

**PRELIMINARY EXAMINATION FOR THE Ph.D. DEGREE**

**Industrial Organization**

September 20, 2005

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.** Consider a monopolist who produces items at a constant unit cost  $k$  and sells these units to retailers who incur zero additional costs (that is, the only cost faced by the retailers is the price paid to the monopolist for each unit). Suppose there are two retailers and they compete in output levels (Cournot competition). Inverse demand is  $P = a - bQ$ .

- (a) Assume that the monopolist uses standard linear pricing. What is the optimal price for the monopolist to set to the retailers?
- (b) Suppose now that the monopolist uses a two-part tariff scheme, where it charges each retailer a (possibly different) fixed fee, plus a per unit charge (the same for both retailers) for any unit bought. What is an optimal two-part tariff for the monopolist?
- (c) Which of the two pricing schemes (linear pricing or two-part tariff) does the monopolist prefer?
- (d) How would your answer to (a)-(c) change if retailers competed in prices (Bertrand competition)?

**2.** Consider an industry composed of  $n$  identical firms producing a homogeneous product.

Suppose that  $k$  of these firms (with  $1 \leq k < n$ ) form a cartel. The cartel acts as price leader: it announces a price and allows the firms not in the cartel (the “competitive fringe”) to sell as much as they want at that price (the firms in the fringe accept the price set by the cartel and act as price-takers). Suppose that firms in the cartel share output and profits equally. Define a cartel to be stable if it is *internally* and *externally* stable, in the following sense. Internal stability requires that no cartel member want to leave the cartel (and become a member of the competitive fringe) and external stability requires every member of the fringe not to want to join the cartel. Assume that when each firm contemplates a move (from cartel to fringe or vice versa) (1) it assumes that no other firm will move and (2) it has rational expectations about the outcome of the move (i.e. it realizes that the price will change in the industry as a consequence of the move). Find all the stable cartels in the following case. There are 5 firms in the industry, each with the

same cost function  $C(q) = \frac{q^2}{2}$ , and industry demand is  $Q = 5(1 - P)$ .

## Section B

### 3.

Consider an industry with two firms that produce a homogeneous product.

- a) The prices charged by the two firms are highly correlated over time. An economist points to this fact as proof that the two firms are colluding. Do you agree? Why?
- b) Suppose you observe marginal costs (or a good proxy for). How could you test if the firms are colluding?
- c) If the firms are colluding, how could you test if the collusion follows a pattern predicted by any particular theory? (you can choose any reasonable theory of collusion you like) Your tests can rely on existing work, but be clear about what data you are using, specifically how you plan to use the data, precisely what you are testing, and what are the alternative hypotheses.
- d) Now assume that you do not observe marginal costs. Without any additional assumptions can you empirically identify the degree of market power in this industry? Explain. (Hint: it may help to demonstrate the identification problem using a graph or using linear demand and cost functions and the associated profit maximization condition.)
- e) List two possible sets of assumptions that would allow you to identify the degree of market power. Explain.
- f) Now suppose you are trying to estimate the demand system for a differentiated products industry. What are the difficulties of estimating the own- and cross-price demand elasticities?
- g) Briefly describe/outline methods available to solve two of the problems you named in (f).
- h) This is a general economics question. Suppose you go to the gas station to buy gas and get your car washed. Gas currently sells for \$3.00 a gallon and car washes cost \$5.00. The gasoline station offers a free car wash if you buy 8 gallons of gas. What is the opportunity cost of the 8<sup>th</sup> gallon? Explain.

**4.**

This question relates to Bresnahan and Reiss (JPE '91) and Berry (Econometrica '92). Both of these papers deal with the economics of entry.

