

Advanced Industrial Organization II Problem Set 1

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Due on January 22nd, at the beginning of the class.

1 Demand in a market with imperfect competition

Consider the following utility function of consumer $i = 1, \dots, N$ choosing $j = 0, \dots, J$ in market $t = 1, \dots, T$:

$$u_{ijt} = \alpha p_{jt} + x_{jt}\beta + \xi_{jt} + \epsilon_{ijt},$$

where p_{jt} is price of product j in market t , and x_{jt} , ξ_{jt} and ϵ_{ijt} denote product characteristics. While consumers and producers observe x_{jt} and ξ_{jt} , the econometrician does not observe the latter. $\epsilon_{ijt} \stackrel{iid}{\sim} T1EV$, independent of all other variables, is only observed by consumer i in market t . Consumer i in market t chooses one product maximizing his utility:

$$y_{it} \equiv \operatorname{argmax}_{0 \leq k \leq J} u_{ikt}.$$

Price and product characteristics of the outside good, $j = 0$, are normalized to 0, with the exception of ϵ_{i0t} . Let $\theta = (\alpha, \beta)'$ be demand-side parameters.

There are $f = 1, \dots, F$ firms in a market, where each firm produces $\mathcal{F}_f = \{j_1, \dots, j_{J_f}\}$. $\{\mathcal{F}_1, \dots, \mathcal{F}_F\}$ constitutes a partition of set $\{1, \dots, J\}$. The marginal cost of product j in market t is:

$$\text{mc}_{jt} = w_{jt}\gamma + \omega_{jt},$$

where w_{jt} and ω_{jt} are observed and unobserved cost components, respectively, in the econometrician's point of view. Assume there is at least one observed cost component not a part of x_{jt} . The profits of firm

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f in market t is:

$$\Pi_{ft} = \sum_{j \in \mathcal{F}_f} (p_{jt} - mc_{jt}) D_{jt}(p, x, \xi; \theta),$$

where $D_{jt}(p, x, \xi; \theta)$ is demand of good j , in the firms' point of view. Firms simultaneously choose prices under static Nash-Bertrand competition.

1. Derive the aggregate demand system, $D_{jt}(p, x, \xi; \theta)$. (Hint: What do the firms observe?¹)
2. Assume a Nash equilibrium exists. Derive the first order conditions of firm f and express it as an (implicit) function of p_{jt} .
3. What does the above result imply in the relationship between p_{jt} and ξ_{jt} ?
4. Define

$$\hat{s}_{jt} = \frac{1}{N} \sum_{1 \leq i \leq N} 1\{y_{it} = j\},$$

for $j = 0, \dots, J$ in market $t = 1, \dots, T$. Compute $\text{plim}_{N \rightarrow \infty} \hat{s}_{jt}$ and discuss its relationship with $D_{jt}(p, x, \xi; \theta)$.

5. (Berry 1994) Suppose you only have market-level data: $(\hat{s}_{jt}, p_{jt}, x_{jt}, w_{jt})_{jt}$, instead of an individual-level dataset. Derive a linear regression equation of $(\hat{s}_{jt}, p_{jt}, x_{jt})_{jt}$. (Hint: Get rid of the denominator of $D_{jt}(p, x, \xi; \theta)$.)
6. Is the OLS estimator consistent for the demand-side parameters, θ ? Why or why not?
7. Discuss potential advantages and disadvantages of the following variables as instruments: (1) $w_{jt} \setminus x_{jt}$ (cost components not a part of x_{jt}), (2) $x_{-j,t}$ (characteristics of other products), (3) $p_{j,-t}$ (prices of j in other markets).
8. In cereal_ps3.xls, you are given a semi-fabricated dataset of Nevo (2000, 2001). In the dataset, product j is a unique identifier of 'firm' and 'brand,' and market t is that of 'city,' 'year' and 'quarter.' x_{jt} has two components, 'sugar' and 'mushy.' There are 20 instruments to be used for estimation ('z1'-'z20'). Assume that the data generating process follows the model we specified. Estimate θ using an estimator you think it is consistent. Compare estimation results with and without brand and market dummies. Discuss the results.

¹Note that there is another interpretation of ε_{ijt} when deriving the aggregate demand: The suppliers observe ε_{ijt} , but a continuum of consumers of total mass N are distributed with Type 1 Extreme Value Distribution in the population. While its microfoundation is somehow different, two interpretations give the same result. See Anderson, de Palma and Thisse (1992) for a reference.

9. From $D_{jt}(p, x, \xi; \theta)$, derive own and cross-price elasticities. Do you find them restrictive? Why or why not? If you think they are, what could be potential remedies? Discuss briefly.