Social Welfare and Cost Recovery in Two-sided Markets

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OUTLINE

- Card-based payment systems and two-sided markets:
  - profits versus welfare
  - competitive pricing structures need not be socially optimal
- Simple IO model of two-sided markets:
  - 3 players, heterogeneity, externality, social welfare function
- Main Results:
  - socially optimal pricing leads to cost underrecovery
  - two types of solutions: interior and skewed pricing
  - Intuition. And how can we solve this..?
- Antitrust implications and (policy) conclusions

TWO-SIDED MARKETS:

- **Examples of *two-sided markets*:**

buyers	platform	sellers
gamers	videogame platform	game developers
users	operating system	application developers
“eyeballs”	portals, newspapers, TV	advertizers
cardholders	debit & credit cards	merchants
men	nightclubs	woman

- **Platform must get both sides on board, they court each side while making money overall. Chicken and egg problem.**

Two-sided markets raise new issues:

- Price structure receives attention from public policymakers:

  - antitrust implications
    (legitimacy of cross-subsidies, excessive pricing, tying,…)
  - antitrust cases
    (Walmart, Dutch debit cards, Visa-MC vs OFT, EU, Australia, Spain...)

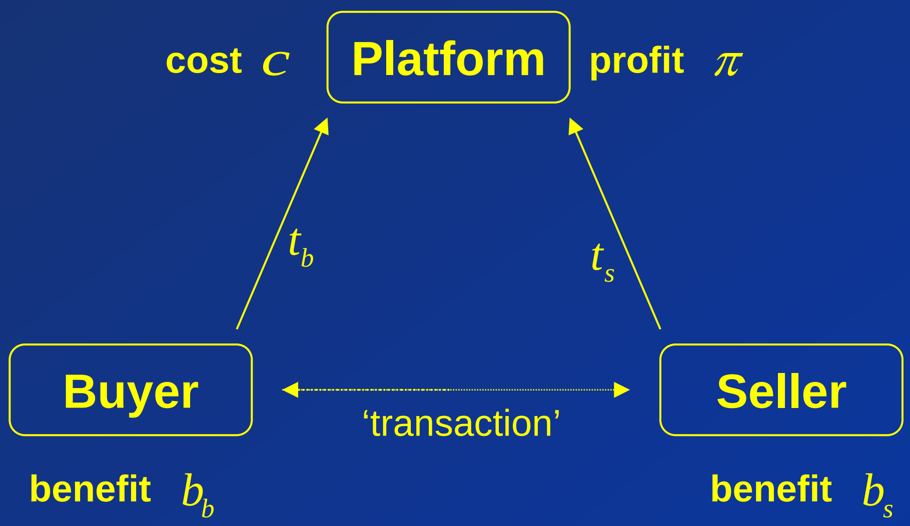
- Main point: cross-group externalities
  Not only the *total price* but also the *pricing structure* matters for total demand!!!

  And externalities need to be properly valued: social optimum

- Real life observation: skewed pricing to one side of the market...
  Question: What pricing scheme is welfare improving..?

THE MODEL

Social planner sets prices for monopoly platform



THE MODEL (2)

- **Platform:**

  cost: c per transaction

  prices: t_b, t_s per transaction

  profit: $\pi(t_b, t_s, c) = (t_b + t_s - c)q$

- **Buyers:**

  (relative) benefits b_b from platform services

  Heterogeneous: $b_b \in \left[\underline{b}_b,\ \bar{b}_b\right]$

  Density: $h_b(.)$ Distribution: $H_b(.)$

  Demand: $q_b = D_b(t_b) = \Pr(b_b \geq t_b) = 1 - H_b(t_b).$

THE MODEL (3)

- **Sellers:**

  (relative) benefits b_s from using platform services

  Heterogeneous: $b_s \in \left[\underline{b}_s,\ \bar{b}_s\right]$

  Density: $h_s(.)$ **Distribution:** $H_s(.)$

  Demand: $q_s = D_s(t_s) = \Pr(b_s \geq t_s) = 1 - H_s(t_s).$

- **Total demand:** $q = D(t_b, t_s) = D_b(t_b) D_s(t_s).$

Note the externality!

