University of California, Davis
Department of Economics
Industrial Organization

Date: June 23, 2009
Time: 3 hours
Reading Time: 20 minutes

PRELIMINARY EXAMINATION FOR THE Ph.D. DEGREE

Answer **four** of the six questions.
You must choose at least one question from each of the three sections (A, B, and C) of the exam.

Section A

1. This question deals with Chevalier and Ellison, "Risk Taking by Mutual Funds as a Response to Incentives" (1997, *JPE*), Chevalier and Ellison, "Career Concerns of Mutual Fund Managers" (1999, *QJE*), Hubbard, "An Empirical Examination of Moral Hazard in the Vehicle Inspection Market" (1998, *RAND*) and Ferrall and Shearer, "Incentives and Transactions Costs Within the Firm: Estimating an Agency Model Using Payroll Records" (1999, *ReStud*).

(a) For Chevalier and Ellison (1997), discuss carefully what the empirical setting is and what their main research question is. Also, describe their data set and empirical strategy.

(b) For Chevalier and Ellison (1999), explain why the (implicit) incentive structure for younger managers and that for older managers may differ? What are their empirical findings? Compare this paper (1999) with the previous one (1997). What are their similarities? What are the differences?

(c) For Hubbard (1998), discuss carefully what the empirical setting is and what his main research question is. Also, describe the data set and empirical strategy.

(d) What are empirical findings of Hubbard (1998)? Compare and contrast this paper with two papers by Chevalier and Ellison (1997, 1999). What do you think can be their common theme? How do they differ in their empirical approaches?

(e) For Ferrall and Shearer (1999), discuss carefully what the empirical setting is and what their main research question is. Also, describe their data set and empirical model as fully as you can.

(f) Why do you think Ferrall and Shearer (1999) employ a structural approach? Discuss a possibility of using non-structural(reduced-form) approaches as an alternative empirical strategy.

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2. This question deals with Guerre, Perrigne, and Vuong, "Optimal Nonparametric Estimation of First-Price Auctions" (*Econometrica*, 2000), Haile and Tamer, "Inference with an Incomplete Model of English Auctions" (*JPE*, 2003) and Haile, Hong, and Shum, "Nonparametric Tests for Common Values in First-Price Sealed-Bid Auctions" (2005).

Common Assumptions to both (a) and (b): There are N potential bidders. Assume N is exogenous and known. Bidders are symmetric and risk-neutral. Independent Private Values. Each bidder draws her private value v_i from a common distribution $F(v)$, which has a support $[0, \infty)$.

(a) Consider a single-object, first-price sealed-bid auction. Assume there is no reserve price for simplicity. Carefully derive symmetric Bayesian Nash equilibrium bidding strategies, $\beta(v_i)$. (Consider increasing and differentiable strategies only.)

(b) Consider a single-object, Milgrom-Weber "button" auction. The seller's value for the object is v_0 and she wants to maximize her revenue from the auction by setting a reserve price r. Write down the seller's maximization problem and derive a condition for the optimal reserve price r^* from the F.O.C. of the max problem.

(c) Describe, as fully as you can, the nonparametric identification result and the two-step nonparametric estimation strategy of GPV (2000).

(d) State the two axioms (or behavioral assumptions) of Haile and Tamer (2003) and construct, as fully as you can, the nonparametric (partial) identification result of Haile and Tamer (2003). Discuss the advantages and disadvantages of this incomplete approach.

(e) Discuss, in general, the advantages and disadvantages of using structural models when conducting empirical research in auctions.

(f) Prove the following theorem from Haile, Hong, and Shum (2005), which is the basis of their nonparametric test of common values.

Theorem Under standard assumptions of symmetry, affiliation, nondegeneracy and an additional assumption of exogenous participation, $v(x, x, n)$ is invariant to n for all x in a PV model, but strictly decreasing in n for all x in a CV model, where $v(x, x', n) = E[V_i \mid X_i = x, \max_{j \neq i} X_j = x']$.

Section B

Question 3

(a) Discuss the logit demand model. In particular, discuss the assumptions underlying the model and the data needed to estimate the model.

(b) The next few questions deal with Berry, Levinsohn and Pakes (*Econometrica* 1995) which estimates a model partially based on the logit demand model. Discuss the empirical setting of the model and the data.

(c) In which direction would you want to extend the demand model? What other data would you need? Can you "sign" the bias present in the simpler BLP model?

(c) Discuss the major differences between BLP and a "standard" logit demand model as well as any issues/weaknesses with the standard model that BLP seek to address. In doing so, discuss Knittel and Metaxoglou.

(d) Give a brief overview of BLP's estimation strategy. That is, outline the steps you would take to estimate a BLP model. Given the nature of their data are there additional hurdles that the authors must overcome? Discuss their results.

(e) Suppose you wanted to use the results from a BLP demand model to simulate the outcome of a merger. How would this be done?

Question 4

A recent paper seeks to understand how "suggested" prices affect competitive behavior. The background is as follows: In the Dutch gasoline market refiners (wholesalers) post "suggested" prices for gasoline retailers. These prices vary by location and time. The paper argues that these suggested prices facilitate tacit collusion. The paper has daily data on retail prices and suggested prices over a two-year period.