Bresnahan and Reiss and Berry

a) Describe the theoretical underpinning for Bresnahan and Reiss' concept of an entry threshold. What is the intuitive interpretation of their entry threshold ratio measure? What are its bounds, and what are the theoretical interpretations of these bounds?

b) Describe the empirical model employed. What is their dependent variable? Do they have actual data on their dependent variable? If not, how do they confront this? What assumptions are made about the error term?

c) Berry also estimates a model of entry. How does his empirical model differ from Bresnahan and Reiss? It may be helpful to write out an equation. Is there any way to view it as a generalization of the BR model?

d) Estimation of the full model is difficult and requires the use of simulation methods. Are there special cases for his model that make estimation simpler? If so, what are they? Be as specific as you can.

e) Describe the context of Berry's paper: What is the industry? What are the data?

f) What feature of Berry's data allows him to estimate a more sophisticated model than Bresnahan and Reiss?

g) One of the goals of Berry's paper is to estimate the effect of an airline's scale of operations at an airport on its profitability. What idea is this trying to capture? How does Berry incorporate this in his empirical model?

h) In general, what does Berry find?

i) This is a general economics question. Suppose you are given two tickets to a Clapton concert. The face value of the Clapton tickets is \$90, but you can't resell them. On the same night that Clapton is playing, there is a Greenday concert. Your personal valuation of going to a Greenday concert, in dollar terms, is \$70; two tickets to Greenday cost \$40. What is the opportunity cost of going to the Clapton concert? Explain.

## Section C

- 5.** Consider which regulatory schemes are appropriate given the following circumstances. For each part below suggest a regulatory scheme. Aim to find schemes that use as much of the available information as possible. In each case, describe how the mechanism works, what the outcome is, and what problems may arise in implementation. State all extra assumptions or conditions needed for the mechanism to be applied.
- A natural monopolist produces a single product. The regulator knows the demand function but not the firm's constant marginal cost. The regulator has a prior belief about MC, described by the probability density function  $f$ . The regulator is allowed to subsidize the firm.
  - A natural monopolist produces multiple products. The regulator does not know the firm's cost or demand functions, but can observe past expenditure and units sold. The regulator is not allowed to subsidize the firm.
  - A natural monopolist produces a single product. The regulator does not know the firm's demand or cost functions, and cannot observe past expenditure and quantities directly, but can observe past operating profit. The regulator is not allowed to subsidize the firm, but is allowed to set a menu of two-part tariffs. Assume a representative consumer to keep things simple.
  - There are several firms competing to become a natural monopolist producing a single product. The regulator does not know the firm's cost or demand functions, and cannot observe past expenditure or units sold. The regulator is not allowed to subsidize the firm and does not want to engage in price regulation on an ongoing basis.
  - Same as previous, except the natural monopolist will produce multiple goods.

**6.** Consider Baumol and Klevorick's model of rate of return regulation, with the added complication that revenue is uncertain. In particular, in addition to the usual assumptions of the model, the timing of the firm's decision is:

1. The firm chooses capital  $K$ .
2. The random variable  $u$  is revealed, which is added to the profit function:  
 $\pi(L, K, u) = R - wL - rK + u$ . Assume  $E(u) = 0$ . For the sake of graphs, you may assume  $u$  has a two-point distribution (the "good" outcome and "bad" outcome).
3. The firm chooses labor  $L$  and price  $p$ .

Assume the firm is risk neutral, and that in the bad outcome profit is low enough that the ROR constraint does not bind. The regulator requires that the ROR constraint be met *ex post*, not just *ex ante*. Your proofs may be graphical or mathematical, with highest credit going toward complete mathematical arguments.

- a) Define  $L^*(K, u)$  to be the optimal labor to use after  $K$  is chosen and uncertainty is revealed. Illustrate the concentrated profit function  $\pi^*(L^*(K, u), K, u)$  and the regulatory constraint.
- b) Will the firm earn the allowed ROR on average?
- c) State the Averch Johnson (A-J) effect. Does the A-J effect still hold in this model (*ex ante* and *ex post*)?
- d) Will the regulated firm use more or less capital than an unregulated firm?