Ownership Consolidation and Product Characteristics: A Study of the US Daily Newspaper Market *by* Ying Fan, 2013 AER

Discussants: Kuan Liu and Yingtong Xie
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Introduction

Question: What are the price and welfare effects of ownership consolidation?

- Looks at the daily newspaper market, a case study of Minneapolis area.
- The model is based on Berry, Levinsohn, and Pakes (1995) (henceforth BLP). Add **mutiple** discrete choice.
  - A consumer can choose up to *two* newspapers.
- Previous literature focuses on the resulting price changes with exogenous product characteristics.
  - Affects identification, estimation, and results.
- This paper endogenizes both the price effects and changes in product characteristics.

The BLP Model—Demand

- BLP provides a method for estimating demand off a **static** discrete choice model.
- It only uses **aggregate** level data.
- A widely used preference is the logit model of random coefficients:

$$u_{ij} = x_j\beta_i - \alpha p_j + \xi_j + \varepsilon_{ij}$$

  where ε_{ij} is i.i.d and follows a Type 1 EV.
- $x_j = (x_{j1}, ..., x_{jK})$ is a vector of K characteristics of product j
- $\beta_i = (\beta_{i1}, ..., \beta_{iK})$ is a vector of consumer $i's$ tastes on the K characteristics
- ξ_j is the unobserved characteristics of product j
- p_j is the price of product j
- The parameters we are interested in estimating are: α, β_i

The BLP Model—Demand

- Each element of the taste vector β_i has two components:

$$\beta_{ik} = \underbrace{\beta_k}_{\text{common taste}} + \underbrace{\sigma_k \eta_{ik}}_{\text{idiosyncratic taste}}$$

  where η_{ik} is i.i.d. and follows a $N(0,1)$.
- Note that we can separate the common and idiosyncratic parts in preferences:

$$v_{ij} = \sum_k x_{jk}\sigma_k \eta_{ik} + \varepsilon_{ij} \qquad \text{(Idiosyncratic)}$$

$$\delta_j = x_j\beta - \alpha p_j + \xi_j \qquad \text{(Common)}$$

  where $\beta = (\beta_1, ..., \beta_K)$
- In turn, we may re-write the preferences of consumer i for product j as follows.

$$u_{ij} = \delta_j + v_{ij}$$

Model Set Up — Demand

Demand for newspapers

- Aggregation of heterogeneous households' multiple discrete choices at the county level. Subscribe to either 1 or 2 newspapers.
- Probability that household i chooses newspaper j in county c year t:

$$\Pr(u_{ijct} \geq \max_{h=0,\ldots,J_{ct}} u_{ihct}) + \sum_{j' \neq j} \Pr(u_{ij'ct} \geq u_{ijct} \geq \max_{h \neq j'} u_{ihct}, u_{ijct} - \kappa \geq u_{i0ct})$$

- Household i's conditional indirect utility is:

$$u_{ijct} = p_{jt}\alpha + \mathbf{x}_{jt}\beta_{ict} + \mathbf{y}_{jct}\psi + \mathbf{z}_{ct}\varphi + \xi_{jct} + \epsilon_{ijt}$$

(Compare to BLP: $u_{ij} = x_j\beta_i - \alpha p_j + \xi_j + \varepsilon_{ij}$)

- $\mathbf{x}_{jt}$ is a vector of endogenous newspaper characteristics.
- β_{ict} is a random coefficient for household heterogeneity in tastes for newspaper characteristics: $\beta_{kict} = \beta_k + \mathbf{z}_{ct}\boldsymbol{\theta}_k + \sigma_k\zeta_{kict}$.

