Competing with Network Externalities and Price Discrimination

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Two-sided markets

The value attached to the services offered by the platform depends on the degree of participation on the other sides

Two-sided platforms combine two elements

$\longrightarrow$ Indirect network effects

$\longrightarrow$ Price discrimination (price structure matters)

Divide and conquer strategies: "subsidize" the side generating the high externality, tax the other side

$\longrightarrow$ "Cross-subsidization" is a competitive tool

$\longrightarrow$ Allows to overcome the coordination problem.

The paper

$\longrightarrow$ extends the analysis of divide&conquer to multi-sided markets;

$\longrightarrow$ clarifies the link with price discrimination;

$\longrightarrow$ provides some examples.

The presentation:

$\longrightarrow$ *An application to price -discrimination by IT networks.*

Network competition with perfect price-discrimination

Two telecommunication networks S (strong) and W (weak)

Population is divided in J groups/sides, each side is homogeneous of mass $1/J$

Termination charges are regulated at cost and networks compete in multi-part tariff (subscription $+$ usage) $\rightarrow$ usage is priced at cost

(or B&K $+$ flat retail rate $+$ balance calling pattern)

The market is covered

Price discrimination in subscription fee: $\{p_1^k, ..., p_J^k\},\ k = S, W$ (net of fixed cost).

The Consumers

Network specific utility (installed based, outside,..) $+$ utility from communications within the market

Imperfect connectivity captured by a parameter $\theta = \frac{surplus\ off-net}{surplus\ on-net} < 1$

$s =$ *surplus on-net*

Utility of side j members if k serves a mass N^k :

$$U_j^k = u_j^k + \beta N^k - p_j^k$$

$$u_j^k = v_j^k + \theta s$$

$$\beta = (1 - \theta)\, s$$

Definitions and assumptions

i) Sides ranked by preferences for S : $\delta_j = u_j^S - u_j^W$ non-increasing

ii) Small externalities: $u_j^W \geq \beta$.

$\longrightarrow$ Ensures that the participation of sides to the market is not an issue in the analysis of out of eq. subgames

Timing

stage 1.1: Firm S sets P^S

stage 1.2: Firm W sets P^W

stage 2: Consumers join a network.

Favorable expectations for network S

In **stage 2**, consumers coordinate on the subgame eq. allocation that maximizes the market share of S (and minimizes $W's$ market share).

$\longrightarrow$ well defined because the stage 2 subgame is supermodular

$\longrightarrow$ S serves sides between 1 and N^S

- For given P^S, the profit of W is the smallest in subgame $\longrightarrow$ best reply and profit of W under worst case scenario

- Maximal "market power" to S (measured by sales at given prices)

Divide and conquer

W subsidizes some sides to ensure that they join, and exploits the bandwagon effect on the others. Consider prices P^W such that:

$$\begin{aligned} p_1^W &< p_1^S - \delta_1 - \beta \\ p_2^W &< p_2^S - \delta_2 - (J-1)\,\beta/J + \beta/J \\ p_j^W &< p_j^S - \delta_j - (J-j+1)\,\beta/J + (j-1)\,\beta/J \end{aligned}$$

price = value gain - subsidy (externality with non divided) + tax (externality with divided)

$\rightarrow$then all consumers join W *(iterative dominance)*

Condition for S to cover the market: $\sum_j \left(p_j^S - \delta_j\right)\frac{1}{J} - \frac{\beta}{J} \leq 0$.

Equilibrium profit

Similar reasoning for market sharing, fixing the prices for the consumers served by W, and focusing on the competition for the consumers served by S (possible because of selection criterion).

Proposition: The profit of platform S selling to $j \leq j^S = N^S J$ is equal to

$$\Pi^S = \frac{1}{J} \sum_{j=1}^{j^S} \delta_j + \beta N^S / J - \beta N^S \left(1 - N^S\right).$$

Remark:

$\longrightarrow$ Externalities between sides reduces the profit of S

$\longrightarrow$ Externalities within sides $(\beta N^S / J)$ benefit S (due to favorable expectations)

Quality of interconnection?

