U. Porto – Doctoral Programme in Economics

The Economics of Two-sided Markets

2. Platform competition

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Learning objectives

- At the end of this lecture, you should be able to…
  - Understand how two competing platforms set prices on both sides.
  - Compare two-sided singlehoming settings with competitive bottlenecks.
  - Understand why competing for-profit platforms may give higher incentives to innovate to sellers than free platforms.
  - Examine the effects of two-part tariffs and of negative within-side effects on platform competition.
- Background readings
  - Armstrong, M. 2006. Competition in Two-Sided Markets. *RAND Journal of Economics* 37, 668-91.
  - Belleflamme, P. and Peitz, M. 2010. Platform Competition and Seller Investment Incentives. *European Economic Review* 50, 1059-1076.
  - Belleflamme, P. and Toulemonde, E. 2009. *Negative Intra-Group Externalities in Two-Sided Markets*. International Economic Review 50, 245-272.

A model of platform competition

▪ Model

Mass 1 of sellers; linear transport cost τ_s

Platform 1 0 ——— 1 **Platform 2**

Mass 1 of buyers; linear transport cost τ_b

- 2 horizontally differentiated platforms
- Mass 1 of buyers and mass 1 of sellers uniformly distributed on [0,1].
- A buyer at platform i buys 1 unit from each seller on this platform.
- Buyer & seller surplus (gross of any opportunity cost) of visiting platform i:

$$v_b^i = n_s^i u - M_b^i \quad \text{and} \quad v_s^i = n_b^i \pi - M_s^i$$

Membership fees set by platform i

Number of sellers and of buyers active on the platform

Net gain from trade for each unit on the buyer side

Net gain from trade for each unit on the seller side

Two-sided singlehoming

- Model (cont'd)
  - Buyers and sellers are restricted to visit only one platform
    - Singlehoming on each side
  - Participation sufficiently attractive
    - All buyers and sellers participate: $n_b^1 + n_b^2 = 1$ and $n_s^1 + n_s^2 = 1$
  - Timing
    - Platforms simultaneously set membership fees on both sides.
    - Buyers and sellers simultaneously choose which platform to visit.
- Buyers and sellers' decisions
  - Indifferent agents: standard Hotelling specification

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

Two-sided singlehoming (2)

- Buyers and sellers' decisions (cont'd)
  - Developing the previous expressions yields

$$n_b^i(n_s^i) = \frac{1}{2} + \frac{1}{2\tau_b}\left[(2n_s^i - 1)u - (M_b^i - M_b^j)\right]$$

$$n_s^i(n_b^i) = \frac{1}{2} + \frac{1}{2\tau_s}\left[(2n_b^i - 1)\pi - (M_s^i - M_s^j)\right]$$

    - An additional seller attracts u/τ_b additional buyers.
    - An additional buyer attracts π/τ_s additional sellers.
  - Assumption
    - Indirect network effects are not to strong: $(u/\tau_b)\ (\pi/\tau_s) < 1$ or $u\pi < \tau_b\tau_s$
    - Otherwise only platform would be active (tipping)

Two-sided singlehoming (3)

- Buyers and sellers' decisions (cont'd)
  - Solving the previous implicit expressions:

$$n_b^i = \frac{1}{2} + \frac{u(M_s^j - M_s^i) + \tau_s(M_b^j - M_b^i)}{2(\tau_b \tau_s - u\pi)}$$

$$n_s^i = \frac{1}{2} + \frac{\pi(M_b^j - M_b^i) + \tau_b(M_s^j - M_s^i)}{2(\tau_b \tau_s - u\pi)}$$

    - Number of buyers (sellers) at one platform
      - not only ↓ with membership fee for buyers (sellers) on this platform
      - *but also* ↓ with membership fee for *sellers* (*buyers*) because of indirect network effects

Two-sided singlehoming (4)

- Platforms' pricing decisions
  - Platform i's problem: $\max_{M_b^i, M_s^i} (M_b^i - C_b) n_b^i + (M_s^i - C_s) n_s^i$
  - First-order conditions in a symmetric equilibrium

