Platform Competition and Seller Investment Incentives

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September 2009

Introduction

- Analyze the effect of intermediation on sellers' investment incentives.
- **Question 1: How does the presence of for-profit trading platforms affect sellers' investment incentives?**
  - More precisely: When are sellers' investment incentives stronger if they sell via (competing) for-profit rather than via open trading platforms?

Introduction

- Analyze the effect of intermediation on sellers' investment incentives.
- Question 1: How does the presence of for-profit trading platforms affect sellers' investment incentives incentives?
  - More precisely: When are sellers' investment incentives stronger if they sell via (competing) for-profit rather than via open trading platforms?
- **Question 2: How does the answer depend on market structure and the nature of the investment?**

Introduction

Mobile Platforms (such as DoCoMo or iPhone)

Other examples:

- Shopping mall developers rent stores to producers (or franchisees).
- Trade fairs rent booths to exhibitors.
- Internet retailers list products in their virtual shop.
- Retailers such as Walmart rent shelf space to producers
- Software platforms have applications run on their operating systems.
- Video game platforms charge royalties to game developers.
- Other examples: yellow pages, auction houses, etc.

Introduction

- linear models from the two-sided market literature
- comparison between
  - competing for-profit platforms (with two-sided access prices) and
  - two open platforms
- market structures:
  - two-sided single-homing model
  - competitive bottleneck with sellers on the multi-homing side
  - competitive bottleneck with sellers on the single-homing side

Introduction

- framework allows to address regulatory questions
  - price regulation on both sides of the market
    (possible extension: only on one side)
  - enforced compatibility of standards (move from single- to multi-homing)
  - prohibition of exclusive contracts (move from single- to multi-homing)
  - ...

Introduction

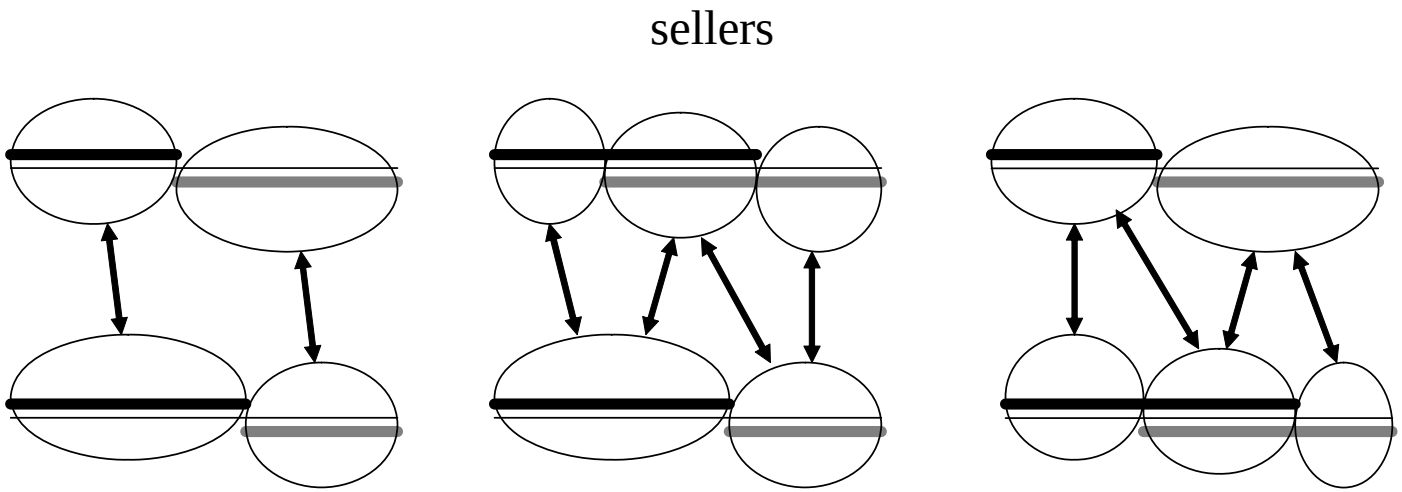

Figure 1:

Introduction

- Part I: investment incentives in reduced form
  - investments as an ex-ante commitment by sellers
- Part II: underlying micro models of investments that affect buyer-seller interactions

Related literature

- literature on two-sided markets
  - e.g. Caillaud and Jullien (Rand 2003), Rochet and Tirole (JEEA 2003, Rand 2006), and Armstrong (Rand 2006).
  - our model set-up related to Armstrong (Rand 2006) and Armstrong and White (ET 2007).
  - open vs for profit platforms: Hagiu (mimeo 2006) and Nocke, Peitz and Stahl (JEEA 2007); silent about investments.
  - our contribution: analysis of investment incentives in a two-sided market setting (+ various microfoundations for the reduced form approach).
  - empirical paper: Boudreau (mimeo 2006).