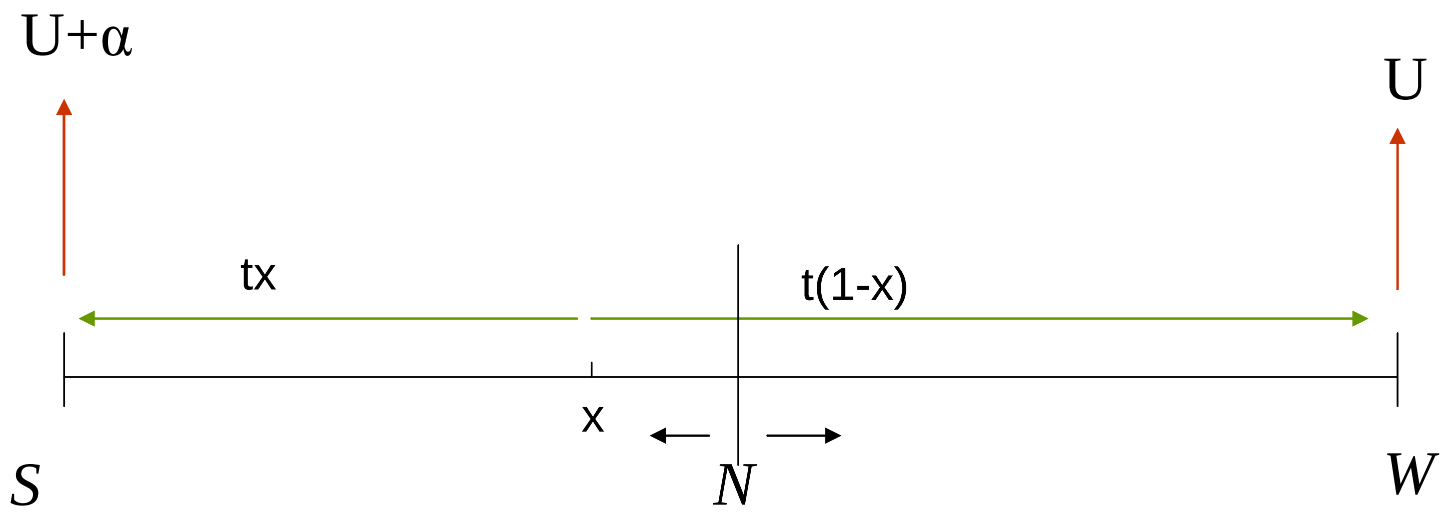
Under imperfect interconnection the profit of S is:

$$\Pi^S = \frac{1}{J} \sum_{j=1}^{j^S} \delta_j - \beta N^S \left(N^W - 1/J \right)$$