(a) Discuss the theoretical argument of why suggested prices may influence competition.

(b) What empirical information would you provide as *initial* evidence that is consistent with the theoretical argument? Obviously, I am not asking what they provide, but rather what *your* first step would be to support this argument.

(c) What other data sources would you want to include in the analysis? Explain why.

(d) Suppose you regressed the change in the retail price on the change in the suggested price and found a positive and statistically significant effect. Is this enough to conclude that suggested prices facilitate collusion? Why or why not.

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(e) How might you expand on the simple empirical model in (d)? Relate your suggestion to paper(s) we covered in class.

(f) How might you "correct" your standard errors in (e) (or even (d))?

(g) To strengthen their paper, the authors make the following argument:

> What we do know is that stations do not buy gasoline every day. According to Beta (the organization for independent gasoline retailers), many stations are supplied with new stock three times a week (Van Gelder 2008). Naturally, there are important differences between stations. This means that each day on average 43% (3/7) of the gasoline stations get new stock. We also know the dates at which the suggested prices change and also that these dates are independent of the delivery moments of new gasoline to stations. As a consequence, if the cost of a liter of gasoline depends on the suggested price and if gasoline stations simply adjust their retail price to the cost level, we expect that only 43% of all gasoline stations will change their price when the suggested price changes (and the suggested price is not equal to the suggested price on the previous day that the gasoline stations bought new stock). We can therefore check how many gasoline stations change their retail prices on days that the suggested price changes to discriminate between the two alternative hypotheses. The non-tacit collusion hypothesis says that *(slightly changed to hide potential answers to previous questions)* at most 43% of the stations should change their price. The coordinated effect hypothesis says that this percentage is (much) higher: it does not say that it should be 100% as this would be implied only if the suggested prices fully coordinate retail prices (which we know is not the case) and there are no menu costs or other costs of price adjustments.

Evaluate this empirical test.

Section C

Question 5

Production Function Estimation. Suppose that you have a random cross section of firm-level data, with information on output, labor and capital. In logs,

$$\{y_i, l_i, k_i : i = 1, 2, ..., N\}$$

You are interested in estimating the Cobb-Douglas production function:

$$y_i = \alpha_L l_i + \alpha_K k_i + \omega_i + e_i$$

1. Discuss the issues with estimating this PF using OLS.

2. What are the two main reasons (in terms of identification, not availability) why input prices are likely poor candidates for instruments?

3. Now suppose that you have panel data and want to estimate the Olley & Pakes (1996) model. Describe clearly how to implement the two-step approach that they propose.

4. What are the three assumptions/requirements for identification of α_L?

5. What is the basis of the Ackerberg, Caves, & Fraser (2006) critique of the OP model?

6. What assumptions do they suggest that allow the OP approach to be salvaged? How does the two-step procedure change in this context?

Question 6

Dynamic Discrete Choice Models.

1. Discuss the main challenges inherent in empirical estimation of dynamic games. Pick the two or three most important, in your view. Be clear and concise.

2. Define a Markov Perfect Equilibrium. Explain why it is useful in estimation of dynamic games. Practically speaking (and in plain english), what does it imply about the beliefs of firms?

3. The next few questions relate to the Pakes, Ostrovsky, & Berry (2007) model, but touch on some common elements of dynamic estimation more generally. Below is the Bellman

equation for incumbent firms in the POB framework. What data are required to estimate the parameters of interest in the POB model? To which static entry/exit model is this most similar? Name the types of firms that this (static) paper examined.

$$VC(n, z; \theta) = \sum_{n', z'} \left[\tilde{\pi}(n', z'; \theta) + \beta E_\phi[max\{\phi_i, VC(n', z'; \theta)\}] \right] P(n', z'|n, z, \chi = 1)$$

where $\pi(n, z; \theta)$ is a one-period profit function, n is the number of active firms, z is a vector of exogenous profit shifters, θ is the parameter vector, e and x are the number of entrants and exitors, respectively, ϕ is the sell-off (exit) value, and χ is an indicator variable equal to one if an incumbent remains.

4. One of Rust's (1987) main contributions was to identify a crucial assumption, which he calls *Conditional Independence*, that greatly facilitates estimation in dynamic settings. Describe this assumption formally, using the relevant part of the equation above. Explain in plain english what implicit assumptions it imposes on the evolution of the state variables.

5. Describe the key observation in Hotz & Miller (1993), and how they propose exploiting it to ease the computation burden of dynamic estimation. (Be brief. A couple of concise sentences are sufficient to earn full points here.)

6. POB exploit the Hotz & Miller framework, and combine it with a parametric assumption on the distribution of ϕ that allows them to reach the following analytical expression, where p_x is the probability of exit:

$$E_\phi[max\{\phi_i, VC(n', z'; \theta)\}] = VC(n, z; \theta) + \sigma p_x(n, z)$$

This allows the Bellman equation to be rewritten as follows, where M^i is an estimate of the incumbents' state transition matrix:

$$VC(n, z; \theta) = M^i \tilde{\pi}(n', z'; \theta) + \beta M^i \left[VC(n, z; \theta) + \sigma p_x(n, z) \right]$$

Using this expression, derive POB's closed-form solution for the value function.