Related literature

- literature on micro-market structure and intermediation more generally
  - set of papers on the coexistence of matching (with search inefficiencies) and dealer market, self-selection of types (e.g. Gehrig, JEMS 1993)
  - Spulber (JPE 2003) analyzes sellers' (and buyers') investment incentives; shows that the introduction of a dealer market leads to stronger investment incentives
  - In our paper no search inefficiencies but indirect network effects central for investment incentives
- literature on R&D incentives and competition starting with Arrow (1962)

Main results

- Two-sided single-homing: Trade via for-profit platforms raises seller incentives to invest in cost reduction and quality improvement and lower incentives to invest in price discrimination.
- Two-sided single-homing: A social underinvestment problem with open platforms translates into a social overinvestment problem with for-profit platforms.
- Competitive bottleneck when sellers can multihome: trade via for-profit platforms leads to weaker investment incentives independent of the type of investment
- Competitive bottleneck when buyers can multihome: trade via for-profit platforms leads to stronger investment incentives independent of the type of investment (single seller)

Two-sided single homing: Timing of the game

- **Stage 0:** finite number of sellers make simultaneous investment decision y
- **Stage 1:** intermediaries set membership fees M_s^i, M_b^i on both sides of the market simultaneously.
- **Stage 2:** sellers privately learn their location in the product space and then sellers and buyers decide simultaneously which intermediary to visit (both sides single-home).
- **Stage 3:** *(monopoly) sellers set their short-term variable (price or quantity).*
- **Stage 4:** *buyers make purchasing decisions.*

Two-sided single homing: Buyers' and sellers' platform choice

- each side of the market is of mass 1
  - the total number of buyers adds up to 1, $n_b^1 + n_b^2 = 1$,
  - total mass of product adds up to one; K sellers, each with mass $1/K$ of products,
- a buyer at platform i buys one unit from each product at the same platform

Two-sided single homing: Buyers' and sellers' platform choice

- Denote π_1 profit per buyer if firm invested and π_0 profit per buyer if firm did not invest; similarly, for buyer's gain u_i
- κ share of firms that has invested
- buyer and seller surplus gross of any opportunity cost of visiting a platform

$$\begin{aligned} v_s^i &= n_b^i \pi_1 - M_s^i \text{ if seller has invested} \\ v_s^i &= n_b^i \pi_0 - M_s^i \text{ if seller has NOT invested} \\ v_b^i &= n_s^i(\kappa u_1 + (1-\kappa)u_0) - M_b^i \end{aligned}$$

- Denote $\widetilde{u} = \kappa u_1 + (1-\kappa)u_0$ and $\widetilde{\pi} = \kappa \pi_1 + (1-\kappa)\pi_0$.

Two-sided single homing: Buyers' and sellers' platform choice

- description of players:
  - Buyers are assumed to be uniformly distributed on the unit interval; seller location are independently drawn from this distribution.
  - Platforms are located at the extreme point of the unit interval
  - Participation is sufficiently attractive such that all buyers and sellers participate in the market.
- Sellers and buyers are assumed to incur an opportunity cost of visiting a platform which increases linearly in distance at rates τ_b and τ_s, respectively.
- standard Hotelling specification on both sides of the market

$$n_s^i = \frac{1}{2} + \frac{v_s^i - v_s^j}{2\tau_s} \text{ and } n_b^i = \frac{1}{2} + \frac{v_b^i - v_b^j}{2\tau_b}.$$

Two-sided single homing: Buyers' and sellers' platform choice

- numbers of buyers and sellers at the two platforms:

$$
\begin{aligned}
n_s^i &= \frac{1}{2} + \frac{(2n_b^i - 1)\widetilde{\pi} - (M_s^i - M_s^j)}{2\tau_s}, \\
n_b^i &= \frac{1}{2} + \frac{(2n_s^i - 1)\widetilde{u} - (M_b^i - M_b^j)}{2\tau_b}.
\end{aligned}
$$

- for given membership fees of buyers, an additional seller attracts $\widetilde{u}/\tau_b$ additional buyers.
- If the gains from trade $\widetilde{u}$ and $\widetilde{\pi}$ were large relative to opportunity costs, two intermediaries cannot be active because indirect network effects are too strong. We exclude this possibility.