$\beta = (1 - \theta)\, s$ decreases with the quality of interconnection

If W is active, the network S prefers a high quality of interconnection

The continuous version: Hotelling Model



The continuous version: Hotelling model with perfect price discrimination

$u^S = U + \alpha - tx;\ u^W = U - t(1 - x)$

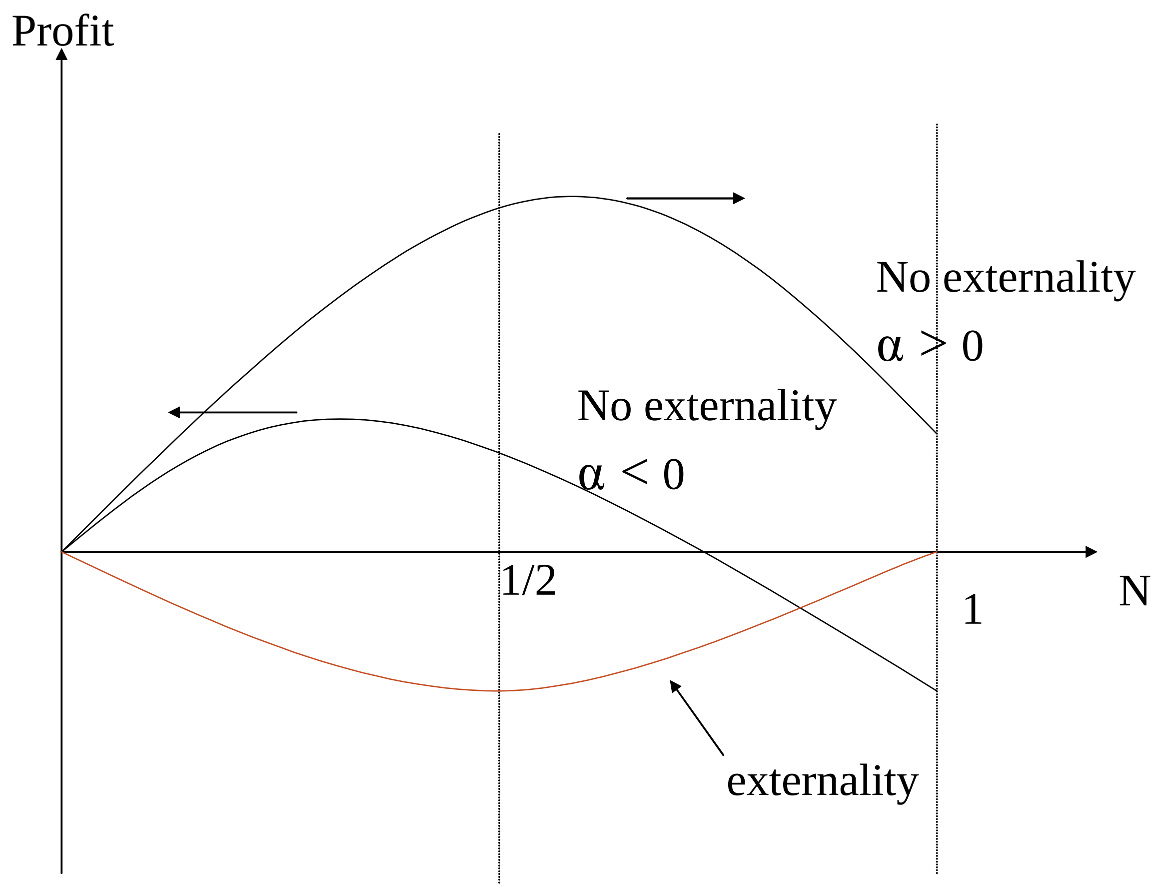
$\delta_x = \alpha + t - 2tx,\ x$ uniform on $[0, 1]$

Network S is the "most efficient" if α is positive

Mass 1 of consumers

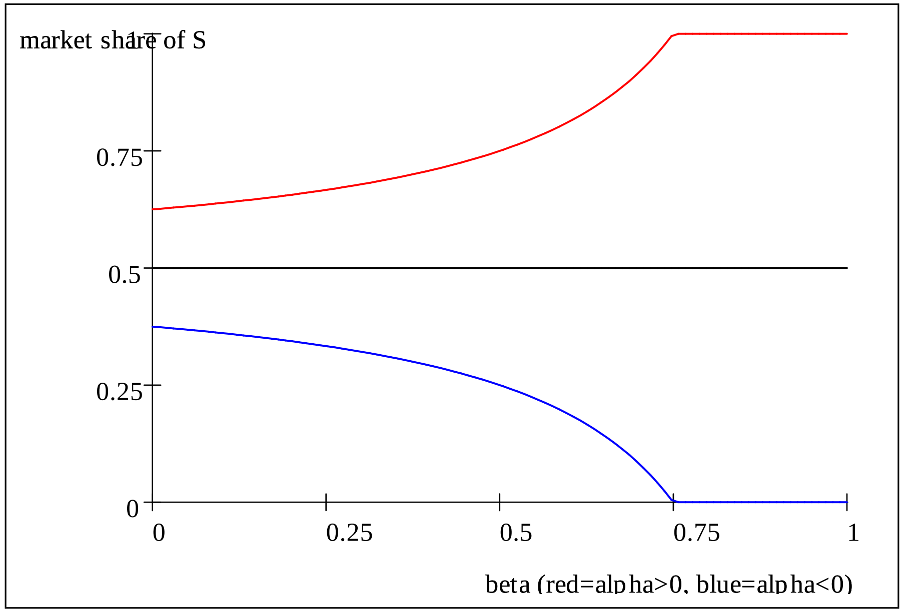
$$\Pi^S = \int_0^N \delta_x dx - \beta N (1 - N) = \alpha N + (t - \beta) N (1 - N)$$

Large differentiation: assume that $t > \beta$


Profit
No externality
α > 0
No externality
α < 0
1/2
1
N
externality

Network S market share

$$\rightarrow N^S = \frac{1}{2} + \frac{\alpha}{2(t-\beta)} \text{ (if interior)}$$



Tipping?

Increasing β:

- increases the size of S if it serves more than half of the market

- reduces the size of S if it serves less than half of the market.

