

Please note that the clarity of your answers will be valued.

You are working for the economic department of the French competition authority. Today, you receive a new merger notification concerning an industry composed of 4 competing firms:

- firm 1 which sells products 1 to 5,
- firm 2 which sells products 6 to 10,
- firm 3 which sells products 11 to 13,
- firm 4 which sells products 14 to 20.

Firms 3 and 4 announce their intention to merge. Each product $j = 1, \dots, 20$ is produced at (constant) marginal cost c_{jt} (which depends on an input price v_{jt}) and is defined by $\{p_{jt}, q_{jt}, x_{jt}, \xi_{jt}\}$, where p_{jt} denotes its price, q_{jt} its total quantity sold, x_{jt} its (non-price) characteristic, and ξ_{jt} its unobserved characteristic term. Denote by δ_{jt} the quality index of product j :

$$\delta_{jt} = \beta_0 + \beta_1 x_{jt} - \alpha p_{jt} + \xi_{jt} \quad (1)$$

The (quality) index for the outside good $j = 0$ is given by $\delta_{0t} = 0$ and q_{0t} denotes its total quantity purchased.

Demand. Consumers behave on the market according to the logit model, which yields the following demand function for product j in market t :

$$s_{jt}(\delta_t) = \frac{\exp(\delta_{jt})}{1 + \sum_{k=1}^{20} \exp(\delta_{kt})} \quad (2)$$

where $\delta_t = (\delta_{1t}, \dots, \delta_{20t})^\top$.

1. Load the dataset “Data_exam_pre” that contains information on pre-merger market outcomes. Describe the data using simple descriptive statistics (e.g., mean, min, max, percentiles).
2. Ignoring the outside good, compute the market shares of each firm: $s_f = \frac{1}{T} \sum_{t=1}^T \sum_{j \in \mathcal{J}_f} \frac{q_{jt}}{\sum_{k=1}^{20} q_{kt}}$, where T is the total number of markets and \mathcal{J}_f is the set of products owned by firm f . Compute the pre- and post-merger Herfindahl-Hirschman Index (HHI). What can you say about the level of concentration and the potential merger effect? Does the HHI provide a reliable measure of the merger effect? Explain and justify your answer.
3. Taking into account the outside good, compute the market share of each product: $s_{jt} = \frac{q_{jt}}{\sum_{k=0}^{20} q_{kt}}$. Based on Berry’s (1994) inversion of the logit model, estimate the vector of demand parameters $\theta^d \equiv (\beta_0, \beta_1, \alpha)^\top$ by OLS. Compute the standard errors and display the results in a table. Comment.
4. Estimate the vector of demand parameters $\theta^d \equiv (\beta_0, \beta_1, \alpha)^\top$ by TSLS or GMM using as instrumental variables:
 - the cost shifter v_{jt} only,
 - the BLP-type instruments $\sum_{k \in \mathcal{J}_{f(j)} \setminus \{j\}} x_{kt}$ and $\sum_{k \in \mathcal{J} \setminus \mathcal{J}_{f(j)}} x_{kt}$ only (where \mathcal{J} is the set of product offered on the market and $\mathcal{J}_{f(j)}$ is the set of products sold by the owner of product j),
 - the cost shifter and the BLP-type instruments together.

Compute the standard errors and display the results in a table.

Which set of instruments do you prefer? Compare the OLS and the TSLS/GMM estimates. Which estimator do you prefer? Justify your answers.

Supply.

5. Using your preferred estimated demand parameters, compute the pre-merger price-cost margins of products assuming that (i) firms compete in prices and (ii) firms collude. Show the distribution of price-cost margins implied by each model of conduct using a histogram. Comment.
6. For each model of firm conduct, compute the marginal cost of products and show the distribution using a histogram. What is the most plausible model of conduct? Comment.

Merger simulation.

7. Given the vector of marginal costs $\mathbf{c}_t^{\text{pre}}$ implied by your preferred model of conduct, approximate the post-merger prices for each market t using the following formula:

$$\mathbf{p}_t^{\text{post}} = -(\mathbf{S}_{\mathbf{p}_t}^{\text{pre}} \circ \mathbf{O}_F^{\text{post}})^{-1} \mathbf{J}_t(\mathbf{p}_t^{\text{pre}}) + \mathbf{c}_t^{\text{pre}}$$

where $\mathbf{S}_{\mathbf{p}_t}^{\text{pre}}$ is the matrix of partial derivatives of market shares with respect to prices $\frac{\partial s}{\partial p}$ evaluated at the pre-merger prices, \circ denotes the Hadamard product, $\mathbf{O}_F^{\text{post}}$ is the post-merger ownership matrix, and $\mathbf{J}_t(\mathbf{p}_t^{\text{pre}})$ is the vector of market shares evaluated at the pre-merger prices. Compute the average percentage price change of the merging and the non-merging firms. Explain your results and comment.

8. Instead of relying on an approximation, compute the post-merger prices for each market by solving the following nonlinear system:

$$\underbrace{\mathbf{p}_t^{\text{post}} + (\mathbf{S}_{\mathbf{p}_t}^{\text{post}} \circ \mathbf{O}_F^{\text{post}})^{-1} \mathbf{J}_t(\mathbf{p}_t^{\text{post}})}_{\mathbf{c}_t^{\text{post}}} - \mathbf{c}_t^{\text{pre}} = \mathbf{0}_J \quad (3)$$

Again, compute the average percentage price change of the merging and the non-merging firms. Compare your results with those obtained under the approximation method and explain the differences.

Retrospective merger analysis. Consider that the merger between firms 3 and 4 is cleared. Several years later, the French competition authority asks you to evaluate the impact of the merger based on post-merger market outcomes.

9. Load the dataset “Data_exam_post” that contains information on both pre- and post-merger market outcomes. For each market t , compute the average price of the merging and the non-merging firms and display both price trends in a figure.
10. Do prices of the merging and the non-merging firms trend differently before the merger? Test this parallel trend by regressing the logarithm of the price before the merger on a linear trend, a linear trend interacted with a dummy variable for the merging firms, and product fixed effects, that is:

$$\ln(p_{jt}) = \beta_j + \text{Trend}_t + \text{Trend}_t \times \mathbb{1}\{\text{Merging}\}_{jt} + u_{jt}$$

Comment.

11. Estimate the price effect of the merger using a difference-in-differences approach where the non-merging firms are used as a control group (include product and market fixed effects in your regression). Compare your results with the merger simulation. Comment.