Bilateral monopoly in telecommunications
Bargaining over fixed-to-mobile termination rates

Tommaso Majer
Universitat Autònoma de Barcelona

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My contribution

- Model with competition among mobile and fixed telecommunication networks.
- Networks negotiate the termination rates between mobile networks and between mobile and fixed networks.
- Two regulatory set-ups:
  - Benchmark: MTF termination rates regulated at cost and negotiations over FTM.
  - Reciprocity: Networks negotiate a reciprocal termination rate.
Introduction

The termination rate is the price that one telecommunications operator charges to another for terminating calls on its network.

- When a phone call is made, providers face two costs: for originating and for terminating the call.
- A customer of BT wishes to call a friend who has a Vodafone mobile.
- Vodafone will charge BT a fee for terminating the call on its network.
- This fee is the termination rate and it is part of BT’s cost of providing the call to its customer.
Competitive bottleneck problem

Controversy about regulation of fixed-to-mobile (FTM) termination rates.

- When a mobile network operator (MNO) terminates a fixed-to-mobile call, it has an ex-post monopolistic position.
- Fixed network operator (FNO) has no countervailing power. Two reasons:
  - MTF termination rates are regulated at cost.
  - Fixed network operator has the obligation to purchase termination.

⇒ Even small or new mobile networks have SMP.
Waterbed effect

- Each additional mobile subscriber will be called by subscribers of other mobile and fixed networks, so he will bring to the network a flow of termination charge revenues.
- Mobile networks use termination profits to attract more subscribers lowering the retail prices.
- reducing the level of termination charges may potentially increase the level of retail prices for mobile customers, causing what is known as the waterbed effect. Genakos and Valletti (2007)
## Regulation in European countries

<table>
<thead>
<tr>
<th>Country</th>
<th>Determination of FTM termination rates (2007)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Austria</td>
<td>Negotiated</td>
</tr>
<tr>
<td>Finland</td>
<td>Negotiated</td>
</tr>
<tr>
<td>France</td>
<td>Negotiated</td>
</tr>
<tr>
<td>Germany</td>
<td>Regulated</td>
</tr>
<tr>
<td>Ireland</td>
<td>Negotiated</td>
</tr>
<tr>
<td>Italy</td>
<td>Regulated (H3G not regulated)</td>
</tr>
<tr>
<td>Spain</td>
<td>Regulated</td>
</tr>
<tr>
<td>Portugal</td>
<td>Regulated</td>
</tr>
<tr>
<td>UK</td>
<td>Regulated</td>
</tr>
<tr>
<td>Australia</td>
<td>Negotiated</td>
</tr>
<tr>
<td>US</td>
<td>Negotiated</td>
</tr>
</tbody>
</table>
The model

- Two mobile network operators $i = 1, 2$
- The (endogenous) market share of mobile network operator $i$ is $s_i$
- Mobile market is covered: $s_1 + s_2 = 1$
- One fixed network operator $F$
- Fixed network is monopolist in the fixed market.
- Costs:

<table>
<thead>
<tr>
<th></th>
<th>$FNO$</th>
<th>$MNO , i$</th>
</tr>
</thead>
<tbody>
<tr>
<td>cost of originating a call</td>
<td>$C_0$</td>
<td>$c_0$</td>
</tr>
<tr>
<td>cost of terminating a call</td>
<td>$C_T$</td>
<td>$c_T$</td>
</tr>
</tbody>
</table>
Retail prices

\[ F \]

1 2
Retail prices

\[ P_{FF} \]

\[ F \]

\[ p_{11} \]

\[ 1 \]

\[ p_{22} \]

\[ 2 \]
Retail prices

The model

Assumptions

Retail prices

\[ P_{FF} \]

\[ P_{F1} \]

\[ P_{F2} \]

\[ p_{11} \]

\[ p_{22} \]
Retail prices
Retail prices

\[ P_{FF} \]

\[ F \]

\[ P_{F1} \]

\[ p_{1F} \]

\[ P_{F2} \]

\[ p_{2F} \]

\[ p_{12} \]

\[ p_{21} \]

\[ p_{11} \]

\[ p_{22} \]
**Timing**

Two stage game.