- **Assumption: Fixed number N of transactions**

Intermezzo: Monopolistic Pricing

- Maximization problem of monopolistic platform:

$$\max_{t_b,\, t_s} \ \pi(t_b,t_s,c) = (t_b + t_s - c)ND(t_b,t_s)$$

subject to:

$$t_b \geq \underline{b}_b,\ t_s \geq \underline{b}_s$$

- Important distinction between interior solution (see Rochet and Tirole, 2003) and corner solution (see Bolt and Tieman, 2003, 2004)

SOCIAL WELFARE

- Total (expected) social welfare that is generated from platform services is equal to buyer plus seller (expected) benefits, conditional upon their participation in the platform network, minus (marginal) costs times total demand

$$W(t_b,t_s,c)=(\beta_b(t_b)+\beta_s(t_s)-c)ND(t_b,t_s), \qquad (1)$$

where

$\beta_i(t_i)$ denotes the expected (conditional) benefit to an agent *i*, defined by

$$\beta_i(t_i)=\mathrm{E}(b_i \mid b_i \geq t_i)=\frac{\int_{t_i}^{\bar{b}_i} x h_i(x)dx}{1-H_i(t_i)}.$$

MAIN RESULT

- In setting prices, social planner must make sure that both sides 'get on board'.
- Social welfare maximization problem:

$$\max_{t_b,\, t_s} W(t_b,t_s,c) = (\beta_b(t_b)+\beta_s(t_s)-c)N\, D(t_b,t_s) \qquad (2)$$

subject to: $t_b \geq \underline{b}_b,\ t_s \geq \underline{b}_s$

- Again, important distinction between interior and corner solution,

  but main result holds for both solutions!!

A. Interior Pricing

- Solving $\max_{t_b,\, t_s} W(t_b, t_s, c)$ leads to FOC:

$$N\, h_i(t_i)\left((1-H_j(t_j))\, t_i + \int_{t_j}^{\bar{b}_j} x h_j(x)dx - c\,(1-H_j(t_j))\right) = 0\,,$$

yielding

$$t_i^* + \beta_j(t_j^*) = c\,.$$

Also, we have: $t_j \leq \beta_j(t_j).$

A. Interior Pricing (2)

- **PROPOSITION I:**

i) **Socially optimal interior prices are characterized by:**

$$t_b^* + \beta_s(t_s^*) = c\,,$$

$$t_s^* + \beta_b(t_b^*) = c\,.$$

ii) **Below-marginal cost pricing (cost recovery problem):**

$$t_s^* + t_b^* \le c\,.$$

Intuition

- Participation on either side of the market generates a positive externality benefitting the opposite side. This social benefit pops up in the standard "marginal revenue = marginal cost" equation.

  This contribution to social welfare leads the social planner to increase end-user participation by setting prices below marginal cost.

  As a result, a cost recovery problem results.