Value to the platform of additional sellers that one additional buyer attracts

$$M_b^1 = M_b^2 = M_b = C_b + \tau_b - \boxed{\frac{\pi}{\tau_s}(u + M_s - C_s)}$$

$$M_s^1 = M_s^2 = M_s = C_s + \tau_s - \boxed{\frac{u}{\tau_b}(\pi + M_b - C_b)}$$

Like in Hotelling model

Value to the platform of additional buyers that one additional seller attracts

Two-sided singlehoming (5)

- Platforms' pricing decisions (cont'd)
  - Nash equilibrium membership fees

$$M_b^* = C_b + \tau_b - \pi \text{ and } M_s^* = C_s + \tau_b - u$$

  - Note: peculiarity of the model $\rightarrow$ market is covered
    - A price reduction by one platform doesn't lead to market expansion but only to an increase in market shares (on both sides)
  - The side of the market that exerts a strong indirect network effect on the other tends to be subsidized.
  - The side of the market with little product differentiation tends to pay a lower fee.
  - $\rightarrow$ confirms qualitative results obtained in the monopoly platform case.

Two-sided singlehoming (6)

- Subgame-perfect equilibrium
  - Equilibrium partition: equal split of buyers and products
  - Equilibrium net surpluses

$$v_b^* = \tfrac{1}{2}u + \pi - (C_b + \tau_b)$$
$$v_s^* = \tfrac{1}{2}\pi + u - (C_s + \tau_s)$$

    - Increasing in the net gain of the other side and, to a lesser extent, in the net gain of the own side.
  - Equilibrium platforms' profits: $\Pi^i = \tfrac{1}{2}(\tau_b + \tau_s - u - \pi)$
    - Decrease with the size of indirect network effects.
    - Why? They make buyers and sellers more valuable to attract and thus intensify price competition.
    - True as long as both platforms are active.

Two-sided singlehoming (7)

- Generalization
  - More general formulation for intra- and inter-group network effects

$$v_b^i = u(n_b^i, n_s^i) - M_b^i \text{ and } v_s^i = \pi(n_b^i, n_s^i) - M_s^i$$

  - Notation

$$\begin{aligned} \Delta^u\left(n_b^i, n_s^i\right) &\equiv u\left(n_b^i, n_s^i\right) - u\left(1 - n_b^i, 1 - n_s^i\right), \\ \Delta^\pi\left(n_b^i, n_s^i\right) &\equiv \pi\left(n_b^i, n_s^i\right) - \pi\left(1 - n_b^i, 1 - n_s^i\right), \end{aligned}$$

$$\Delta_b^u \equiv \frac{\partial \Delta_u\left(n_b^i, n_s^i\right)}{\partial n_b^i}, \Delta_s^u \equiv \frac{\partial \Delta_u\left(n_b^i, n_s^i\right)}{\partial n_s^i}, \Delta_b^\pi \equiv \frac{\partial \Delta_\pi\left(n_b^i, n_s^i\right)}{\partial n_b^i}, \Delta_s^\pi \equiv \frac{\partial \Delta_\pi\left(n_b^i, n_s^i\right)}{\partial n_s^i}$$

  - Equilibrium fees:

$$\boxed{\begin{aligned} M_b^* &= C_b + \tau_b - \left(\Delta_b^u + \Delta_b^\pi\right)/2, \\ M_s^* &= C_s + \tau_s - \underbrace{\left(\Delta_s^u + \Delta_s^\pi\right)}_{\text{Evaluated at } (½,\, ½)}/2, \end{aligned}}$$

Two-sided singlehoming (8)

- Comparison with monopoly
  - Elasticity of the number of buyers and sellers w.r.t. to membership fees are $\eta_b = M_b / \tau_b$ and $\eta_s = M_s / \tau_s$
  - Equilibrium markups

-1 in monopoly formulae

$$\frac{M_b - (C_b - 2n_s\pi)}{M_b} = \frac{1}{\eta_b} \text{ and } \frac{M_s - (C_s - 2n_b u)}{M_s} = \frac{1}{\eta_s}$$

- Compared to the monopoly platform case, membership fee on one side is reduced *twice as strongly* in the size of the indirect network effect exerted by the other side.
- Effect of a lost seller on the platforms' profit is more pronounced under competition.
- This lost seller joins the competitor's platform and thus makes it more difficult to keep the same number of buyers.

