for some parameter  $f$ . What will the equilibrium allocations look like? What if it is of the form  $f_0 + f_1 \cdot s^{\frac{1}{1-\alpha}}$ ?

2. Consider the following entry/exit model. Demand function is  $p(Q) = Q^{-1}$ . Cost functions of a firm with productivity  $s$  is  $c(s, q) = \frac{1}{2} \left(\frac{q}{s}\right)^2$ . There is a cost of entry  $c_e$  and no fixed cost. Firms die exponentially at rate  $\delta$ . All entrants start with  $s = 1$  and exactly after  $T$  periods (if survived) increase their value of  $s$  to  $x > 1$ . There is no discounting (except for the exponential rate  $\delta$ .)
- (a) Define a competitive stationary industry equilibrium
  - (b) Suppose  $T = 0$ . Show that in equilibrium the number of firms is independent of  $x$ .
  - (c) Suppose  $T > 1$ . Does the number of firms increase or decrease with  $x$ ? Explain.

3. Using an example of your choice, describe how Rust's "Alternative-Specific Value Function" approach can reduce computational burden in single agent dynamic problems. What crucial assumption on the unobservables is necessary to use this approach?

4. Consider the following infinite horizon dynamic discrete game. There are two players. In each period  $t$  firms simultaneously make a binary decision  $a_{it} \in \{0, 1\}$ , where  $i \in \{1, 2\}$  denotes the player. There is a single common knowledge state variable for each firm denoted  $S = (S_1, S_2)$  that evolves stochastically according to  $S_{it} \sim G(\cdot | S_{it-1}, a_{it-1})$ . There is also a private information state variable (vector) for each player,  $\epsilon_{it} = (\epsilon_{i0t}, \epsilon_{i1t})$ , which are iid across firms and over time and follow a type 1 extreme value distribution, denoted  $F$ . Flow payoffs are symmetric and are given by ( $a_t = (a_{1t}, a_{2t})$ ):

$$U_i(a_t, S_t, \epsilon_t) = \pi(a_t, S_t) + \epsilon_{iat}$$

- (a) Define a Markov Perfect Equilibrium for this game.
- (b) Assume we observe  $\{a_{mt}, S_{mt}\}_{t=1, \dots, T}^{m=1, \dots, M}$ , for a large number of markets  $M$  and periods  $T$ . Is the general model identified? Prove it one way or the other
- (c) Make whatever assumptions you need to make to ensure identification of the model. Prove it's identified.

5. Suppose you are asked to determine if firms are engaging in entry deterrence in the ... industry. Making explicit references to the entry and entry deterrence literature, discuss some of the challenges in answering this question with typically available data sets and typical industries. Imagining your ideal data set and industry (within reason), devise a strategy for modeling and identifying entry deterring behavior.

## 6. Product Variety

Product variety is often analyzed using the Salop circle model. Consumers are uniformly located on a circle of circumference 1. Each consumer wishes to purchase one unit and has a reservation price of  $a$ . You may assume that firms are evenly located a distance  $d$  apart so that the number of firms is  $1/d$ . (Don't worry about the integer issue.) A consumer travelling a distance  $x$  to a firm pays a "transportation cost" of  $tx^2$ . Each firm has a constant marginal cost of production  $c$  and a fixed cost of  $F$ .

- (a) Analyze the pricing problem that a firm faces if both the neighboring firms set the same price  $\bar{p}$  and solve for the size of the firm's market if it sets its profit-maximizing price.
- (b) Assuming free entry solve for the symmetric equilibrium number of firms and hence the equilibrium market price,
- (c) Suppose that a regulator has the authority to restrict entry below the free entry number of firms. Would total cost of production be lowered by such regulation? Would social surplus be raised?
- (d) Provide the intuition for your conclusion.