Uniform Distribution: Interior Solution

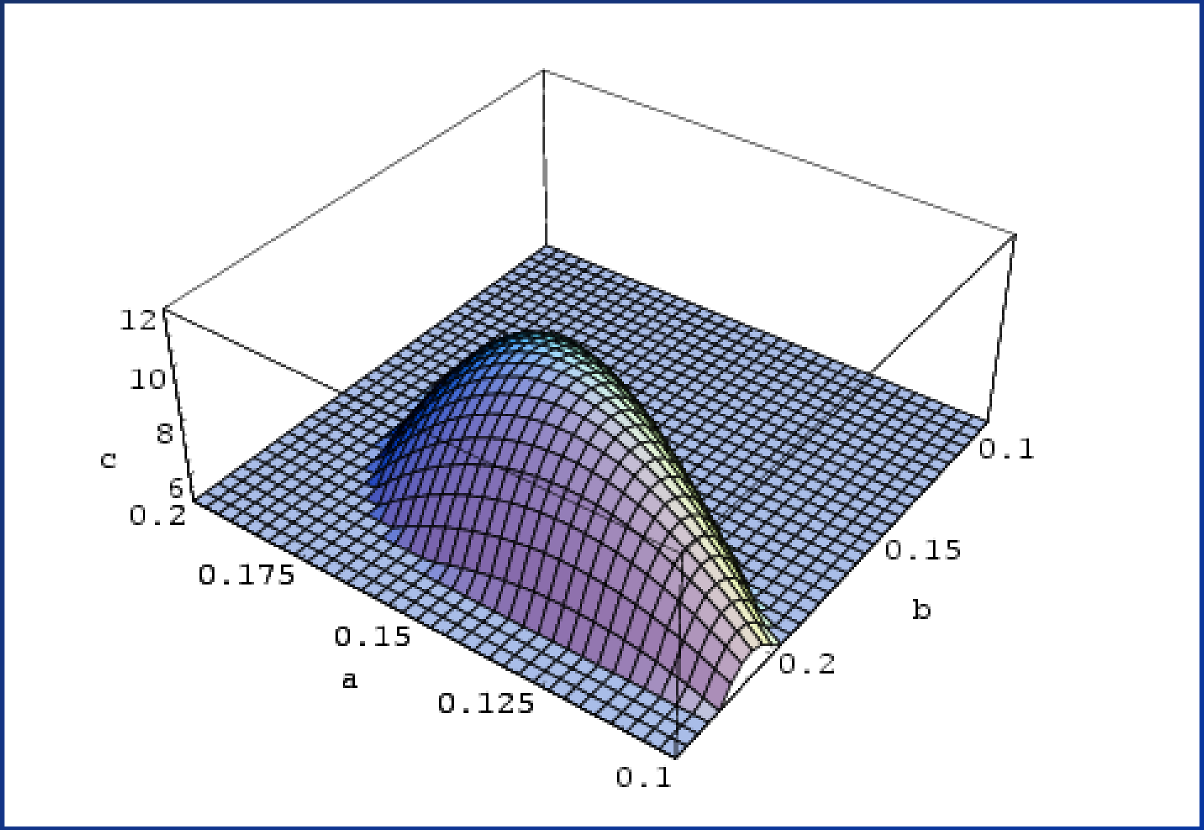


TABLE 1: Social Welfare and Interior Pricing

Table 1: Results for a uniform distribution: social welfare

		Interior pricing		
		buyer	seller	total
Price:	t_i^*	0.17	0.12	0.29
Conditional expected benefit:	$\beta_i^U(t_i^*)$	0.20	0.15	0.35
Elasticity:	$\epsilon^U(t_i^*)$	3.00	2.20	
Demand (in %):	$D_i^U(t_i^*)$	45.1	62.6	28.2
Profit:				
per transaction	$t_T^* - c$			-0.03
total	$\pi^U(t_b^*, t_s^*, c)$			-0.79
Welfare:	$W^U(t_c^*, t_r^*, c)$			0.79

Parameters: $c = 0.32$, $\underline{b}_b = 0.10$, $\bar{b}_b = 0.22$, $\underline{b}_s = 0.09$, $\bar{b}_s = 0.18$, $N = 100$.

B. Skewed Pricing

- Skewed Pricing is characterized by corner solutions that arise from non-logconcave demand:

A corner solution (t_i^{co}, t_j^{co}) is given by

$$t_i^{co} = \underline{b}_i \quad \text{and} \quad t_j^{co} = \operatorname{argmax}_{t_j} W(\underline{b}_i, t_j, c)$$

- In a corner solution, one side of the market is charged its minimal price so that full participation is achieved, while the other side pays a high price. In that sense, pricing is completely skewed to one side of the market.

B. Skewed Pricing (2)

- Solving $\max_{t_j} W(\underline{b}_i, t_j, c)$ leads to FOC:

$$N\, h_j(t_j)\left(-\mathrm{E}(b_i) - t_j + c\right) = 0\,,$$

yielding

$$t_j^* + \mathrm{E}(b_i) = c\,.$$

Also, we have: $\mathrm{E}(b_i) \geq \underline{b}_i = t_i^*\,.$

B. Skewed Pricing (2)

- **PROPOSITION II:**

i) **Socially optimal skewed prices are characterized by:**

$$t_i^* = \underline{b}_i \, ,$$

$$t_j^* + \mathrm{E}\,(b_i) = c \, .$$

ii) **Below-marginal cost pricing (cost recovery problem):**

$$t_s^* + t_b^* \leq c \, .$$

Intuition

- **Skewed pricing result:**

  (Elastic) side is used to boost demand (i.e. $D_i(\underline{b}_i) = 1$)

  (Inelastic) other side generates revenues

- **Full participation on one side generates huge positive externality benefitting the other side. Social planner reacts by setting low price as to increase participation as well on this side.**

  As a result, a cost recovery problem results.

