Endogenous Products

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Roadmap of Talk

Motivation

Berry and Waldfogel (1999, RAND)

Eizenberg (2014, ReStud)

Endogenous Product

- *What do I mean by this?*[1]

- Firms consider market interactions (pricing, etc) when optimally choosing entry of products, or positioning of products in characteristics space, or product-line length.

[1] This is not an accepted term in the literature.

Way-back Motivation – IO pre-1980

- Understand the "effect" of x on profits/prices/sales.

$$y_{jt} = \beta_0 + \beta_1 * HHI_{jt} + \beta_2 * x_{jt} + \alpha * \mathbf{z}_{jt} + \varepsilon_{jt}$$

- Many times the level of observation is the industry.
- If not, still have rather aggregate data on the firms.
- HHI or shares are endogenous. Typically no serious attempt to truly identify the effect.
- Example: what is the "effect" of concentration on prices.
  - Typically, theory makes a stark prediction.
  - But market structure is endogenous. So the empirical strategy is very important!
- 1980's revolution in IO (Tirole et. al.): Let's think seriously about strategic interactions and choices like price, entry, marketing, product positioning.

Mankiw and Whinston (1986 RAND)

Main Idea

- Firms face strategic interactions in prices/quantities.
- Free entry condition with non-zero fixed costs to enter.
- Entrant causes incumbent firms to reduce output
- *Entry of last entrant is more valuable to entrant than society*
- Because net total increase in production (lower prices) is less valuable than fixed costs.

Mankiw and Whinston (1986 RAND)

Two Takeaways

1. Entry is endogenous – long run? short run? Different for different industries.

2. Socially optimal may not be privately optimal with imperfect competition.
   - Post-entry business stealing – new entrant makes profit at expense of incumbents.
   - If this is true for marginal entrant, so private value greater than social value.

Mankiw and Whinston (1986 RJE)

Details

- Quite general assumptions lead to weakly excessive entry compared to second best (social planner entry with post-entry competition)

Assumption 1. $Nq_N > \hat{N}q_{\hat{N}}$ for all $N > \hat{N}$ and $\lim_{N\to\infty} Nq_N = M < \infty$.

Assumption 2. $q_N < q_{\hat{N}}$ for all $N > \hat{N}$.

Assumption 3. $P(Nq_N) - c'(q_N) \geq 0$ for all N.

- If there is love of product variety, now the trade-off becomes an empirical question.

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Berry and Waldfogel (1999 RJE)

Main Idea

- Take Mankiw and Whinston to data.
- What is optimal number of radio stations?

Empirical Strategy

1. Estimate listener demand.
   - More listeners with more variety.
   - More variety in larger markets.
2. Estimate advertiser willingness to pay for advertisements.
3. Estimate entry costs (in revenues, $) a la Berry (1992).
   - Recall: Berry (1992) is a discrete choice with unit-less latent payoffs.

Radio

- Homogeneous goods, where listeners are sold to advertisers.
- Price of an ad:
$$p(N) = p(Ns(N))$$
- Price of ads (rev. per listener) declines in total listening share.
- Price a function of listener share, not total listeners. Implies num. of advertisers scales with market size.
- Fixed cost, F. Entry decision exactly that of Mankiw and Whinston.

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- Fixed cost, F. Entry decision exactly that of Mankiw and Whinston.
- *Yes, they ignore things like targeting, multi-homing, ads congestion...but we need to start somewhere. This paper is truly groundbreaking on multiple dimensions.*

Free Entry

- Profits:

$$\pi(N) = Mp(N)s(N) - F$$

- Determination of num. of eqm firms, N_e:

$$\pi(N_e) \geq 0 \quad and \quad \pi(N_e + 1) < 0$$

- Consider social welfare the welfare of advertisers minus fixed station costs. Planner chooses N to max

$$M \int_0^{Ns(N)} p(x)d(x)$$

- with FOC (like MW86):

$$\pi(N) + MNp(N)\frac{\partial s}{\partial N}$$

- and $\frac{\partial s}{\partial N}$ is negative from MW86 – so we know entry is excessive.

Monopoly Entry

- Consider a monopolist who owns all of the stations.

$$N\pi(N) = R(N) - NF$$

- Internalizes the business stealing effect.
- Monopoly profit increases less in output than social planner because social planner values *inframarginal* benefit of reduction in price caused by additional station.
- Why is this important? The policy prescription is not to grant monopoly power.

Radio Data

DGP - Listeners

- Use survey data on radio listening habits.
- Nested logit a la Berry (1994).

$$u_{ij} = \delta_j + \nu_i(\sigma) + (1-\sigma)\epsilon_{ij}$$

- As $\sigma \to 1$ then stations are identical. Complete biz-stealing and total quantity does not expand with additional entrant.
- Awkwardness: Entry model has identical firms, but Berry (1994) is for heterogeneous firms – $\delta_j = \delta$.

$$s_j(N, \delta, \sigma) = \frac{1}{N} \frac{N^{1-\sigma}}{e^{-\delta} + N^{1-\sigma}}$$

DGP – Advertising Prices

- Fixed number of ads per hour.
- Price of ad proportional to # of listeners.
- Tot. Rev. is mkt ad price per listener $\times$ avg. # listeners.
- Inverse advertising demand curve:

$$p = \alpha(S(N))^{-\eta},$$

where $S(N)$ is total share listening to radio, η is inv. elas. of demand, and α is a demand shifter.

- Estimating equation:

$$ln(p_k) = x_k\gamma - \eta ln(S_k) + \omega_k$$

Fixed Costs

- Firms can choose to enter/exit the market and incur fixed costs.

$$ln(F_k) = x_k\mu + \lambda v_k$$

- Fixed costs are the same for all firms (modulo the stochastic term), so we can estimate this as an ordered probit.

- Eqm: $\pi(N_e) \geq 0$ and $\pi(N_e + 1) < 0$.

- Unlike Bresnahan and Reiss, we have outcome data! What do we do here?!

- Use outcome data to construct variable profits $v(N) = Mp(N)s(N)$

Empirical Strategy

- Share equation (linear IV), ads price equation (linear IV), entry likelihood.
- Jointly estimate using GMM.

$$g(\theta) = \sum_k \begin{pmatrix} \xi_k(\beta, \sigma) z_k \\ \omega_k(\gamma, \eta) z_k \\ \partial ln(L_k(\theta)) / \partial(\mu, \lambda) \end{pmatrix}$$

- Key is that there is nothing “endogenous” in the log-likelihood function.

Welfare of Free Entry

- Welfare in terms of advertisers and stations (not listeners).
- σ is the key parameter determining the biz-stealing effect.

TABLE 4 Comparison of Free Entry, Optimality, and Monopoly

	Free Entry	Optimal	Monopoly
In-metro entry	2,509	649	341
		(46)	(55)
Aggregate costs ($ millions)	5,007	1,144	602
	(3)	(92)	(101)
Aggregate revenue ($ millions)	5,100	4,334	3,959
		(204)	(173)
Welfare ($ millions)	5,331	7,640	7,422
	(3,064)	(3,037)	(2,878)
Ad price	277	326	375
		(11)	(48)
Listening share (%)	12.91	9.28	7.53
		(.19)	(.50)

The free-entry numbers without standard errors are calculated directly from data. The difference between free entry and optimal welfare has a standard error of 167.

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