

Consumer Heterogeneity in Two-Sided Markets

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AmEx and the Globe

American Express and Boston Globe

- Both two-sided markets but...
 - AmEx
 - Loyalists value acceptance more than marginals
 - Imperfect internalization because no discrimination
 - Higher card-holder price \implies more cross-subsidies
 - Classic 2sms logic (Rochet and Tirole 2003)
 - Globe
 - Loyalists hate advertising more
 - Ad prices too low?
 - Higher subscription price \implies less ads, higher prices
 - Ignored or assumed away by current analysis
- Today: full Rochet and Tirole (2006) accommodates both
 - Crucial difference is *source of consumer heterogeneity*

Outline

- 1 Two-sided markets and RT2006 model
- 2 Monopoly platform pricing
- 3 Socially optimal pricing
- 4 Comparative statics and identification
- 5 Special cases
- 6 Applications
- 7 Conclusion

Two-sided markets and the RT2006 model

- Definition of 2sms controversial
- For me: modeling approach (not market-type), useful when
 - 1 Cross-network effects
 - 2 Bilateral market power
 - 3 Market expansion
- Otherwise much easier approaches
- Simple, but general model by RT2006...assumptions:
 - 1 Valuations exogenous, no direct interactions
 - 2 (Direct) Network effects only across
 - 3 Affine valuations (not essential) and random sample
 - 4 Consumers equally valuable/harmful to other side

Model primitives

1 Demand

- Two groups of consumers A and B, each unit mass
- Consumers heterogeneous in two values
 - Fixed *membership* benefit/cost B_i^j (Armstrong)
 - *Interaction* benefit/cost b_i^j per partner (RT2003)
- $$U_i^j = B_i^j + b_i^j N^j - P^j(N^j)$$
- Arbitrary correlations allowed (only smoothness)

2 Supply

- Membership costs C^j and interaction cost c
- Only uniform pricing (no discrimination)

3 Equilibrium

- 1 Firms choose price (schedules) anticipating...
- 2 Induced equilibrium determines participation/demand

Participation rates and price schedules

- Potential multiplicity (for some price schedules)
- But unique equilibrium prices $P^I(N^I, N^J)$
 - So multiplicity inessential
 - Only possible multiple equilibria given prices
 - Evans and Schmalensee (2009)'s “failure to launch”
- Platform can always achieve desired $(\tilde{N}^A, \tilde{N}^B)$ uniquely
 - Set *full insurance price schedule* $P^I(N^J) \equiv P^I(\tilde{N}^I, N^J)$
 - Simple in many markets
 - Thus we can ignore coordination problem
 - Why not more common?
- So platform just chooses participation rates!
 - No more fixed point: dramatically simplifies analysis

Privately optimal pricing

$$\pi(N^A, N^B) = (P^A [N^A, N^B] - C^A) N^A + (P^B [N^B, N^A] - C^B) N^B - cN^A N^B \quad (1)$$

For first-order condition directly take derivatives:

$$P^I = C^I + cN^J - \bar{b}^J N^J + \mu^I$$

- $\bar{b}^I \equiv$ average interaction benefit of *marginal* consumers
- Also equivalent Lerner form
- Same as one-sided, but internalize marginal cross-value
- v. RT2006: primitives not just multiproduct monopoly
- One step to simplify to...
 - Armstrong $P^I = C^I - b^J N^J + \mu^I$
 - Or RT2003 $p^A + p^B - c = m^A = m^B$
- Also give sufficient conditions (first and near-necessary)

Pigouvian pricing and the Spence distortion

Start with first-best, takes Pigou (1920) form

$$P^I = C^I + cN^J - \tilde{b}^J N^J$$

- $\tilde{b}^I \equiv$ avg. int. benefit of *all participating* consumers
- Thus two distortions
 - 1 Classic market power: prices too high
 - 2 If $\bar{b}^I \neq \tilde{b}^I$ don't internalize right interaction benefits
 - Inability to price discriminate
 - Like Spence (1975)'s quality distortion, so *Spence distortion*
 - Even more important in two-sided markets
 - May go in either direction (credit cards vs. newspaper)
 - Depends crucially on source of consumer heterogeneity
 - So RT2003 \implies upwards, Armstrong \implies none

Ramsey-Oum-Tretheway pricing

- Optimum may require subsidies
- If these infeasible, Ramsey pricing is second best
- Ramsey pricing+externalities=Oum and Tretheway (1988)

$$P^I = C^I + cN^J - \left(\alpha \bar{b}^J + [1 - \alpha] \tilde{b}^J \right) N^J + \alpha \mu^I$$

$$\alpha = \frac{K + (\tilde{b}^A + \tilde{b}^B - c) N^A N^B}{N^A \mu^A + N^B \mu^B + (\tilde{b}^A + \tilde{b}^B - \bar{b}^A - \bar{b}^B) N^A N^B}$$

- I also do RT2003 (rate of return on variable costs)

Policy implications

Of course, we need calibration for policy implications but...