Welfare (exogenous quality of interconnection)

Welfare gain (compared to absence of network S) : $\Delta W = \Pi^S - \beta N (1 - N)$

$\rightarrow N^* = \frac{1}{2} + \frac{\alpha}{2(t-2\beta)}$ (if interior)

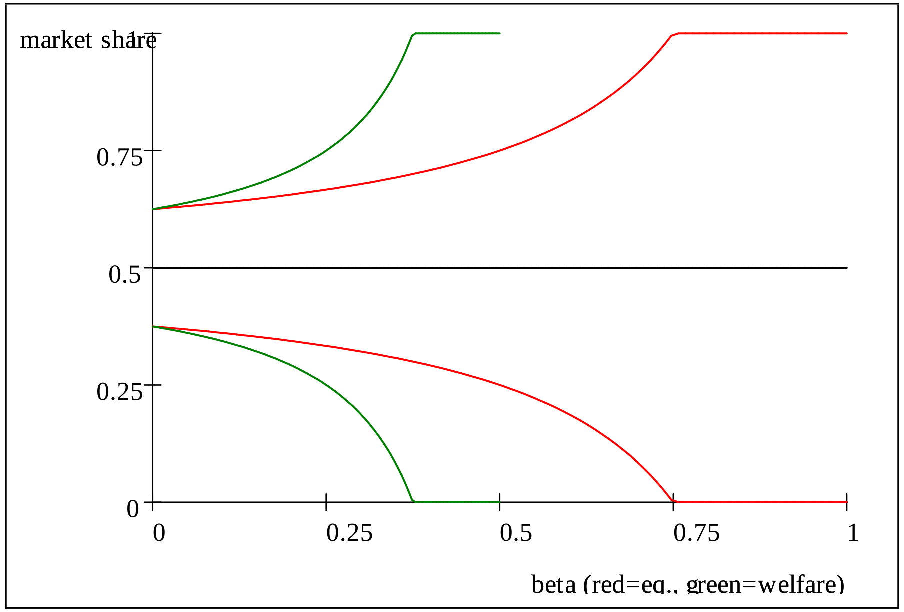
If S serves more than half of the market, then N^* is larger than N^S

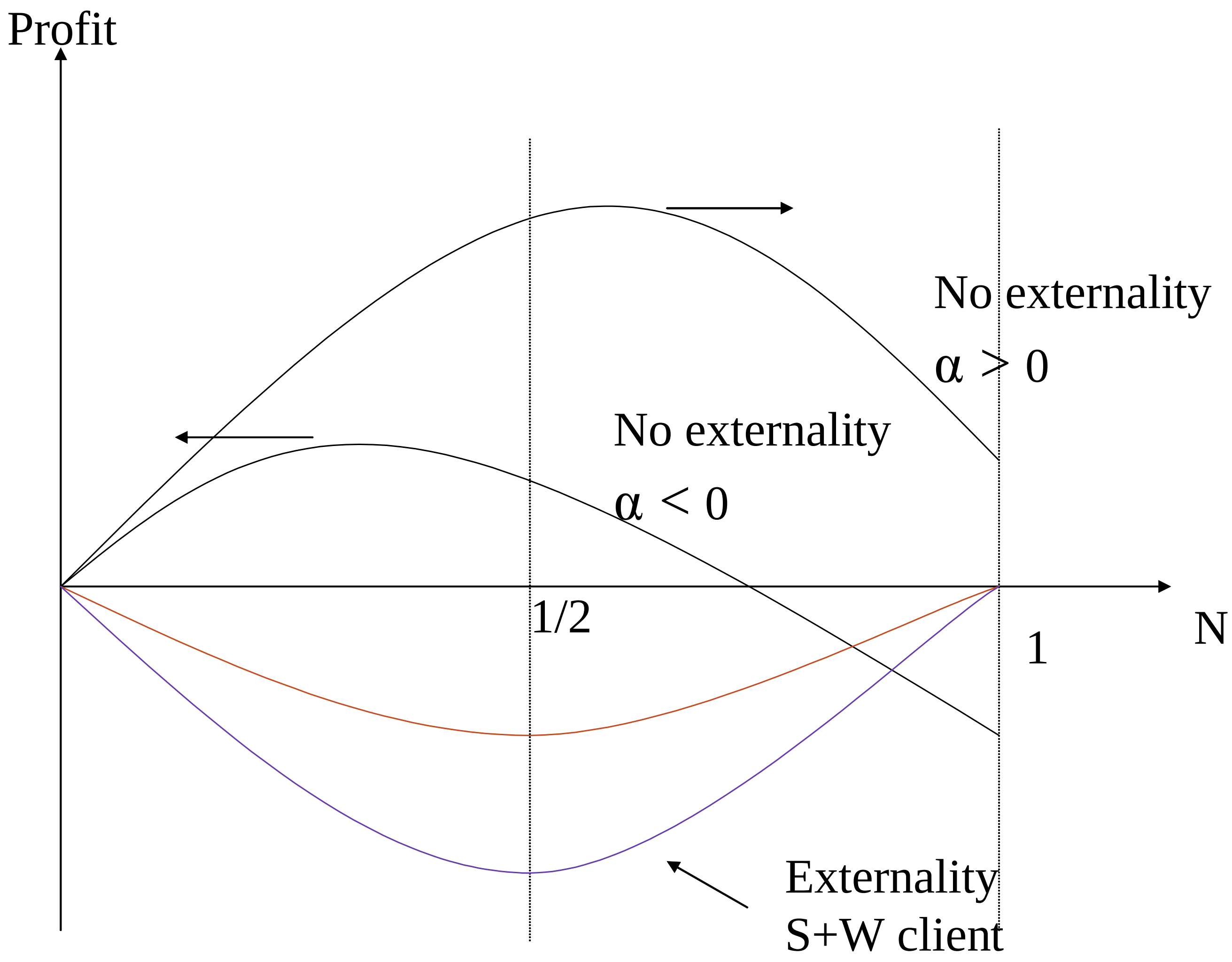
If S serves less than half of the market, then N^* is smaller than N^S.

