Strategic Intermediation in a Two-Sided Market

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Two-sided intermediaries and product markets

There are many two-sided markets where intermediary/platforms bring consumers and sellers together.

- Media markets
- Exhibitions
- Shopping Malls
- Supermarkets
- Shopbots and Auction-sites on the web

What is interesting about these two-sided markets is that intermediaries pricing policies indirectly "steer" the formation of prices in product markets.

Two-sided intermediaries and product markets (cont.)

- How do product markets function in the presence of mediated trade?
- Does competition at the intermediary level increase or decrease overall efficiency in the market?
- Who gains/loses from fostering competition at the platform level?

In this paper we try to contribute to this line of enquiry by studying a simple model of intermediation.

Related literature

Literature on intermediation

- Gehrig (1993)
- Yavas (1994, 1996)

Two-sided markets

- Anderson and Coate (2003), Armstrong (forth.), Baye and Morgan (2001), Dukes (2003)
- Caillaud and Jullien (2001, 2003)
- Armstrong and Wright (2004)
- Rochet and Tirole (2003, 2004)
- Evans (2003)
- Gabszewicz and Wauthy (2004)
- PLUS new papers in this conference!

Contribution and main result

We compare mediation via a monopoly platform with mediation via competing platforms in a setting where:

- Identical sellers produce homogeneous goods
- Buyers have identical valuations for the goods.

We find that monopolistic intermediation yields an *efficient* outcome, while duopolistic intermediation produces a market failure if agents cannot multi-home.

The problem is solved when agents can multi-home, in which case platform competition yields gains to consumers compared to the monopoly platform case.

The Model

Agents

- firms
- consumers
- intermediaries

Intermediaries

- two intermediation market structures:
  - monopoly intermediary
  - duopolistic intermediation, A and B.
- compete to attract firm advertising and consumer audience
- entry in the intermediation market is possibly costly ($\varepsilon > 0$)

The Model (cont.)

Firms

- $(N \geq)2$ firms, $i = 1, 2$, with identical marginal cost $r = 0$.
- homogeneous products with price competition

Consumers

- unit mass with 3 segments: a fraction $\alpha/2$ loyal to A, similarly for B, and $1 - \alpha$ of non-loyals.
- all hold inelastic demands; maximum willingness to pay is v.

Fully intermediated market: firms must advertise in the intermediaries to be able to sell and consumers must subscribe to the intermediaries to learn price and product information.

The Model (cont.)

Notation

- Intermediaries' ad. and subs. fees: $\{a_j, s_j\}$, $j = A, B$.
- Firms strategies: $\{\lambda_j^i, F_j^i(p)\}_{j\in\{O,A,B,AB\}}$, $i = 1, 2$.
- Consumers strategies:
  - A-loyals: $\{\mu_k\}_{k\in R=\{O,A\}}$ (B-loyals similarly)
  - non-loyals: $\{\mu_k\}_{k\in\{O,A,B,AB\}}$.

Two-stage Game

- Stage 1: advertising fees and subscription charges by platforms
- Stage 2: firms choose where to place their ads and which price to charge while consumers decide which intermediary to subscribe to, if any.

We look for subgame perfect equilibria.

Analysis

Monopolistic intermediation

Monopoly intermediation: continuation game equilibria

Distinction between loyals/non-loyals is irrelevant under monopoly

Proposition

1. There is a symmetric equilibrium with full consumer participation:
$\lambda = \frac{v-a}{v}$, $p \in [a, v]$, $F(p) = 1 - \frac{a}{v-a}\frac{v-p}{p}$.

2. There is an equilibrium with partial consumer participation.
$\lambda = \frac{\mu v-a}{\mu v}$, $p \in \left[\frac{a}{\mu}, v\right]$, $F(p) = 1 - \frac{a}{\mu v-a}\frac{v-p}{p}$;
Consumers subscribe with probability $\mu = \frac{a}{v(1-\sqrt{s/v})}$.

These equilibria exist for a, s *such that* $0 \leq a < v$ *and* $0 \leq s \leq (v-a)^2/v$.

Monopoly intermediation: continuation game eq. (cont.)

Remark: Nature of indirect network externalities

- Expected payoff to an advertising firm is $E\pi = (1-\lambda)\mu v - a$
  An increase in μ increases profits, *ceteris paribus*.

  However, in equilibrium $E\pi = 0$ so an increase in μ is accompanied by a decrease in λ !
  Gains from increasing buyer participation are competed away.

- Expected utility to a subscribing consumer $Eu = \lambda^2 v - s$
  An increase in λ increases utility, *ceteris paribus*.

Monopoly Intermediation: Subgame perfect equilibrium

The profits of the monopolist intermediary are:

$$\Pi(a, s) = a \sum_{i=1}^{2} \binom{2}{i} \lambda^i (1-\lambda)^{2-i} + s\mu - \varepsilon = 2\lambda a + s\mu - \varepsilon$$

Lemma: If a SPE exists, consumers must participate fully.

Intuition: In partial consumer participation equilibrium, elasticity of consumer demand for participation is positive
You have $Eu = \lambda^2 v - s = 0$
If monopolist increases s yields $Eu < 0$; to reestablish equilibrium $\lambda = \frac{\mu v - a}{\mu v}$ must increase, which can only occur if μ goes up.

Monopoly Intermediation: SPE (cont.)

