

Problem Set #5

Due October 24, 2001

1. Consider an infinitely repeated game in which  $N$  firms with constant marginal costs simultaneously choose prices for goods which are perfect substitutes in each period and face discount factors of  $\delta$  per period. Suppose that the firms attempt to enforce collusion at the monopoly price with the threat that they will revert to marginal cost pricing in a price war if anyone deviates.

(a) Suppose that a price war lasts only  $T$  periods. First, precisely write down an algebraic formulation of each firm's strategy. Second, derive the condition that must hold for no firm to have an incentive to deviate from this strategy in equilibrium.

(b) Suppose that there are observation lags in detecting price cuts so that a cut in prices in period  $t$  isn't observed until right before period  $t + k$  actions are chosen. What conditions must now hold for there to be an equilibrium with monopoly pricing?

2. Tirole exercise 6.8, p. 264.

3. You are asked to conduct a study of the plate glass industry in the United States to assess its market power. In particular, you are instructed to estimate  $\theta$  from the following generalization of the monopolist's first-order condition:

$$P + \theta Q \frac{\partial P(Q, Y)}{\partial Q} = MC(Q, W) \quad (1)$$

where  $P(Q, Y)$  is the inverse demand curve and  $MC(Q, W)$  is industry marginal cost. The parameter  $\theta$  is a measure of conduct, with a value of 0 for perfectly competitive behavior and a value of 1 for perfectly collusive (monopoly) behavior.

You have twenty years of weekly time series data on plate glass prices ( $P$ ) and quantities ( $Q$ ). Finally, you have data for a wage variable ( $W$ ) which affects but does not fully constitute marginal cost. Note that you do not observe marginal cost itself, but you are told that the marginal cost of producing plate glass does not vary with output. There are no fixed costs.

Assume that the demand and marginal cost for plate glass take the following form:

$$\ln Q = a_1 + a_2 \ln P + \nu \quad (2)$$

$$MC(Q, W) = W + \eta \quad (3)$$

(a) Given the data available to you and the assumed functional forms for demand and costs, can you distinguish between competitive and collusive behavior? Derive your estimating equation(s) and explain whether each equation is identified. Can you recover an estimate of  $\theta$ ?

(b) Now suppose that the industry is governed by a cartel. Suppose that, because of difficulties in coordinating the cartel on the monopoly price without attracting the attention of antitrust

authorities, the firms use “rule of thumb” pricing. In particular, they always simply add \$2 to marginal cost:

$$P = 2 + MC(Q, W) \tag{4}$$

The price of plate glass has averaged \$5 over this period. If you are not aware of this rule of thumb pricing and you attempt to infer market power by estimating (1), what will you conclude? Is this a correct inference? Explain.

4. Consider a binary choice model where consumers (indexed by  $k$ ) decide whether to make a purchase. Their utilities for not purchasing are zero and for purchasing are a sum of an index in observable characteristics,  $X_k\beta$ , and a random error,  $\epsilon_k \sim \text{Uniform}[-L, L]$ . What is the probability of a purchase as a function of  $X_k, \beta$ , and  $L$ ? Draw a graph of the probability over  $X_k\beta$ . How does it compare with the analogous graph from a binomial logit model?