Constant Elasticity of Demand: Saddle Point

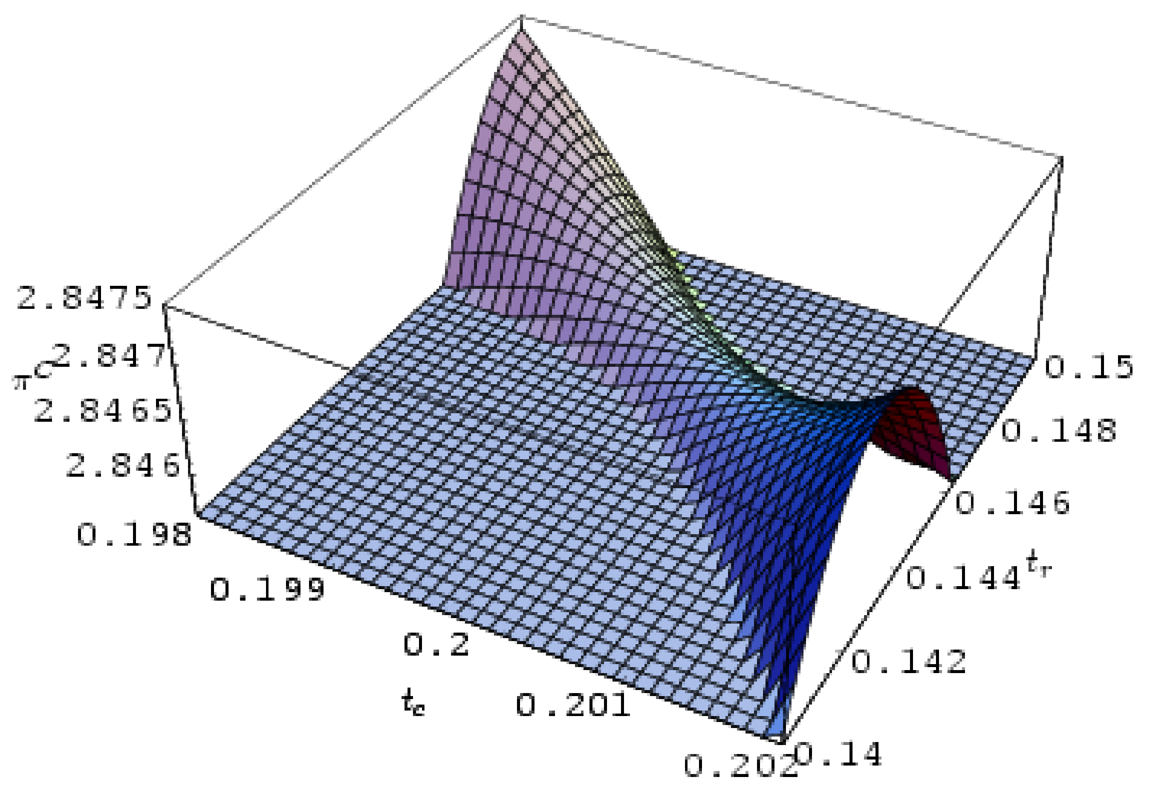


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TABLE 2: Social Welfare and Skewed Pricing

Table 1: Results for constant elasticity of demand: social welfare

		Skewed pricing		
		buyer	seller	total
Price:	t_i^{**}	0.10	0.17	0.27
Conditional expected benefit:	$\beta_i^C(t_i^{**})$	0.15	0.31	0.46
Elasticity:	ϵ_i	3.00	2.20	
Demand (in %):	$D_i^C(t_i^{**})$	100	24.7	24.7
Profit:				
per transaction	$t_T^{**} - c$			-0.05
total	$\pi^C(t_b^{**}, t_s^{**}, c)$			-1.23
Welfare:	$W^C(t_c^{**}, t_r^{**}, c)$			3.50

Parameters: $c = 0.32$, $\epsilon_b = 3$, $\epsilon_s = 2.2$, $\underline{b}_b = 0.10$, $\underline{b}_s = 0.09$, $N = 100$.

Consequence of all this..?

- Beneficial from social point of view, but loss-making business: how to resolve?
  - (government) subsidies
  - cross-selling and tying
  - interchange fees in payment systems
  - second-best under balanced-budget (Ramsey)
  - introduction of fixed fees

- Question: Is a two-sided network a public good..?

ANTITRUST ISSUES

- In antitrust matters, because benefits and cost arise jointly in two-sided markets, there is no *direct* economic relation between price and cost on either side of the market.
- Socially optimal pricing is never purely cost-based, and there is no simple relation between profit-maximzing and welfare maximizing pricing structures.
- Socially optimal asymmetric pricing induces non-neglible price mark-up on one side of the market. Is skewed pricing a signal for abuse of market power? Are prices on one side of the market excessive..?
- Right now, it seems that no economic sensible test is available to check for abuse of market power and excessive pricing in two-sided markets.

(POLICY) CONCLUSIONS

- Profits vs welfare: elasticities are important, raising an empirical issue
- Socially optimal prices are at odds with cost recovery

- Other issues still to be studied:
  - network/system competition
  - impact of single/multihoming
  - bundling and tying
  - two-sided 'antitrust rules'
  - impact of fixed cost

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