Competitive bottlenecks

- Effects of multihoming
  - Suppose sellers can multihome while buyers can only singlehome.
  - A seller lost to one platform is not a seller gained by the other platform.
  - Intermediaries have to be more concerned with losing buyers.
  - Intermediaries compete fiercely for buyers
    - Tends to lead to low and possibly even negative prices for buyers accessing the platform.
  - **Lesson**: In a market with competing intermediaries in which sellers can set up shops at both intermediaries, the sellers' surplus is ignored in the pricing decisions of the intermediary. For any given number of buyers, the intermediary maximizes the joint surplus between buyers and the intermediary itself.

Competitive bottlenecks (2)

Model

- Indifferent agents
  - Same as before for buyers: indifference between the 2 platforms
  - For sellers: indifference between platform i and no participation

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

- Developing the previous expressions yields

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

Competitive bottlenecks (3)

- Model (cont'd)
  - Solving for platforms' pricing decisions

$$M_b^* = C_b + \tau_b - \tfrac{\pi}{4\tau_s}(3u + \pi - 2C_s)$$

$$M_s^* = \tfrac{1}{2}(C_s + \tfrac{\pi}{2}) - \tfrac{u}{4}$$

- On the seller side, platforms have monopoly power.
  - If they focused only on sellers, they would charge a monopoly price equal to $C_s/2 + \pi/4$ (assuming that each seller would have access to half of the buyers and, therefore, would have a gross willingness to pay equal to $\pi/4$).
  - This price is adjusted downward by $u/4$ when the indirect network effect that sellers exert on the buyer side is taken into account.
- On the buyer side, platforms charge the Hotelling price, $C_b + \tau_b$, less a term that depends on the size of the indirect network effects.

Extension 1 - **Sellers' investment incentives**

- Abstract model of trade on a platform (Belleflamme and Peitz, EER, 2010)

K sellers; each sells a mass *1/K* of products; draw their location from a uniform distribution (learn it after investment decision; private information); linear transport cost τ_s

Mass 1 of buyers; draw their location from a uniform distribution (private information); linear transport cost τ_b

Sellers' investment incentives (2)

- Comparison between
  - Intermediated trade: 2 for-profit platforms
  - Non-intermediated trade: 2 free platforms (benchmark)
- In 3 different market structures
  - Both sides of the market singlehome
  - Sellers multihome, buyers singlehome
  - Buyers multihome, sellers singlehome
- Seller investments
  - Different types: Cost reduction, quality improvement, marketing measures that facilitate price discrimination or demand expansion
  - Long-term decisions giving commitment to sellers
    - Decided before sellers know their opportunity costs of visiting platforms and before platforms set their prices.

Sellers' investment incentives (3)

- Timing for intermediated trade
  - Stage 1: Intermediaries simultaneously set membership fees on both sides of the market (for sellers, fee is per product) + sellers and buyers learn their location (this is private information for them)
    - Sellers are ex ante identical
    - This stage disappears if trade is non-intermediated.
  - Stage 2: Sellers and buyers decide which platform(s) to visit
  - Stage 3: Sellers set the price of their goods simultaneously
    - Assumption: Sellers' pricing decisions are independent.
  - Stage 4: Buyers make purchasing decisions
    - Assumption: A buyer at platform i has a downward-sloping demand function for each product traded on this platform

Sellers' investment incentives (4)

- Reduced-form representation of buyer-seller interaction
  - Net gains from trade absent any investment
    - For buyer: u_0
    - For seller: π_0
  - Net gains from trade after investment
    - For buyer: $u_1 = u_0 + \Delta_u$
    - For seller: $\pi_1 = \pi_0 + \Delta_\pi$
- We also propose micro-foundations for these generic functions.