Two-sided single homing: Buyers' and sellers' platform choice

– Then

$$
\begin{aligned}
n_s^i &= \frac{1}{2} + \frac{\widetilde{\pi}(M_b^j - M_b^i) + \tau_b(M_s^j - M_s^i)}{2(\tau_b\tau_s - \widetilde{u}\widetilde{\pi})}, \\
n_b^i &= \frac{1}{2} + \frac{\widetilde{u}(M_s^j - M_s^i) + \tau_s(M_b^j - M_b^i)}{2(\tau_b\tau_s - \widetilde{u}\widetilde{\pi})}.
\end{aligned}
$$

The number of buyers at one platform is not only decreasing in the membership fee for buyers on this platform but also, due to indirect network effects, in the membership fee for sellers.

Two-sided single homing: Platform pricing

– We can write platform i's profit (for simplicity of presentation zero costs) as

$$\begin{aligned}\Pi^i &= M_s^i\left(\frac{1}{2}+\frac{\widetilde{\pi}(M_b^j-M_b^i)+\tau_b(M_s^j-M_s^i)}{2(\tau_b\tau_s-\widetilde{u}\widetilde{\pi})}\right)\\ &\quad + M_b^i\left(\frac{1}{2}+\frac{\widetilde{u}(M_s^j-M_s^i)+\tau_s(M_b^j-M_b^i)}{2(\tau_b\tau_s-\widetilde{u}\widetilde{\pi})}\right).\end{aligned}$$

Two-sided single homing: Platform pricing

– first-order conditions in symmetric equilibrium, i.e. $M_s^1 = M_s^2 \equiv M_s$ and $M_b^1 = M_b^2 \equiv M_b$,

$$M_s = \tau_s - \frac{\widetilde{u}}{\tau_b}(\widetilde{\pi} + M_b),$$
$$M_b = \tau_b - \frac{\widetilde{\pi}}{\tau_s}(\widetilde{u} + M_s).$$

– Equilibrium price for seller M_s = (marginal costs) + the product differentiation term as in the standard Hotelling model – $(\widetilde{\pi} + M_b)\widetilde{u}/\tau_b$

Two-sided single homing: Platform pricing

- last term $(\widetilde{\pi} + M_b)\widetilde{u}/\tau_b =$ value of additional seller
  - Each additional seller attracts $\widetilde{u}/\tau_b$ additional buyers
  - Each additional buyers allows the intermediary to extract $\widetilde{\pi}$ per seller (without affecting the sellers' surplus)
  - and also yields a profit of M_b
- If $\frac{\widetilde{u}}{\tau_b}(\widetilde{\pi} + M_b)\uparrow$, then intermediaries price more aggressive.

Two-sided single homing: Platform pricing

– Nash equilibrium membership fees

$$M_s = \tau_s - \widetilde{u}, \text{ and } M_b = \tau_b - \widetilde{\pi}.$$

– equilibrium net surplus of sellers and buyers (gross of transportation cost)

$$\begin{aligned} v_s^* &= \tfrac{1}{2}\widetilde{\pi} + \widetilde{u} - \tau_s, \\ v_b^* &= \tfrac{1}{2}\widetilde{u} + \widetilde{\pi} - \tau_b. \end{aligned}$$

∗ v_s and v_b are increasing in the net gain of the other side and, to a lesser extent, also in the net gain of the own side.

Two-sided single homing: Open trading platform

- two platforms with open access, $\overline{M}_s = \overline{M}_b = 0$ (located at extreme locations)
  - each seller has access to half of the unit mass of consumers and derive net surplus (but gross of transport costs) equal to $\widetilde{\pi}/2$.
  - similarly for buyers
  - sufficient differentiation for no tipping (assumed to hold)

Two-sided single homing: Seller investments

- without loss of generality, each seller invests in some R&D or marketing activity for all or none of its products
- suppose that k of the other $K-1$ sellers invest
- seller i obtains $v_s^* = \frac{1}{2}\pi_0 + \widetilde{u}(\kappa) - \tau_s$ if it does not invest and $v_s^* = \frac{1}{2}\pi_1 + \widetilde{u}(\kappa + \frac{1}{K}) - \tau_s$ if it does
- The incentives to innovate are then determined by the effect of y on $\widetilde{\pi}$ and $\widetilde{u}$.

