Mobile Termination and Mobile Penetration

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1. **Introduction**

2. **Model**

3. **Analysis Fixed MTC**

4. **Analysis Benchmarking Approach**

5. **Conclusion**
Mobile Termination Charges

- Competing mobile network operators need to interconnect to provide service.
- MTC is the price to be paid by *originating* operator to the *terminating* operator.
- MTC affects retail price competition:
  - enters as a *cost* for originating off-net calls
  - generates *revenue* from terminating incoming calls
- Terminating operator has SMP
  \[\rightarrow\] Ex-ante regulation of MTC may be justified
Forms of Regulation

- Obligatory bilateral negotiation of reciprocal MTC
- Fix MTC (Bill & Keep, cost-based, cost + return)
- Regulate MTC by fixing a benchmarking rule (Jeon and Hurkens, RAND 08)
This Paper

Extends retail benchmarking approach (Jeon and Hurkens, RAND 08) by

- Assuming elastic subscription demand (Logit)
- Allowing for termination-based price discrimination

And reviews fixed MTC, extending

- Gans and King (Economics Letters, 01) to elastic subscription
- Dessein (RAND 03) to termination-based price discrimination
The Model: Timing

1. MTC is set
2. Two firms set tariff: \((F_i, p_i, \hat{p}_i)\) (Fixed fee, on-net price, off-net price)
3. Consumers form (rational) expectations \((\varphi_1, \varphi_2, \varphi_0)\) about size of networks and subscribe to at most one
The Model: Costs

- marginal cost of call $c$
- marginal cost of termination $c_0$
- $\text{MTC} = a$, mc off-net call: $\hat{c} = c + a - c_0$
- cost of serving costumer $f$
The Model: Call Demand

- utility of calls $u(q)$
- call demand $q(p)$ defined by $u'(q(p)) = p$
- indirect utility $v(p) = u(q(p)) - pq(p)$
- $R(p) = (p - c)q(p)$
The Model: Subscription Demand

Deterministic utility

- utility of network 1 \( V_1 = \phi_1 v(p_1) + \phi_2 v(\hat{p}_1) - F_1 \)
- utility of network 2 \( V_2 = \phi_2 v(p_2) + \phi_1 v(\hat{p}_2) - F_2 \)
- utility of not subscribing \( V_0 \)
The Model: Subscription Demand

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**Random utility**

\[ U_i = V_i + \mu \varepsilon_i \quad \mu > 0, \varepsilon_k \text{ iid double exponential} \]
The Model: Subscription Demand

**Deterministic utility**
- utility of network 1 $V_1 = \varphi_1 v(p_1) + \varphi_2 v(\hat{p}_1) - F_1$
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**Random utility**
- $U_i = V_i + \mu \varepsilon_i$, $\mu > 0$, $\varepsilon_k$ iid double exponential

**Subscription rates**
$$\varphi_i = \frac{\exp[V_i/\mu]}{\sum_{k=0}^{2} \exp[V_k/\mu]}.$$
Fixed MTC

Profit:

\[ \Pi_i = \phi_i (\phi_i R(p_i) + \phi_j R(\hat{p}_i) + F_i - f) + \phi_i \phi_j (a - c_0) (q(\hat{p}_j) - q(\hat{p}_i)). \]
Fixed MTC

Profit:

\[ \Pi_i = \phi_i \left( \phi_i R(p_i) + \phi_j R(\hat{p}_i) + F_i - f \right) + \phi_i \phi_j (a - c_0) (q(\hat{p}_j) - q(\hat{p}_i)) \]

Perceived Marginal Cost Pricing

It is optimal for firm \( i \) to set \( p_i = c \) and \( \hat{p}_i = c + a - c_0 \).
Equilibrium

Profit:

$$\Pi_i = \varphi_i(F_i - f + \varphi_j R(\hat{c}))$$
Equilibrium

Profit:

\[ \Pi_i = \varphi_i(F_i - f + \varphi_j R(\hat{c})) \]

First Order Condition

\[ \frac{\partial \Pi_i}{\partial F_i} = 0 \]

Rational Expectations

\[ F = \varphi(v(c) + v(\hat{c})) - V_0 - \mu \ln \left[ \frac{\varphi}{1 - 2\varphi} \right] \]
Symmetric Equilibrium $a = c_0$

Existence, uniqueness, comparative statics ...
Business Stealing vs. Network Externality

Business Stealing
An increase in $F_1$ makes some customers switch to network 2.