Sellers' investment incentives (5)

- **Main results:** Sellers may have stronger incentives to innovate if competing platforms are for-profit and charge membership fees.
- Why?
  - Due to for-profit intermediation, sellers partly internalize increases in consumer surplus resulting from their investment.
- When? It depends on
  - Market structure (which side of the market, if any, multihomes?)
  - Type of investment (how does it affect sellers' profits and consumer surplus?)

Sellers' investment incentives (6)

- Both sides singlehome (e.g., specialized magazines)
- Surplus (gross of any opportunity cost) of visiting platform i
  - Suppose $0 \leq k \leq K$ sellers have invested, so measure $\kappa = k/K$ of products benefit from an innovation

$$v_s^i = \begin{cases} n_b^i \pi_1 - M_s^i & \text{if seller has invested} \\ n_b^i \pi_0 - M_s^i & \text{otherwise} \end{cases}$$

$$v_b^i = n_s^i (\kappa u_1 + (1-\kappa) u_0) - M_b^i$$

Number of buyers and of products on the platform

Membership fees set by intermediary i

  - Indifferent types

$$b_{12} = \frac{1}{2} + \frac{(n_s^1 - n_s^2)(\kappa u_1 + (1-\kappa)u_0) + M_b^2 - M_b^1}{2\tau_b}$$

$$s_{12} = \frac{1}{2} + \frac{(n_b^1 - n_b^2)\pi_0 + M_s^2 - M_s^1}{2\tau_s} \text{ and } s'_{12} = \frac{1}{2} + \frac{(n_b^1 - n_b^2)\pi_1 + M_s^2 - M_s^1}{2\tau_s}$$

Sellers' investment incentives (7)

- Nash equilibrium membership fees (same analysis as before)

$$M_b^* = C_b + \tau_b - \tilde{\pi} \text{ and } M_s^* = C_s + \tau_b - \tilde{u}$$
$$\text{with } \tilde{u} = \kappa u_1 + (1-\kappa)u_0, \tilde{\pi} = \kappa\pi_1 + (1-\kappa)\pi_0$$

- Equilibrium partition: equal split of buyers and products
- Equilibrium net surpluses

$$v_s^* = \begin{cases} \frac{1}{2}\pi_1 + \tilde{u} - (C_s + \tau_s) & \text{if seller has invested} \\ \frac{1}{2}\pi_0 + \tilde{u} - (C_s + \tau_s) & \text{otherwise} \end{cases}$$
$$v_b^* = \tfrac{1}{2}\tilde{u} + \tilde{\pi} - (C_b + \tau_b)$$

  - Increasing in the net gain of the other side and, to a lesser extent, in the net gain of the own side

Sellers' investment incentives (8)

- Seller invests in none or all of his products.
- Per product net surplus (supposing $0 \leq k < K$ sellers invest)

$$\text{If no investment:} \quad V_s(\kappa) = \tfrac{1}{2}\pi_0 + \tilde{u}(\kappa) - (C_s + \tau_s)$$

$$\text{If investment:} \quad V_s'(\kappa + \tfrac{1}{K}) = \tfrac{1}{2}\pi_1 + \tilde{u}(\kappa + \tfrac{1}{K}) - (C_s + \tau_s)$$

- Incentives to innovate under intermediated trade

$$I^m = V_s'(\kappa + \tfrac{1}{K}) - V_s(\kappa) = \tfrac{1}{2}(\pi_1 - \pi_0) + \tfrac{1}{K}(u_1 - u_0)$$

- Non-intermediated trade: each seller interacts with ½ of the buyers $\rightarrow$ $I^n = \tfrac{1}{2}(\pi_1 - \pi_0)$
- Comparison:

$$\boxed{I^m - I^n = \tfrac{1}{K}(u_1 - u_0) = \tfrac{1}{K}\Delta_u}$$

Sellers' investment incentives (9)

- **Proposition 1.** In the two-sided singlehoming model, for-profit trading platforms give stronger investment incentives for sellers if and only if the investment increases the buyer's surplus.
- Intuition
  - If investment increases buyer's surplus, then platforms charge lower fees to sellers.
  - This provides an extra incentive to invest w.r.t. free platforms (where this price effect is absent).
  - Naturally, the opposite prevails if investment *decreases* buyer's surplus.

