

14.271 Midterm Exam

October 31, 2005

**Answer all questions.** You have 90 minutes in which to complete the exam. Don't spend too much time on any one question.

1. (20 Minutes – 20 Points) Answer each of the following subquestions BRIEFLY.

(a) Ellison and Ellison report own-elasticities of -25 to -40 for low-quality memory chips sold online, suggesting that firms would be hard-pressed to recover their fixed costs. How do their findings of the cross-price elasticity of demand for medium- and high-quality memory chips with respect to the price of the low-quality good can rationalize how firms can survive in such an environment? In a model of add-on pricing, why would firms have an incentive not to lower the price of the low-quality good?

(b) Porter studies the operation of the Joint Executive Committee (JEC) in the late 1800's. What is the primary commodity that the JEC transports? Porter uses a dummy variable indicating the navigability of the Great Lakes as an instrument that shifts the demand curve. Why does he have to use a demand-side shifter, and is this a valid instrument? What continuous variable would be an improvement over the dummy approach, and why does he not use it?

(c) We discussed two papers by Noel, which examine the dynamics of pricing in the gasoline industry. What country does his data come from? He is specifically interested in documenting Edgeworth cycles. Briefly list the characteristics that define price dynamics in an Edgeworth cycle.

(d) Berry shows how to invert the share equations to obtain estimates of the product-specific unobservables from the residuals. In an IV framework, these "error terms" are used to construct moments used to estimate the underlying primitives. What is special about the error terms in the share equations with aggregate data when the model is correctly specified? Does this change your interpretation of these error terms, or the way the moments are constructed to recover the demand parameters?

2. (25 Minutes – 30 Points)

A monopolist sells a good that provides direct and network benefits to a continuum of potential consumers. The monopolist has a constant marginal cost  $c$ .

Consumers are heterogeneous. A consumer of type  $\theta$  receives utility  $\theta(s + x) - p$  if she buys a good of quality  $s$  at price  $p$  and  $x$  other consumers also buy the good. Assume that  $\theta$  is uniformly distributed on  $[0, 2]$  and that the total mass of consumers is 2.

Assume that the timing of the game is that the monopolist first sets its price and consumers then simultaneously decide whether or not to buy.

(a) Suppose  $s = 1$  and  $c = 1$ . What is the highest profit that the monopolist can receive in a subgame perfect equilibrium? What are the prices and quantity in this equilibrium?

(b) For the same parameter values, show that the model also has an equilibrium in which the monopolist earns zero profits. For what values of  $c$  must all equilibria have positive profits?

(c) Suppose now that you have data on a set of markets similar to that described above. In each market, the price is set and demand is determined as in the above model. Outcomes vary, however, because the quality of the good in the  $i^{th}$  market is  $s_i$  and the marginal cost is  $c_i$ . Assume that  $s_i = \bar{s} + \epsilon_i$  and  $c_i = \bar{c} + \eta_i$ , where  $\epsilon_i$  and  $\eta_i$  are independent normal random variables with standard deviations  $\sigma_\epsilon$  and  $\sigma_\eta$ , respectively. Assume that  $\bar{s}$  and  $\bar{c}$  are unknown, and that the quality and cost shocks are observed by the monopolist, but not by the econometrician.

Discuss how the two unknown parameters might be estimated if we had price and quantity data from a large set of markets. Can  $\bar{c}$  be identified if we only have price data?

3. (30 Minutes – 32 points)

Consider a slight elaboration of the traditional competition-on-a-line model. A unit mass of consumers get utility  $v - p$  if they purchase one unit of a good at price  $p$ . Two firms can produce the good at a constant marginal cost  $c < v$ .

Consumer's types  $\theta$  are distributed uniformly on  $[0, 1]$ . A type  $\theta$  consumer incurs a disutility of  $t\theta$  if she drives to the store at the left endpoint and  $t(1 - \theta)$  if she drives to the store at the right endpoint. Assume that these disutilities are driving costs incurred whenever the consumer visits a store, regardless of whether she makes a purchase.

(a) Suppose the two firms choose prices simultaneously, but these prices are not observable to consumers, so the only way that consumers can learn the price that a firm charges is to visit the firm. Show that there is no pure strategy equilibrium in which the firms make positive sales.

(b) Suppose an advertising intermediary informs consumers of both firms' prices. (The game is then identical to the standard competition-on-a-line model.) Derive the equilibrium under the assumption that  $v$  is sufficiently large.

(c) Suppose now that the advertising is not perfectly effective: a fraction  $1 - x$  of consumers learn both prices, but a fraction  $x$  (uniformly distributed along the line) do not see an advertisement and will need to visit a firm to learn its price. Show that for small  $x$  this model has a pure strategy equilibrium in which the price is higher than in part (b). Why is the outcome of this model different from the outcome of Stahl's model of price dispersion?

(d) Suppose that the firms have greater scope to design partially-revealing advertising intermediary: suppose that they can partition the real line into a set of intervals  $I_1, I_2, I_3, \dots, I_k$  and have the intermediary commit to a policy of announcing the interval to which each firm's price belongs. Show with an appropriately chosen advertising policy the firms can receive the same profits as if they fully colluded on price setting. What practical policy implications might this model have?

4. (15 Minutes – 18 points)

Penelope Goldberg published a paper on the automobile industry contemporaneously with Berry, Levinsohn, and Pakes. Instead of using a random-coefficients model on aggregate data, Goldberg estimates demand from a household-level dataset that includes household characteristics as well as what car each household purchased (if any). Her model assumes that a household chooses between the various car models  $j$  to maximize its utility  $U_j^h$ . She assumes that utility is of the form

$$U_j^h = \bar{V}(X^j, \Gamma^h; \theta) + \epsilon_j^h, \quad (1)$$

The deterministic component of utility,  $\bar{V}$ , is a linear function of product characteristics  $X^j$  (like *Horsepower<sub>j</sub>*), household-level characteristics  $\Gamma^h$  (like *Income<sub>h</sub>*), and interactions between product- and household- characteristics (like *Income<sub>h</sub> \* Horsepower<sub>j</sub>*). Aggregate quantities, such as demand elasticities, are calculated from the estimated parameters  $\hat{\theta}$  by summing over individual household purchase decisions.

(a) BLP show that incorporating random coefficients into their utility model allows for more flexible substitution patterns than the plain logit model can capture. Does Goldberg’s model of micro-level utility similarly allow for flexible substitution patterns at the aggregate level? Why or why not?

(b) BLP assume that the random coefficients are not correlated across characteristics, in the sense that a high willingness-to-pay for one characteristic has no bearing on whether or not that same agent has a high willingness-to-pay for a different characteristic. Does Goldberg’s approach necessarily also suffer from this limitation?

(c) In the first paper of the semester, Hendel and Nevo describe the biases that arise from measuring elasticities in a static framework when consumers are solving a dynamic problem. Outline the analogous problem here, under the assumption that the households in the sample have expectations over future price changes. For example, how would the short-term and long-term measurements of elasticity compare if you estimated static demand models using data from this summer’s “employee pricing” promotions in the car market? Suppose there is a price bump up in November; would a static model predict the correct demand response?