UCLA
Department of Economics

Second-Year Field Examination in INDUSTRIAL ORGANIZATION

Spring 2008

This is a 4 hour closed book/closed notes exam.

Answer any 5 out of the 6 questions. All questions are weighted equally. Answering fewer than 5 questions is not advisable, so do not spend too much time on any question.

DO NOT answer all questions.

BE SURE to Clearly Number Each Question.

Use a SEPARATE blue book to answer each question.

Calculators and other electronic devices are not allowed.

GOOD LUCK!

1. Auction Design

There is one item for sale and there are 2 buyers. Buyer *j*'s valuation is distributed with c.d.f. $F_j(v_j)$, pd.f. $f_j(v_j)$ and support $[0,1]$. The hazard rate $h_j(v_j) = \frac{f_j(v_j)}{1-F_j(v_j)}$ is increasing.

(a) Explain why the equilibrium of any selling scheme can be reduced to an "allocation rule" $\pi_1(v_1,v_2), \pi_2(v_1,v_2)$ (where π_j is the probability that the item is assigned to buyer *j*) and an expected payment $r_1(v_1,v_2), r_2(v_1,v_2)$.

(b) Explain why expected total surplus from the auction is

$$SS = \iint [v_1\pi_1 + v_2\pi_2] f_1(v_1) f_2(v_2) dv_1 dv_2 .$$

(c) Show that the marginal "informational rent of buyer 1 is

$$\frac{dU_1}{dv_1} = \int \pi_1 f_2(v_2) dv_2 .$$

(d) Hence show that the expected informational rent of the buyers is

$$\overline{IR} = \iint [v_1 \frac{\pi_1}{h_1} + v_2 \frac{\pi_2}{h_2}] f_1(v_1) f_2(v_2) dv_1 dv_2 .$$

For part (e) and (f) you should assume symmetry, that is $f_1 = f_2$

(e) Prove that the sealed high-bid and second-bid auctions with reserve price *r* are buyer and seller equivalent.

(f) Obtain an expression for expected revenue in the auction and hence characterize the expected revenue maximizing auction.

(g) In the asymmetric case is the sealed second-price auction revenue maximizing among all efficient auctions? Explain.

2. At time $t = 0$ there are $m \in (0,1)$ firms producing a low quality good. Consumers are heterogeneous as in the vertical differentiation model: a consumer of type x gets utility $xq - p_t^q$ by consuming a unit of the good of quality $q \in \{L, H\}$ where $L < H$ and x is distributed uniformly between 0 and 1. Firms can upgrade their quality as follows: by investing a flow c they get a Poisson arrival rate ρ for the upgrade. The alternative is to invest zero and get no arrival.

   (a) Suppose that $0 \leq m_H \leq m$ firms have adopted. Write an expression for the profits of low and high quality firms as a function of m_H, m, H and L.

   (b) Take m_H as state variable and conjecture that in equilibrium all low quality firms will invest until $m_H = \bar{m}$, where $\bar{m} \in [0, m]$. Write the value functions of low and high quality firms. Show that in this conjectured equilibrium $V_H - V_L$ is decreasing in m_H.

   (c) Give conditions so that in equilibirum: (i) $\bar{m} = 0$; (ii) $\bar{m} = m$ and (iii) $0 < \bar{m} < m$. Describe how the equilibrium path changes with m in the latter case.

   (d) Suppose at time zero there are no firms in the industry but they could enter as low quality firms by paying a cost of entry $c_e > 0$. Explain how the mass of entrants in period zero m is determined in equilibrium. According to this model, where would you expect more heterogeneity, industries with high or low c_e?

3. Time is discrete $t = 0, 1, \ldots$ There is a unit measure of labor. A firm with technology γ can employ at most one worker to produce γ units of output and uses no capital. At time t the frontier technology has $\gamma = (1+g)^t$. A new firm with the frontier technology can be created by using m_0 workers at the beginning of the period. Let n denote the lag of a firm's technology relative to the frontier, that is with $\gamma(n) = (1+g)^{t-n}$. A firm of type n can invest at the beginning of period t to upgrade its technology as follows: to get a probability ρ of upgrading its technology from n to $n-1$ it needs to hire $m(\rho)$ workers. Firms can exit at any time. Consider a balanced growth path where wages grow at rate g.

   (a) Give the equilibrium conditions for a balanced growth path: write down the Bellman equation defining the value function of a firm $v(n)$, upgrading decisions, determination of the frontier wage and labor market clearing. (You may assume that in your equilibrium all firms with sufficiently high n exit.)

   (b) Suppose that the technology for upgrading is as follows: a firm can either choose to invest zero at cost zero or m units of labor to get a probability $0 < \rho < 1$ of upgrading. Conjecture an equilibrium characterized by two numbers $n_1 \leq n_e$ where all firms with $n \leq n_1$ choose to invest in the upgrade and firms with $n = n_e$ exit. Show that in this equilibrum $v(n-1) - v(n)$ is decreasing in n for all $n \leq n_1$.

(c) What qualitative properties will the equilibrium derived in part (b) display?

(d) Now consider again the general upgrading technology with cost in terms of workers $m(\rho)$. Under what conditions will the equilibrium have no entry of new firms? Under what conditions will it have entry? (Try to make these conditions as tight as possible.)

4. Identifying Market Power

   (a) Consider a market with two firms producing a homogeneous product. Suppose that at the equilibrium price and quantity, the price elasticity of demand is 0.4. Is this consistent with these firms playing a Cournot quantity setting game? Prove your answer.

   (b) Describe intuitively how Porter (1983) was able to ascertain that firms in the Joint Executive Committee (the railroad "cartel") were colluding. Was Porter able to identify the level of the collusion, e.g. whether or not the firms were able to acheive perfect collusion in collusive periods? Why or why not?

5. Product Differentiation

   (a) Compare and contrast the substitution patterns generated by the one-dimensional vertical model, the logit model, the nested logit model, and the random coefficients model.

   (b) Discuss the various types of instruments that have been used to solve the "price endogeneity" problem in estimating these models (note: in class I listed 3 distinct types of instruments that have been used). For each type of instrument, describe in what situations you would expect the instrument to be a valid instrument, and in what situations you would expect the instrument to be invalid.

6. Production Functions - Consider the following Cobb-Douglas production function in logs:

$$y_{it} = \beta_0 + \beta_1 l_{it} + \beta_2 k_{it} + \omega_{it}$$

   where ω_{it} is the unobserved productivity shock for firm i in period t. Note that the productivity shock ω_{it} is the only unobservable in this production function. Suppose that the expectation of ω_{it} given firm i's information set at $t-1$ (i.e. I_{it-1}) is a *known* function of ω_{it-1}, i.e.

$$E[\omega_{it}|I_{it-1}] = f(\omega_{it-1})$$

   and assume that both l_{it} and k_{it} (as well as ω_{it-1}) are part of I_{it-1}.

   (a) When would the assumption that l_{it} and k_{it} are part of I_{it-1}be reasonable?

(b) Suppose you observe panel data on (y_{it}, l_{it}, k_{it}). Describe precisely how you could use GMM to estimate the parameters β_0,β_1, and β_2. Note: you do not need to do an "inversion" like Olley and Pakes or Levinsohn and Petrin.