Sellers' investment incentives (10)

- Competitive bottlenecks?
  - **Proposition 2.** In the competitive bottleneck model in which sellers are on the multihoming 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.
  - **Proposition 3.** In the competitive bottleneck model in which buyers are on the multihoming side, for-profit trading platforms give stronger investment incentives for sellers if the joint buyer's and seller's surplus increases.

Sellers' investment incentives (11)

- **Summary:** higher incentives under intermediated trade if

$$
\begin{array}{lll}
(1) & \text{buyers and sellers singlehome:} & \Delta_u > 0 \\
(2) & \text{buyers singlehome/sellers multihome:} & \Delta_u > \Delta_\pi \\
(3) & \text{sellers singlehome/buyers multihome:} & \Delta_u + \Delta_\pi > 0
\end{array}
$$

- Intuition
  - As the intensity of competition for sellers increases, for-profit platforms are more likely than open platforms to provide better seller investment incentives.
  - Condition become less demanding when nature of platform competition moves
    - From (2) to (1)
    - From (1) to (3)

Sellers' investment incentives (12)

- Micro foundation of buyer-seller relationship and of different types of investment.

	cost reduc.	quality improv.	price disc.	demand expan.
sellers multihome buyers singlehome	−	−	−	−
both sides singlehome	+	+	−	+/−*
sellers singlehome buyers multihome	+	+	+	+
* "+" if demand sufficiently convex ("−" otherwise)				

Extension 2 – **Two-part tariffs**

- Platforms often charge two-part tariffs to at least one of the sides, i.e., combinations of
  - Membership (or subscription) fees, and
  - Usage (or per-transaction) fees
- Examples
  - Software platforms $\rightarrow$ developers are charged a fixed fee for getting access to the system's source code and in addition pay royalties for the applications they sell to users.
  - Credit card systems.
- Implications of this form of price discrimination on the profits of competing platforms and on the welfare of the two sides?

Extension 2 – **Two-part tariffs** (2)

- Modified model
  - Buyer & seller surplus (gross of any opportunity cost) of visiting platform i:

$$v_b^i = (u - m_b^i)n_s^i - M_b^i \text{ and } v_s^i = (\pi - m_s^i)n_b^i - M_s^i$$

Usage fees set by platform i

  - Platform i's profit

Per-transaction cost

$$\Pi_i = (M_b^i - C_b)n_b^i + (M_s^i - C_s)n_s^i + (m_b^i + m_s^i - c)n_b^i n_s^i$$

  - Each platform has now 4 choice variables.
- General result: there exist a continuum of equilibria in the price-setting game.

Extension 2 – **Two-part tariffs** (3)

- Two-sided singlehoming (Armstrong, RAND, 2006)
  - Suppose $c = 0$ and $4\tau_b\tau_s > (u+\pi)^2$
  - A continuum of symmetric equilibria exist with platforms charging $T_b = M_b + m_b n_s$ and $T_s = M_s + m_s n_b$, where

$$M_b = C_b + \tau_b - \pi + \tfrac{1}{2}(m_s - m_b)$$
$$M_s = C_s + \tau_s - u + \tfrac{1}{2}(m_b - m_s)$$
$$0 \le m_b \le 2u \text{ and } 0 \le m_s \le 2\pi$$

  - Platforms' profit at equilibrium: $\Pi = \tfrac{1}{2}(\tau_b + \tau_s - u - \pi) + \tfrac{1}{4}(m_b + m_s)$
    - Increasing in the usage fees.
    - Why? High usage fees reduce, and even overturn, the cross-side network effects that make the platform market so competitive.
  - Multiple equilibria arise because each platform has a continuum of best responses for a given choice of tariff by its rival.
    - Different combinations of fixed and usage fees yield same profit.