The BLP Model—Demand, Cont'd

- The demand of product j is:

$$s_j(x_j, p_j, \xi_j) = \int \frac{exp(\delta_j + \sum_k x_j \eta_{ik} \sigma_k)}{1 + \sum_{j'} exp(\delta_{j'} + \sum_k x_{j'} \eta_{ik} \sigma_k)} dF(\eta_j)$$

- Note that the integrand above is just the CCP of the model.
- $s_j(x_j, p_j, \xi_j)$ is interpreted as market share of product j, which has an empirical counterpart $\hat{s}_j$.
- BLP proved that the following is a contraction:

$$\delta_j^{(n+1)} = \delta_j^{(n)} + \ln \hat{s}_j - \ln s_j(x_j, p_j, \xi_j)$$

- We can compute $s_j(x_j, p_j, \xi_j)$ using the model and calculate $\hat{s}_j$ from data. We are able to find the value of δ_j by iterating the above contraction until convergence.
- Knowing δ_j, the value of ξ_j is:

$$\xi_j = \delta_j - (\xi_j \beta - \alpha p_j)$$

Model Set Up — Demand, Cont'd

- County market penetration of newspaper j, measured as the share of total newspaper circulation in county c: $s_j(\delta_{ct}, \mathbf{x}_{ct}; \delta, \kappa)$.
- Following BLP to invert the market penetration equation to obtain the relative mean utility

$$\begin{aligned}\delta_{jct}(\mathbf{s}_{ct}; \sigma, \kappa) =& p_{jt}\alpha + \mathbf{x}_{jt}\beta + \mathbf{x}_{jt}\mathbf{z}_{ct}\theta + \mathbf{y_{jct}}\psi \\ &+ \mathbf{z}_{ct}\varphi + \xi_{jct} - (t - t_0)\rho \end{aligned} \quad (1)$$

  which is the difference between mean utility in county c from newspaper j and the mean utility of the outside choice.
- Demand for newspaper j

$$q_j(\delta_{ct}, \mathbf{x}_{ct}; \boldsymbol{\sigma}, \kappa) = \sum_{c: c \in \mathcal{C}_{jt}} H_{ct} s_j(\delta_{ct}, \mathbf{x}_{ct}; \boldsymbol{\delta}, \kappa)$$

- Demand for advertising:

$$\log a_{jt} = \eta + \lambda_0 \log H_{jt} + \lambda_1 \log q_{jt} + \lambda_2 \log r_{jt} + \iota_{jt} \quad (2)$$

Model Set Up — Supply

- Partial overlapping of newspaper coverage
- Assumes: National newspapers don't compete with small ones; compete in counties that has enough circulation; can exploit economies of scope if its home county is nearby.
- In the game, all player publishers choose characteristics in the first stage and prices and advertising rates in the second stage.
- Profit function for the first-stage decision is

$$\pi_{j,\mathrm{I}}(\mathbf{x}) = \pi_{j,\mathrm{II}}(\mathbf{P}^*(\mathbf{x}), \mathbf{r}^*(\mathbf{x}), \mathbf{x}) - fc(\mathbf{x}_j, \nu_j; \tau)$$

- $\pi_{j,\mathrm{II}}(\mathbf{P}^*(\mathbf{x}), \mathbf{r}^*(\mathbf{x}), \mathbf{x})$: variable profit from circulation and advertising

$$\pi_{j,\mathrm{II}} = (p_j q_j - ac_j q_j) + (r_j a_j - mc_j a_j) + (\mu_1 q_j + \frac{1}{2}\mu_2 q_j^2)$$

Model Set Up — Equilibrium Conditions

Optimal display advertising rate as a function of circulation Q_{jt}:

$$r_{jt} = \bar{\zeta} + \frac{\gamma_3}{1 + 1/\lambda_2} \log(Q_{jt})^{\gamma_4} q_{jt} + \zeta_{jt} \tag{3}$$

First-order condition w.r.t the subscription price in matrix form:

$$\mathbf{p} = \Delta^{-1}\mathbf{q} - [\Lambda + (\mu_1 + \mu_2 \mathbf{q})] + \Gamma \mathbf{q} + \mathbf{ac}^{(q)} \tag{4}$$

- $\Delta_{hj} = -\partial q_j / \partial p_h$; Λ as vector of the effect of circulation on display advertising profit; Γ captures economies of scale and scope.