Two-sided single homing: Seller investments

- In a market with for-profit platforms, a seller's willingness-to-pay for the investment is $I^m \equiv \frac{1}{2}(\pi_1 - \pi_0) + \frac{1}{K}(u_1 - u_0)$.
- In a market with open platforms, this is $I^n \equiv \frac{1}{2}(\pi_1 - \pi_0)$.
- Denote $\Delta_\pi = \pi_1 - \pi_0$ and $\Delta_u = u_1 - u_0$.

Proposition 1. *In the two-sided single-homing model, for-profit trading platforms give stronger investment incentives for sellers if and only if the investment increases the buyer's surplus, i.e.*

$$I^m > I^n \iff \Delta_u > 0.$$

Competitive bottlenecks when sellers multi-home: Seller investments

Proposition 2. *In the competitive bottleneck model in which sellers are on the multi-homing side, for-profit trading platforms give stronger investment incentives for sellers if and only if the change of the buyer's surplus is larger than the change of the seller's surplus, i.e.*

$$I^m > I^n \iff \Delta_u > \Delta_\pi.$$

- condition is more demanding than the corresponding rule in the two-sided single-homing environment (provided that profits are increasing in the investment level y.)
  - Since intermediaries directly compete for buyers but not for sellers, access fees on the seller side are less sensitive to the investment.

Competitive bottlenecks when sellers single-home

Proposition 3. Under some conditions that are spelled out in the paper, *in the competitive bottleneck model in which sellers are on the single-homing side, for-profit trading platforms give stronger investment incentives for sellers if if the joint buyers' and sellers' surplus increases, i.e.*

$$I^m > I^n \iff \Delta_u + \Delta_\pi > 0.$$

- condition is less demanding than the corresponding rule in the two-sided single-homing environment (provided that profits are increasing in the investment level y.)
  - Since intermediaries directly compete for sellers but not for buyers, access fees on the seller side are more sensitive to the investment.

Summary of the reduced-form analysis

- Propositions 1 to 3: investment incentives are stronger in a market with for-profit instead of open platforms if and only if
  - $\Delta_u > 0$ in a market in which both sides single-home,
  - $\Delta_u > \Delta_\pi$ in a market in which buyers single-home and sellers can multi-home,
  - $\Delta_u + \Delta_\pi > 0$ in a market in which sellers single-home and buyers can multi-home.

Microfoundations for u and π

Set-up for given investment decisions

- each seller offers an independent product, i.e. a product that is neither a substitute nor a complement for the other products.
- Each consumer has independent variable demand for each of the products.
- Suppose that inverse demand for each product is given by $P(q) = 1 - q^{\alpha}$ for $\alpha > 0$.
- If $\alpha = 1$, demand is linear; if $0 < \alpha < 1$, demand is convex, and if $\alpha > 1$, demand is concave.
- Suppose that marginal cost is constant and equal to $0 \leq c < 1$.

Microfoundations

- Sellers can invest in R&D in order to
  - reduce their marginal cost of production (cost-reducing R&D joint venture),
  - improve the quality of their product (quality-improving R&D jointventure, quality or standard setting association),
  - enhance their ability to price discriminate through information sharing arrangement (price discrimination).
  - expand demand through joint marketing (demand expansion)
- determines u and π endogenously

Microfoundations: Summary

	cost-reducing R&D	quality standard	price discrimination	demand expansion
single-homing on both sides	+	+	–	+/–
multi-homing on seller side single-homing on buyer side	–	–	–	–
single-homing on seller side multi-homing on buyer side	+	+	+	+

Conclusion

- Analysis of investment incentives in two-sided markets (two-sided single-homing and competitive bottleneck)
- Comparison between a market with competing for-profit platforms and a market with open platforms
- Identify environments in which sellers invest more on for-profit than on open platforms
- Due to platform pricing, sellers partially internalize effects of investment on consumer rents.

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