Extension 2 – **Two-part tariffs** (4)

- Competitive bottlenecks (Reisinger, 2011)
  - Same problem of continuum of equilibria with two-part tariffs.
  - The profit and the welfare of the two sides is different in each of these equilibria. $\rightarrow$ Model lacks predictive power.
  - Proposed solution
    - Allow for heterogeneous trading behavior of agents on both sides.
    - $\rightarrow$ Unique equilibrium even in the limit as the heterogeneity vanishes.
  - Model
    - Sellers can multihome; buyers can only singlehome.
    - On each side: 2 types differ with respect to their trading behavior.
      - A mass b of buyers interact with each seller only with probability $\beta < 1$.
      - A mass s of buyers interact with each buyer only with probability $\sigma < 1$.
      - with b , $s > 0$ but small.
    - Platforms are unable to price discriminate across types.

Extension 2 – **Two-part tariffs** (5)

- Competitive bottlenecks (cont'd)
  - Buyer & seller surplus

$$v_b^i = \begin{cases} (1-s)(u-m_b^i)n_s^i + s(u-m_b^i)\sigma n_{s\sigma}^i - M_b^i \text{ (regular)} \\ (1-s)(u-m_b^i)\beta n_s^i + s(u-m_b^i)\beta\sigma n_{s\sigma}^i - M_b^i \text{ (b-type)} \end{cases}$$

$$v_s^i = \begin{cases} (1-b)(\pi-m_s^i)n_b^i + b(\pi-m_s^i)\beta n_{b\beta}^i - M_s^i \text{ (regular)} \\ (1-b)(\pi-m_s^i)\sigma n_b^i + b(\pi-m_s^i)\sigma\beta n_{b\beta}^i - M_s^i \text{ (s-type)} \end{cases}$$

  - Leads to a unique equilibrium, even with $b,s \to 0$
    - See details in Reisinger (2001).
    - Note: his model differs slightly from the one presented here
      - Notation
      - Distribution of sellers

Extension 2 – **Two-part tariffs** (6)

- Competitive bottlenecks (cont'd)
  - Intuition
    - The two types react differently to a particular combination of the membership and the usage fee.
      - E.g., seller of type s trades less often $\rightarrow$ to keep his utility constant, an increase in usage fee must be coupled with a smaller reduction of the membership fee than to keep the utility of a seller of regular type constant.
    - $\rightarrow$ The effect on profit of a marginal change in i's usage fee is no longer a constant multiple of the effect of a marginal change in i's membership fee.
      - This multiple varies continuously as the fees change because the ratio of the two types that join platform i also varies continuously.
    - $\rightarrow$ Each platform has a unique optimal combination of the fees as a reaction to the price quadruple of its rival.

Further issues 1 – **Effects of competition**

- Competition on two-sided markets may be price-increasing
  - Böhme and Müller (2010)
    - Compare monopoly and duopoly model of a two-sided market.
      - Consumers / Advertisers
      - If 2 platforms, consumers singlehome while advertisers multihome.
    - The two settings are fully comparable
      - Homogeneous good produced at zero costs without capacity constraints
      - Identical parameterization of market sizes.
    - They determine the duopoly equilibrium and the monopoly optimum in terms of the parameters and obtain solutions with and without subsidization (prices below marginal cost) of one market side.
    - They show that there exists a continuum of economically plausible parameter sets for which duopoly equilibrium prices exceed optimal monopoly prices and one with no observable price effect of competition, i.e. one where optimum and equilibrium prices become equal.
    - Effect of competition on total welfare? Ambiguous in subsidization cases, but strictly positive if no subsidization takes place.