Necessary optimality condition for the kth characteristic in the first-stage:

$$\sum_{h \in \mathcal{J}_{mt}} \left(\frac{\partial \pi^{II}_{ht}}{\partial x_{kjt}} + \sum_{j' \in \mathcal{J}_{g(jt)}} \frac{\partial \pi^{II}_{ht}}{\partial p_{j't}} \frac{\partial p^*_{j't}}{\partial x_{kjt}} \right) = \tau_{k0} + \tau_{k1} x_{kjt} + \nu_{kjt} \tag{5}$$

Data

- New dataset of the US newspaper market between 1997 and 2005.
- Information on newspaper characteristics: news hole, the number of reporters, the local news ratio, variety, the frequency of publication, and edition.
- 5,843 newspaper observations and 8,947 county observations over all years.
- Take equations (1), (2), (3), (4), and (5) to the data to estimate parameters.
  - calculate the empirical values of the unobservables and disturbances using these 5 equations and data.
  - In this paper, these items include $(\xi_{jct}, \iota_{jt}, \omega_{jt}, \zeta_{jt}, \nu_{kjt})$.

The BLP Paper—Estimation

Key Assumption: Product characteristics are exogenous.

Instruments: Product characteristics of competitors.

- Let Θ denote the set of parameters to be estimated; let $\omega(\Theta)$ be the values of unobservables and disturbances given value of Θ (e.g. ξ_j).
- The GMM estimator is:

$$\Theta^* = arg \min_{\Theta} \omega(\Theta)' Z W Z' \omega(\Theta)$$

where $Z = (z_1, ...z_M)$ is the set of instruments and W is a weighting matrix

- Typically there are more moment equations than parameters so that the model is over-identified.
- In Fan's paper the estimator is formed in the same way, only that her instruments are different.

This Paper—Estimation

Key Assumption: Entry and location choices are exogenous.

Instruments: Demographics in competitors' market

- In the model, newspaper publishers know the unobserved county specific newspaper taste ξ_{jct} and unobserved cost disturbances $\zeta_{jt}, \omega_{jt}, \nu_{jt}$ before deciding on characteristics and prices.
- Partial overlapping feature of the newspaper industry:
  - Competitors' price and characteristics choices affect home newspaper's decision
- There are 38 parameters in total to be estimated.
- Estimation utilizes data from all states in the U.S.

Estimation Results

- Endogenous characteristics:
  - More educated and older people prefer more local content.
  - A crease in local news ratio by 0.1 percent is equivalent to an increase in annual price by \$0.19.
- Exogenous characteristics:
  - Readers prefer morning newspapers and they prefer local newspapers.
- Demographics:
  - Duplicate readership is negligible in about 45 percent of the county-year pair with multiple newspapers.
  - In county-year pair where some households purchase two newspapers, about 9.41 percent subscribers do so.
- Households' outside choice has a time trend ρ that is positive.
  - A decrease in utility over time from subscribing to newspapers.
  - Consistent with the advent of online news and other news media.

Counterfactual simulations

- Computed using best-response iteration.
- Welfare measure through compensating variation

$$CV_{ict} = \frac{V^0_{ict} - V^1_{ict}}{\alpha}$$

  where $V^0_{ict} - \alpha I_i$ and $V^1_{ict} - \alpha I_i$ are the expected maximum utility for household i with income I_i before and after a merger.
- Using the same set of parameters from the estimation results but recalculating the corresponding utility.

Counterfactuals - A Case Study

A Case Study for the Minneapolis/St.Paul Metropolitan Area:

- Five newspapers in the game:
  1. the Minneapolis Star Tribune (the Star),
  2. the St.Paul Pioneer Press (the Pioneer),
  3. and three other smaller newspapers.
- Consolidation of the Star and the Pioneer.
- Both would increase price but have a decrease in circulation.
- Incentive to shift circulation to larger newspaper, the decrease in the Pioneer has a bigger margin.
- Welfare analysis through compensating variation shows a decrease in reader surplus by $3.28 million.
- Ignoring characteristic adjustment underestimates reader welfare loss by $1.05 million.

Welfare Analysis of Duopoly and Triopoly Mergers

The welfare effects of such mergers and how they vary with market characteristics:

- Changes in average per-household reader surplus
- An increase in the penetration by 1 percentage point corresponds to a welfare loss of $0.42 per household on average.
- A larger overlap of merging parties' circulation area, the bigger is the welfare loss for readers.
- A larger asymmetry between the mergers' circulation volume, the smaller is the welfare loss.

This paper does not consider entry/exit in the newspaper market.