

# MNL models and simulating the effects of a horizontal merger\*

Spring 2009

You are encouraged to work on the programming in groups. However, you must write up the assignments individually. These assignments are due March 25th.

**Part 1** (refer to Berry (1994) and Nevo (2000))

1. Logit: Derive the own and cross-price elasticity formulas for the case where a representative consumer's indirect utility for product  $j$  in period  $t$  is given by

$$u_{jt} = X_{jt}\beta - \alpha p_{jt} + \xi_{jt} + \epsilon_{jt} \quad (1)$$

where  $X$  denotes observed characteristics,  $p$  denotes price, and  $\xi$  denotes unobserved (to the econometrician) characteristics. Assume that  $\epsilon$  has a type 1 extreme value distribution and is iid across products.

2. Random coefficients: Derive the own and cross-price elasticity formulas for the random coefficients case where consumer  $i$ 's indirect utility for product  $j$  is given by

$$u_{ijt} = X_{jt}\beta - \alpha p_{jt} + \xi_{jt} + \sum_k \sigma_k \nu_{ik} x_{jkt} + \epsilon_{ijt}. \quad (2)$$

Let  $x_{jk}$  denote elements of the matrix  $X$ , and so the random coefficients are over a product's non-price characteristics.

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\*This homework draws from those posted by Aviv Nevo

3. Nested logit: Finally, derive the own and cross-price elasticity formulas for the nested logit case. Following Berry (1994), assume that products are divided into  $G$  mutually-exclusive groups. There are a total of  $G + 1$  groups, because the outside good is in its own group.
4. Independence of Irrelevant Alternatives: A bad feature of the logit model is that the cross-price elasticities are solely a function of market shares. Hence, if two vastly different products (e.g. luxury sports car and a compact car) have the same market share, they will have the same cross-price elasticity with respect to a third product (e.g. a luxury SUV). Using your answers above, discuss the how the random coefficients and nested-logit specifications correct this problem.

## Part 2

Download the data from the course web-page and use to it estimate the following (Logit) model:

$$u_{ijt} = X_j\beta - \alpha p_{jt} + \xi_{jt} + \epsilon_{ijt} \quad (3)$$

where  $i = 1, \dots, I; j = 1 \dots, J; t = 1, \dots, T$  and  $\epsilon$  is distributed i.i.d extreme value. The vector of characteristics,  $x_j$ , contains a constant, sugar content and a mushy dummy variable ( $=1$  if cereal gets soggy in milk).

Estimate the following 4 specifications: (i) OLS without brand fixed effects, (ii) OLS with brand fixed effects; (iii) IV (using the instrumental variables provided in the data) with and (iv) without brand fixed effects. For each specification report the estimated coefficients and their standard errors.

1. Using the results for the last specification (IV with brand fixed effects) compute the own- and cross-price elasticities. Compute these for each of the markets and report the median across markets. To save space you can report these for a subset of the products. Are there any particular patterns in the elasticities?
2. Using the results for the last specification (IV with brand fixed effects) and the price elasticities, compute the markups predicted by a (i) single-product Nash-Bertrand

- equilibrium; (ii) a multi-product Nash-Bertrand equilibrium; and (iii) joint pricing of all the brands. For each model report the median of the distribution of the markups and margins. Are there any particular patterns in these numbers?
3. Using the estimated markups, compute the implied marginal costs. Report the median of the implied marginal costs.
  4. Use the pre-merger estimate of marginal costs, the estimated price elasticities and an assumption of multi-product firm Nash-Bertrand post-merger equilibrium to simulate the post merger equilibrium. Explain exactly each step. Simulate the effect of a Post-Nabisco merger and GM-Quaker merger. (A company can be identified by the first digit in the id variable. GM=2, Post=3, Quaker =4, Nabisco=6). Report the changes in the equilibrium prices and quantities (relative to a pre-merger multi-product Nash-Bertrand equilibrium).
  5. Discuss the potential issues with the analysis you performed in the previous question. Offer at least four separate issues. How can you deal with these issues?