Further issues 1 – **Effects of competition** (2)

- Price-increasing competition (cont'd)
  - Intuition
    - Two conflicting effects of competition
      - Traditional effect of reducing prices.
      - Demand-enhancing effect on the single-homing market side, which drives prices upwards.
    - It is possible that the former effect does not fully compensate the latter effect, which either causes no observable price effect or price-increasing competition.
  - Implications
    - Merger analysis $\rightarrow$ mergers do not necessarily lead to higher prices in two-sided markets

Further issues 2 – **Within-side effects**

- So far
  - Focus on cross-side effects.
  - Competition among existing platforms.
- To be considered
  - Within-side effects $\rightarrow$ competition among sellers.
  - Launch of a new platform
- Belleflamme and Toulemonde (IER, 2009)
  - Can a for-profit platform succeed in an environment where agents have the possibility to interact on a free (public or open) platform?
  - If yes, how?
  - What are the effects of within-side effects (intra-group externalities)?

Further issues 2 – **Within-side effects** (2)

- Main intuition
  - New platform faces a "chicken-and-egg" problem.
  - Way to solve it $\rightarrow$ "divide-and-conquer" pricing strategy
    - Subsidize the participation of one side (divide) and recover the loss on the other side (conquer)
  - Within-side effects (rivalry) blur the picture
    - Willingness to pay of rival agents $\uparrow$ if only a few move
    - *Good news*: rival agents' care less about other group's participation.
    - *Bad news*: other group less willing to join if only a few rival agents join
- Main results
  - Benchmark (no rivalry): always profitable to launch the new platform with appropriate divide-and-conquer strategy
  - Rivalry in one group: within-side effects may undermine all attempts to launch the new platform.

Further issues 2 – **Within-side effects** (3)

- Model
  - 2 groups of homogeneous agents, 1 and 2: $N_1 \geq 3$ and $N_2 \geq 3$ agents
  - At $t = 0$, the 2 groups interact on a free platform
  - At $t = 1$, intermediary considers launching a competing platform
  - Both sides single-home
  - $\pi_i(n_i, n_j) \rightarrow$ gross benefit for an agent of type i from interacting on a platform with n_i agents of its own type and n_j agents of the other type
  - Properties of benefit functions:

Positive cross-side effects

$$\pi_i(n_i, n_j + 1) \geq \pi_i(n_i, n_j)$$

Negative within-side effects (possibly)

$$\pi_i(n_i + 1, n_j) \leq \pi_i(n_i, n_j)$$

Further issues 2 – **Within-side effects** (4)

- Benchmark: no rivalry
  - Notation
    - Benefit functions: $\pi_1(n_2)$, $\pi_2(n_1)$
    - Initial benefits: $\pi_1(N_2)$, $\pi_2(N_1) \rightarrow$ Outside option (endogenous!)
    - If $N_i\pi_i(N_j) > N_j\pi_j(N_i)$, then group i is 'high-value group'
  - Timing
    - Intermediary sets membership fee A_1 for agents of group 1.
    - Agents of group 1 choose whether to switch to the new platform or not.
    - Intermediary sets membership fee A_2 for agents of group 2.
    - Agents of group 2 choose whether to switch to the new platform or not.
  - Equilibrium concept: subgame perfection *with unique implementation*
    - Intermediary must set fees so that a unique NE ensues (with participation of both groups)

Further issues 2 – **Within-side effects** (5)

- Benchmark: no rivalry (cont'd)
  - **Lemma 1**. Suppose group j is non rival and does not move before group k. Then all agents of group j make the same switching decision.
    - Why? Homogeneous agents and no effect on other group's moves.
  - Stage 4. 2 potential NE
    - No agent switches iff $A_2 > \pi_2(n_1) - \pi_2(N_1 - n_1)$
    - All N_2 agents switch iff $A_2 \leq \pi_2(n_1) - \pi_2(N_1 - n_1)$
  - Stage 3. Highest fee compatible with N_2 agents moving

$$A_2 = \pi_2(n_1) - \pi_2(N_1 - n_1) \geq 0 \Leftrightarrow n_1 \geq N_1/2$$

$$\rightarrow n_2^*(n_1) = \begin{cases} N_2 & \text{if } n_1 \geq N_1/2 \\ 0 & \text{otherwise} \end{cases}$$

  - Stage 2. No NE with $0 < n_1 < N_1$ agents of group 1 switching.
    - (More complicated argument than for stage 4!)