$\rightarrow$The "most efficient" network equilibrium size is too small

Network externalities tends to favour unbalanced situations, but less than required by welfare optimality (similar to Argenziano for uniform prices)

Efficient and equilibrium market shares





Profit
No externality
α > 0
No externality
α < 0
1/2
1
N
Externality
S+W client

With uniform prices

Reduced demand accounting for externality $(t > \beta)$: $N\left(p^S, p^W\right) = \frac{1}{2} + \frac{\alpha + p^W - p^S}{2(t-\beta)}$

Then standard Stackelberg game with demands $N(p^S, p^W)$ and $1 - N(p^S, p^W)$

$\longrightarrow N^U = \frac{3}{8} + \frac{\alpha}{8(t-\beta)}$ (if interior)

S serves less with uniform prices than with PD if $\alpha > -\frac{t-\beta}{3}$.

Small differentiation: $t < \beta$

Network S serves all the market or nothing

The allocation is efficient $(N^S = 1\ iff\ \alpha > 0)$

With uniform prices, S serves all the market or nothing but the allocation may be inefficient.

S *sells more with uniform prices* $(N^U = 1\ iff\ \alpha + \beta - t > 0)$.

Asymmetric network effects

Same model except that there is heterogeneity in network effects

Utility at network k : $U_j^k = u_j^k + \sum_l \beta_{jl} n_l^k - p_j^k$ where $\beta_{jl} \geq 0$.

Favorable expectation for S is still a well defined concept

Maximal profit

Let $\mathcal{K}$ be a set sides, and σ denote a "ranking" on $\mathcal{K}$.

The value captured with a divide&conquer strategy on $\mathcal{K}$ is

$$\Omega_{\mathcal{K}} = \max_{\sigma} \sum_{j,l \in \mathcal{K},\ \sigma(l) > \sigma(j)} \left(\beta_{lj} - \beta_{jl} \right) \geq 0.$$

Proposition: If the subset $\mathcal{K}$ joins S in eqlb, then

$$\Pi^{S} \leq \sum_{j \in \mathcal{K}} \delta_j - \Omega_{\mathcal{K}} - \sum_{j \in \mathcal{K}, l \notin \mathcal{K}} \beta_{jl},$$

with equality if S sells to all individuals.

Some conclusions

$\longrightarrow$ Price-discrimination intensifies competition due to divide and conquer strategies (different than standard case where it eliminates cross-subsidies).

$\longrightarrow$ On-net call externalities increase the size of the largest network.

$\longrightarrow$ But the largest network is "too small" from a welfare point of view.

$\longrightarrow$ Efficient allocation if little differentiation.

$\longrightarrow$ Price discrimination reduces the incentives to degrade the quality of interconnection

Extensions

Termination charges: asymmetries / traffic imbalance

Heterogeneity in calling patterns (second and third degree price discrimination)

Negative price and bundling

Dynamics (sides, prices)