Network Externality
An increase in $F_1$ makes also network 2 less attractive, so that some subscribers of network 2 may become unsubscribed.
Business Stealing vs. Network Externality

Business Stealing
An increase in $F_1$ makes some customers switch to network 2.

Network Externality
An increase in $F_1$ makes also network 2 less attractive, so that some subscribers of network 2 may become unsubscribed.

The net effect is ambiguous.

\[ \frac{\partial \phi_2}{\partial F_1} > 0 \quad \text{or} \quad \frac{\partial \phi_2}{\partial F_1} < 0 \]
Net Business Stealing: Comparative Statics

fixed fee

market penetration

RE

FOC
In the case of a net business stealing effect

An increase in MTC above cost
- increases market penetration
- lowers fixed fee
- lowers firms’ profits
In the case of a net business stealing effect

An increase in MTC above cost
- increases market penetration
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Intuition
Below cost MTC softens competition since consumers prefer to belong to smaller network.
Net Network Externality: Comparative Statics

![Graph showing fixed fee vs. market penetration]

- **FIXED FEE**
- **RE**
- **FOC**

**Fixed Fee**

**Network Externality** Comparative Statics
In the case of a net network externality effect:

An increase in MTC above cost:
- decreases market penetration
- lowers fixed fee
- lowers firms’ profits
In the case of a net network externality effect

An increase in MTC above cost

- decreases market penetration
- lowers fixed fee
- lowers firms’ profits

Intuition

Below cost MTC makes subscribers care more about the size of the other network, and thus helps firms to internalize the network externality.
Retail Benchmarking Approach

**Definition:** Network $i$ pays for termination

\[ \lambda(a, \kappa) := a + \kappa \frac{\pi_i(a)}{q(\hat{p}_i)}. \]

where

\[ \pi_i(a) = \varphi_i(p_i - c)q(p_i) + \varphi_j(\hat{p}_i - (c + a - c_0))q(\hat{p}_i) + F_i \]

is retail profit per customer gross of fixed cost.
Profit can be rewritten as

$$\Pi_i = \varphi_i [\pi_i(a) + \varphi_j (a - c_0) q(\hat{p}_j) - f] - \kappa \varphi_i \varphi_j [\pi_i(a) - \pi_j(a)].$$
Retail Benchmarking Approach

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For fixed market shares $\phi_1$ and $\phi_2$, max. $\Pi_i$ is equivalent to max. $\pi_i$ when $\kappa \leq 1$. 
Retail Benchmarking Approach

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$$\Pi_i = \varphi_i \left[ \pi_i(a) + \varphi_j(a - c_0)q(\hat{p}_j) - f \right] - \kappa \varphi_i \varphi_j \left[ \pi_i(a) - \pi_j(a) \right].$$

For fixed market shares $\varphi_1$ and $\varphi_2$, max. $\Pi_i$ is equivalent to max. $\pi_i$ when $\kappa \leq 1$.

Perceived marginal cost pricing

Under retail benchmarking rule with $\kappa \leq 1$, firms set $p_i = c$, $\hat{p}_i = \hat{c}$. 
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**Perceived marginal cost pricing**

Under retail benchmarking rule with $\kappa \leq 1$, firms set $p_i = c$, $\hat{p}_i = \hat{c}$.

$$\Pi_i = \varphi_i [F_i + \varphi_j R(\hat{c}) - f] - \kappa \varphi_i \varphi_j [F_i - F_j]$$

Extra competition in fixed fee for $\kappa > 0!$
Comparative Statics

$\kappa = 0$

$\kappa = 0.5$

$\kappa = 1$

fixed fee

market penetration

FOC

RE

S. Hurkens and D.-S. Jeon

Mobile Termination and Mobile Penetration
Conclusion

- Analyze effect of fixed MTC when subscription demand is elastic
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Conclusion

- Analyze effect of fixed MTC when subscription demand is elastic
- Identify business stealing and network externality effects
- Firms and regulators want to deviate from cost-based charges...
- ... but disagree about the direction when there is a net business stealing effect
- Using a benchmarking approach, regulator can intensify competition without distorting efficient call volumes
- In comparison with any fixed MTC different from cost-based, some benchmarking approach is better for consumers and firms