Further issues 2 – **Within-side effects** (6)

- Benchmark: no rivalry (cont'd)
  - Stage 2. 2 potential equilibria

$$n_1^* = \begin{cases} N_1 & \text{if } A_1 \le \pi_1(N_2) \\ 0 & \text{if } A_1 > -\pi_1(N_2) \end{cases}$$

$$\rightarrow \text{ coexistence of equilibria for all } -\pi_1(N_2) < A_1 \le \pi_1(N_2)$$

  - Stage 1. Unique implementation: select fee such that $n_1 = N_1$ is the unique equilibrium in stage 2
    - A_1 = - $\pi_1(N_2)$
    - Intermediary's profits: -N_1 $\pi_1(N_2) + N_2$ $\pi_2(N_1)$
    - Positive if group 2 is high-value group
    - Otherwise, start with group 2
  - Optimal conduct: (1) subsidize low-value group, (2) tax high-value group
  - All agents move *(same result with simultaneous switching)*

Further issues 2 – **Within-side effects** (7)

- Effects of rivalry
  - Notation
    - Rival group: $\pi_r(n_i , n_r)$
    - Independent group: $\pi_i(n_r)$
  - Example: linear specification

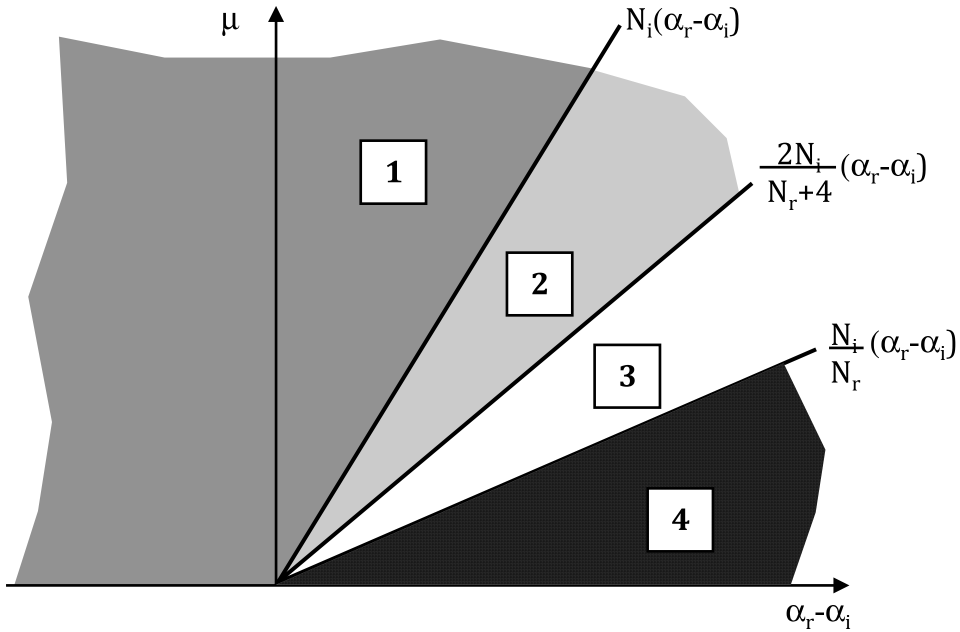
$$\pi_i(n_r) = \alpha_i n_r$$

$$\pi_r(n_i, n_r) = \begin{cases} \alpha_r n_i - \mu n_r & \text{if } n_i > 0 \\ 0 & \text{if } n_i = 0 \end{cases}$$

$$\text{with } \mu N_r < \alpha_r$$

Further issues 2 – **Within-side effects** (8)

- Effects of rivalry – linear specification



  - Area 1. Subsidize rival agents
  - Area 2. Subsidize rival agents (sequential) / No profit (simultaneous).
  - Area 3. No profit.
  - Area 4. Subsidize independent agents