- In the first stage network operators negotiate the access prices.
- In the second stage they set the retail prices.
  - Mobile networks compete in prices.
  - Multi-part tariff.
  - Prices per minute equal to the perceived marginal cost.
  - They extract the consumers’ surplus with the fixed fee.
Network operators negotiate the following access prices:

\[ A_{F_1} = A_{2F} = C_T \]

\[ A_{1F} = C_T = A_{2F} \]

\[ A_{1F} \text{ and } A_{2F} \text{ are regulated at the cost } C_T. \]
Networks solve three simultaneous and interdependent negotiations (over MTM termination rate and FTM termination rates $A_{F1}$ and $A_{F2}$).


Outside options:

- If a negotiation fails, there is no interconnection between the two parties. Subscribers of a network can not call subscribers of the other network. Networks adjust their prices according to this.

- Results are robust to changes in the outside options.
  - Alternative: regulator intervenes, sets a price and assesses a fine to the parties. The fine scales the interval where the price lies.
MTM interconnection charge $a$

$$\max_a [\pi_i(a) - \pi_i]^2$$

**Proposition**

*MNOs prefer an interconnection charge below cost:*

$$a < c_T$$

Firms make less profits every time they terminate a call and this makes MNOs more reluctant to compete aggressively for the market share. Therefore competition is softened and MNOs can increase their profits raising the fixed fee.
Negotiation over FTM termination rate $A_{iF}$

Networks choose $A_{iF}$ that maximizes the product of their net profits:

$$\max_{A_{Fi}} \left[ \pi_i(A_{Fi}) - \overline{\pi}_i \right]^\alpha \left[ \pi_F(A_{Fi}) - \overline{\pi}_F \right]^{1-\alpha},$$

where $\alpha$ is the bargaining power of the MNO.

**Proposition**

$$A_{Fi} = c_T$$  \hspace{1cm} \text{when } \alpha = 0,$$

$$A_{Fi} = c_T - \frac{Q_{Fi}}{Q'_{Fi}}$$  \hspace{1cm} \text{when } \alpha = 1.$$
Comparative statics

Consider a linear demand function:

![Graph showing comparative statics on FTM access price with respect to the degree of network differentiation.](image)

**Figure:** Comparative statics on FTM access price wrt the degree of network differentiation $t$.

The higher is the degree of differentiation, the higher will be the FTM termination rate.
Intuition

Subscribers value interconnection with FNO.

- Consider very homogeneous mobile networks (small $t$). If interconnection breaks down, all subscribers switch to the other provider. FNO has low incentives to reach an agreement.

- Consider very differentiated mobile networks (high $t$). If interconnection breaks down, few subscribers switch to the other provider. FNO has high incentives to reach an agreement.

$\implies$ FNO will pay a higher price when networks are differentiated (i.e. competition less intense)
Comparative statics

Consider a linear demand function:

![Graph showing comparative statics on FTM access price with respect to MTM termination rate.](image)

**Figure:** Comparative statics on FTM access price wrt MTM termination rate $a$

The higher is $a$, the lower is the FTM termination rate.
Intuition

With high MTM termination rate, off-net calls are more expensive than on-net calls, therefore consumers want to join large networks.

- If interconnection breaks down, some subscribers switch to the other provider.
  - When $a$ is high, more people want to switch network, because they want to belong to a large network. High incentives for MNO to reach an agreement.
  - When $a$ is low, the switching effect is mitigated. Low incentives for MNO to reach an agreement.