Proposition

The monopolist sets $a^* = 0$ and $s^* = v$. Firms enter with probability 1, advertise $p^* = 0$ and obtain zero profits. Consumers subscribe to the intermediary with probability 1, buy a product surely and obtain no utility. Monopoly intermediary profits are $\Pi = v(-\varepsilon)$ and the market outcome is efficient.

Intuition:

$E\pi = (1 - \lambda)\mu v - a$
$Eu = \lambda^2 v - s$

Analysis

Duopolistic intermediation:

- With single-homing
- With multi-homing

Duopoly with single-homing: continuation game equilibria

Proposition

There are 4 equilibria in the continuation game:

1. *Full firm and full consumer participation.*
2. *Full firm and partial consumer participation.*
3. *Partial firm and partial consumer participation.*
4. *Partial firm and partial consumer participation.*

In all cases firms mix over advertising actions and prices, while consumer mix over subscription decisions.

Corollary

There is no equilibrium in pure strategies; as a result the market outcome is inefficient.

Duopoly with single-homing: Subgame perfect equilibrium

The profits of intermediary j are:

$$\Pi_j(a_j, s_j; a_{-j}, s_{-j}) = 2\lambda_j(\cdot)a_j + s_j\mu_j(\cdot) - \varepsilon \tag{1}$$

Lemma

If a SPE exists, consumers must participate fully.

Duopoly with single-homing: SPE (cont.)

Proposition

The unique symmetric outcome which can be sustained as a SPE with two active intermediaries is as follows:

- $a_A^* = a_B^* = v/4$ *and* $s_A^* = s_B^* = v/4$.
- *With probability* $1/2$, *firms advertise* $p \in [v/2, v]$ *with cdf* $F(p) = 1 - (v-p)/p$ *in intermediary* A,*; with the remaining probability they do so in intermediary* B.
- *Consumers subscribe to intermediary* A *with probability* $1/2$ *and to intermediary* B *with probability* $1/2$.

In equilibrium $\Pi = 3v/8 - \varepsilon$, $E\pi^* = 0$ *and* $Eu^* = 0$. *The market outcome is inefficient and the dead-weight loss is equal to* $v/4$.

Duopoly with multi-homing

Given the efficient benchmark of monopoly intermediation, we ask whether an efficient equilibrium can be sustained in the multi-homing case.

Lemma

Necessary conditions for an efficient outcome are:

- *Both sides of the market must participate with probability 1*
- *Firms must multi-home with probability 1.*

Duopoly with multi-homing: efficient subgame perfect equilibrium

Firms multi-homing can only be part of the equilibrium if the advertising fees are set equal to zero, i.e., $a_j = 0, j = 1, 2$.

Because no matter where consumers are, firm competition drives prices down to marginal costs.

So the bulk of profits will be made on consumers.

The non-loyals can play either of the following strategies: $\mu_A = 1$, $\mu_B = 1$, $\mu_M = 1$, $\mu_A + \mu_B = 1$, $\mu_A + \mu_M = 1$, $\mu_B + \mu_M = 1$ or finally $\mu_A + \mu_B + \mu_M = 1$.

Duopoly with multi-homing: efficient subgame perfect equilibrium (cont.)

- $\mu_A = 1$, in which case $v - s_A > v - s_B$, which cannot be sustained.
- $\mu_B = 1$ (The same argument as before applies here)
- $\mu_{AB} = 1$, in which case $s_A = s_B = 0$, which cannot be sustained as SPE.
- $\mu_A + \mu_{AB} = 1$, in which case $v - s_A > v - s_A - s_B$, which implies $s_B = 0$ and this cannot be sustained in SPE.
- $\mu_B + \mu_{AB} = 1$ (The same argument as before applies here)
- $\mu_A + \mu_B + \mu_{AB} = 1$, in which case $v - s_A = v - s_B = v - s_A - s_B$, which can only hold if $s_A = s_B = 0$, and again this cannot be sustained.

The only possibility left is where consumers $\mu_A + \mu_B = 1$

Duopoly with multi-homing: efficient subgame perfect equilibrium (cont.)

Proposition

There exists an efficient symmetric subgame perfect equilibrium where platform fees are $a_A^* = a_B^* = 0$ *and* $s_A^* = s_B^* = s > 0$ *where* s *is randomly distributed in* $(\frac{\alpha v}{2-\alpha}, v)$ *with c.d.f.* $F(s) = 1 - \frac{\alpha}{2(1-\alpha)} \frac{v-s}{s}$*; firms advertise a price* $p^* = 0$ *in both platforms and make zero-profits while consumers go to platform* A *with probability* $\frac{1}{2}$ *and to platform* B *with probability* $\frac{1}{2}$.

In SPE firms make zero-profits, platforms obtain an (expected) profit $E\Pi = \frac{\alpha v}{2}$ *and consumers get (expected) utility* $Eu = \frac{(2-\alpha)v}{2}$.

Conclusions

- Monopoly intermediation yields an *efficient* outcome: firm advertising is for free and consumers pay for information. Firms and consumers all participate, and firms charge mg. cost. Monopolist gets all the rents.
- Duopoly intermediation yields an *innefficient* outcome when agents must *single-home*. Firms and consumers pay equal fees, all participate and firm prices are dispersed. Some rents fail to be realized due to the emergence of coordination frictions.
- Efficiency can be obtained when firms *multi-home*. In that case consumers gain from introducing competition in the platform market vis-á-vis the monopoly case.