- 1 Prices may be below socially optimal level
- 2 Market power may be especially bad, or beneficial
- 3 Ramsey pricing calls for balanced regulation
- 4 Price discrimination more beneficial...or may be harmful

Armstrong or RT2003 models impose answer

Complements v. substitutes

- Most basic comparative static: “seesaw” principle
 - RT2006 seem to think it is general
- Not clear what it means more broadly: what prices?
 - Equivalent to substitution of participation rates in RT2003
 - Natural way to generalize...but not true generally
- Some definitions
 - 1 $\alpha \equiv \frac{b^A + b^B - c}{\pi}$ *marginal interaction surplus ratio*
 - 2 $\beta \equiv \frac{\mu_b^A}{\mu_b^B}$ *interaction heterogeneity ratio*
 - Decompose $\mu^I = \mu_b^I + \mu_B^I$ and aggregate $\mu = N^A \mu^A + N^B \mu^B$
- Substitutes if $\mu_b^B \leq 0$ or $\beta > \alpha$
- If $\mu_b^B > 0$, complements if $\alpha > \beta$, independent if $\alpha = \beta$
- Change in cross-subsidy versus scaling
- Again source of heterogeneity, link to normative properties
 - RT2003 \implies substitutes, Armstrong \implies complements

Equilibrium externalities

- For me: 2sms = externalities *in absence of transfers*
 - But other say “holding fixed price” *indirect* externalities
 - But what price? Model says only $P^I(N^{J^*})$ “matters”
- Perhaps more sensible: does I want C^J to rise or fall?
- Sign is same as $\tilde{b}^I - \bar{b}^I + \rho^I \chi^X$
 - $\rho^I \equiv \left. \frac{dP^I}{dC^I} \right|_{N^J \text{ fixed}}$ *pass-through rate*
 - χ^X is cross participation effect
- Crucial: infra-marginal v. marginal
 - But pass-through related to this as $V = \rho \mu D$ (other talk)
 - For example: RT2003 sign determined by ρ^{II}
 - Third derivative of log-demand important
- Even possible that $C^I \uparrow$ good for I
 - Again, when infra-marginal dominates marginal (by a lot)

Identification and other comparative statics

Lots of ambiguity left

- Much resolved by intuition, casual empiricism
- But rigorous empirics may help resolve some as well
- So what does data give us? Identification problem
 - I take a different approach vs. parametric or non-parametric
 - Parametric puts restrictions
 - Non-parameteric assumes infinite data
 - Instead: observe some derivatives, what do they say?
 - N^l variations give μ^l, \bar{b}^l
 - Signed C^l variations give substitutes v. complements
 - Measured C^l shocks given ρ^l, χ^x
 - Tests as well, demand side can replace cost shock
- In fact, methods give arbitrary comparative statics
 - In paper example of multiplicative demand shock

Unidimensional models

- Another way to resolve ambiguity is more structure
- Also make more concrete
- Natural direction: only one dimension of heterogeneity
 - Armstrong and RT2003 examples
 - But Armstrong heterogeneity rarely plausible
 - RT2003 restricts membership costs/benefits implausibly
 - Easily solved: only source of heterogeneity matters
 - *Generalized* RT2003 model potentially well-suited
 - Analyzed in paper; quite similar to RT2003
 - But still many markets seem mismatched to these
 - So here: two new models, perhaps more realistic
 - First is *Hybrid*: one side RT2003, one Armstrong
 - May fit some better (advertising, software platforms)
 - But better is one I'll discuss in more detail

Scale-Income model

- Idea: homogeneous ratio $\frac{b_i^l}{B_i} \equiv \beta^l$
- Either dimension may be negative
- Examples:
 - 1 Newspapers: reader wealth, advertiser size
 - 2 Software platforms: constant profit ratio, project size
- For concreteness: newspapers
- Now $\bar{b}^l = \frac{P^l}{N^J + \frac{1}{\beta^l}} \equiv P^l \nu^l$
- $\nu^J \mu^J \tilde{\rho}^J$ is Spence distortion
 - Sign determined by $\nu^l = \text{sign of } \frac{\bar{b}^l}{P^l}$
 - Serve large or small scale readers?
 - Tabloids v. serious papers
 - Different predictions on effects of competition, discrimination
- Predicts complementary participation for serious papers
- Empirical data now very useful

Identifying market power, predation and costs

- Identifying market power, predation are old open questions
- Two approaches, paper speaks to both
 - 1 Casual/applied
 - Use price cost margins, but 2sms complicate...
 - No reason to dismiss market power or predation
 - Just add in $\bar{b}^j N^j$
 - Not much harder to measure than other costs
 - 2 Structural (Bresnahan 1989)
 - Costs, other things may be hard to estimate directly
 - If so, can use data to back out: measure demand directly
 - Add: multiproduct, too many costs
- Under competition (guess) just adjust
 - Right marginal consumers, instruments to hold things fixed
- Not much more complicated than standard market

Mergers

Alternative merger analysis for 2sms is holy grail

- But requires work-horse model of competition
 - Working on this with Alex White (TSE)
 - But in mean time, my paper mostly monopoly
- Nonetheless three small contributions to merger analysis
 - 1 Quantity approach simplifies analysis, makes more possible
 - In appendix I show merger with non-two-sided firm easy
 - Companion does complements case in detail
 - General Armstrong single-homing competition
 - 2 Helps deal with multiplicity
 - Full insurance natural refinement of price schedules
 - 3 Source of consumer heterogeneity important (caution!)
 - RT2003 merger help welfare, lower overall prices
 - Under weak conditions Armstrong merger harmful both sides

Directions for future research

- Paper aspires to make two contributions
 - 1 Simplify analysis
 - 2 Importance of *source* of consumer heterogeneity
- Empirical applications: which models fit, test predictions
- Direct important extensions
 - 1 Direct interactions
 - 2 Crowding within a side
 - 3 Heterogeneous quality
 - 4 Price discrim., N -sided markets, regulatory design, etc.
- Two big, open theoretical questions
 - 1 Revenue maximizing matching (market design meets 2sms)
 - 2 Price schedules and coordination problems