$\implies$ MNO charges a lower price when MTM is high (i.e. competition more intense)
Reciprocity

Bilateral monopoly in telecommunications

City University London, January 2010
Negotiation over MTF-FTM access charge $A_i$

$$\max_{A_i} \left[ \pi_i(A_i) - \pi_j \right]^\alpha \left[ \pi_F(A_i) - \pi_F \right]^{1-\alpha}$$

**Proposition**

$$A_i = C_T + \frac{Q_F - q_F}{q'_F}$$ \quad \text{when } \alpha = 0,$$

$$A_i = c_T + \frac{q_F - Q_F}{Q'_F}$$ \quad \text{when } \alpha = 1.$$

Remember:

$$Q_F = Q_F(C_0 + A_i), \text{ fixed-to-mobile calls}$$

$$q_F = q_F(c_0 + A_i), \text{ mobile-to-fixed calls.}$$
Negotiation over MTF-FTM access charge $A_i$

- When $\alpha = 1$, MNO prefers a reciprocal access price higher than the termination cost when there are more FTM than MTF calls. \( \iff \) termination rate is a source of revenues.
- In the other cases, when there are more MTF than FTM calls, termination price is a cost and MNO prefers a low access price.
Comparative statics

The difference in quantity of calls depends on the cost of originating a call.

Consider identical linear demand functions, with $c_O = 0, 1$ and $C_O = 0, 3$ (left) and $c_O = 0, 3$ and $C_O = 0, 1$ (right):

![Graph showing comparative statics on reciprocal MTF-FTM access price]

**Figure:** Comparative statics on reciprocal MTF-FTM access price

Comparative statics on $t$ and MTM access charge.
Reciprocity
Welfare

Welfare increases with reciprocity

With similar cost of originating a call and identical demands, welfare under reciprocity is higher than welfare in the benchmark. Consider $\alpha = 1$. Remember that the equilibrium price is

$$A = c_T + \frac{q_F - Q_F}{Q'_F}$$

and

$$Q_F = Q_F(C_0 + A_i),$$

$$q_F = q_F(c_0 + A_i).$$

The difference between mobile and fixed calls depends on the cost of originating a call $c_0$ and $C_0$. If costs are similar, therefore the quantities of calls are similar and the difference is very small. Hence, the reciprocal termination rate will be close to the marginal cost.
Welfare increases with reciprocity

Therefore, on the one hand MTF termination rate goes from a price equal to marginal cost (in the benchmark) to the reciprocal access price which is close to the marginal cost. On the other hand, FTM termination rate have decreased from the monopoly price (in the benchmark, when $\alpha = 1$) to the reciprocal price, close to the marginal cost.

Hence, if costs of originating a call are similar, reciprocity increases welfare.
Conclusions

- Interaction between mobile and fixed networks.
- Negotiations on telecommunications framework.
- FTM termination rate depends negatively on the intensity of competition and positively on MTM access price (different from Gans and King (2002) and Wright (2002)).
- Reciprocity increases welfare for similar cost of originate a call.
## Fixed network operators market share in EU

<table>
<thead>
<tr>
<th>Country</th>
<th>Incumbent market share %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Austria</td>
<td>88.5</td>
</tr>
<tr>
<td>Czech Republic</td>
<td>94.8</td>
</tr>
<tr>
<td>Finland</td>
<td>90</td>
</tr>
<tr>
<td>France</td>
<td>93</td>
</tr>
<tr>
<td>Germany</td>
<td>87</td>
</tr>
<tr>
<td>Ireland</td>
<td>94</td>
</tr>
<tr>
<td>Italy</td>
<td>89.8</td>
</tr>
<tr>
<td>Netherlands</td>
<td>75</td>
</tr>
<tr>
<td>Spain</td>
<td>82.8</td>
</tr>
<tr>
<td>Portugal</td>
<td>85.6</td>
</tr>
<tr>
<td>UK</td>
<td>71.2</td>
</tr>
</tbody>
</table>
Profits of mobile network $i$

\[ \pi_i = s_i [r_i - f] \quad \text{fixed charge minus cost} \]
Profits of mobile network $i$

$$\pi_i = s_i [r_i - f] + s_i^2 (p_{ii} - c_0 - c_T) q_{ii}$$

fixed charge minus cost
on-net calls
Appendix
Retail competition

Profits of mobile network \( i \)

\[
\pi_i = s_i [r_i - f] + s_i^2 (p_{ii} - c_0 - c_T) q_{ii} + s_i (1 - s_i) (p_{ij} - c_0 - a) q_{ij}
\]

- \( \pi_i \): Profits of mobile network \( i \)
- \( s_i \): Share of mobile network \( i \)
- \( r_i \): Revenue of mobile network \( i \)
- \( f \): Fixed charge
- \( c_0 \): Cost of the base network
- \( c_T \): Cost of the trunk
- \( q_{ii} \): On-net calls
- \( q_{ij} \): Off-net calls
- \( p_{ii} \): Price of on-net calls
- \( p_{ij} \): Price of off-net calls
- \( a \): Additional cost

fixed charge minus cost
on-net calls
off-net calls
Profits of mobile network \( i \)

\[
\pi_i = s_i [ r_i - f ]
+ s_i^2 ( p_{ii} - c_0 - c_T ) q_{ii}
+ s_i ( 1 - s_i ) ( p_{ij} - c_0 - a ) q_{ij}
+ s_i ( 1 - s_i ) ( a - c_T ) q_{ji}
\]

fixed charge minus cost

on-net calls

off-net calls

profits from term. off-net calls
Profits of mobile network $i$

$$\pi_i = s_i [r_i - f] + s_i^2 (p_{ii} - c_0 - c_T) q_{ii} + s_i (1 - s_i) (p_{ij} - c_0 - a) q_{ij} + s_i (1 - s_i) (a - c_T) q_{ji} + s_i (p_{iF} - c_0 - A_{iF}) q_{iF}$$

- fixed charge minus cost
- on-net calls
- off-net calls
- profits from term. off-net calls
- MTF calls
Profits of mobile network $i$

\[
\pi_i = s_i [r_i - f] \\
+ s_i^2 (p_{ii} - c_0 - c_T) q_{ii} \\
+ s_i (1 - s_i) (p_{ij} - c_0 - a) q_{ij} \\
+ s_i (1 - s_i) (a - c_T) q_{ji} \\
+ s_i (p_{iF} - c_0 - A_{iF}) q_{iF} \\
+ s_i (A_{Fi} - c_T) Q_{Fi}
\]

- **fixed charge minus cost**
- **on-net calls**
- **off-net calls**
- **profits from term. off-net calls**
- **MTF calls**
- **profits from term. FTM termination**
Retail competition

Mobile network operators compete in prices and sell a differentiated product. The degree of differentiation is represented by $t$.

\[
\begin{array}{c|c}
MNO 1 & MNO 2 \\
\hline
0 & 1
\end{array}
\]

The utility from joining network $i$ is $w_i$ and consumers chooses the networks that gives them the higher utility. The indifferent consumer is located at $s_i$ such that:

\[
s_i = \frac{1}{2} + \frac{1}{2t} (w_i - w_j).
\]
Retail competition

The optimal retail prices are:

\[ p_{ii} = c_0 + c_T, \]
\[ p_{ij} = c_0 + a, \]
\[ p_{iF} = c_0 + A_{iF}. \]

The fixed fee is:

\[ r_i = f - (1 - 2s_i)(a - c_T)\hat{q} - (A_{Fi} - c_T)Q_{Fi} + 2s_i(t + \hat{v} - v) \]

where the market share is:

\[ s_i = \frac{1}{2} + \frac{(A_{Fi} - c_T)Q_{Fi} - (A_{Fj} - c_T)Q_{Fj}}{2[2(a - c_T)\hat{q} + 3(t + \hat{v} - v)]}. \]
Comparative statics on the degree of differentiation $t$

Figure: Comparative statics on reciprocal MTF-FTM access price wrt to the degree of network differentiation when $c_O = 0, 1$ and $C_O = 0, 3$ (left) and when $c_O = 0, 3$ and $C_O = 0, 1$ (right)
Comparative statics on MTM termination rate $a$

Figure: Comparative statics on reciprocal MTF-FTM access price wrt to the MTM termination rate when $c_O = 0, 1$ and $C_O = 0, 3$ (left) and when $c_O = 0, 3$ and $C_O = 0, 1$ (right)