Asymmetric Equilibria and Non-cooperative Access Pricing in Telecommunications

by

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Summary

- A model of two-way access pricing in telecommunications based on Armstrong, 1998 and Laffont, Rey, and Tirole, 1998a,b.

- The model looks at *non-cooperative* access charges with *asymmetric* mobile telecommunications networks that compete in two-part tariffs with price discrimination.

Previous Literature

- In a symmetric setting, LRT, 1998, and Gans and King, 2001 find that with non-cooperative access charges networks will deviate upwards from cost-based access due to a double marginalization effect.

- Carter and Wright, 2003 look at an asymmetric setting and also note that networks will deviate upwards from cost-based access but do not say how the asymmetry affects the charges.

Regulatory Practice

Mobile termination charges in Germany in cent/minute

	1998	1999	2000	2001	2002
T-mobile	27,86	27,86	17,09	14,39	14,30
Vodafone	28,44	28,44	28,51	15,42	14,30
E-Plus	42,60	42,60	42,68	19,03	16,94
O_2	29,24	29,24	29,32	18,77	17,88

Regulatory Practice

- Market shares in Germany (2003): T-Mobile 43%, Vodafone 37%, E-Plus 13%, and O_2 8%.
- Mobile termination is currently still unregulated in Germany despite EU legislation.
- Political pressure has been responsible for recent reductions in charges.
- Monopolkommission suggests that true termination cost is about *half* of the charges (7,4 cent)

Regulatory Practice

- Monopolkommission advocates a cost-orriented price cap legislation as in the UK.
- It is unclear how the network do in fact set the access charges but they may be used collusively (see Höffler, 2006).
- High charges are seen as facilitating entry (or preventing exit) but this may not always be socially desirable (see Behringer, 2004b).

The Model

- A Hotelling model with two networks located at the endpoints on the unit line choosing two part tariffs with network-based price discrimination.

- We use the linear demand technology of Armstrong, 1998 and indirect utility for on-net or off-net calls is

$$v(p) \equiv \int_p^\infty q(\zeta)d\zeta = q(p)\left(1 - \frac{1}{2}q(p)\right) - pq(p)$$

- A two stage game with non-cooperative access charges (a^k, a^{-k}) chosen first followed by the price vector

$$\Xi^k \equiv \{p^k_{on}(a^k, a^{-k}), p^k_{off}(a^k, a^{-k}), G^k(a^k, a^{-k})\} \quad k = i, j$$

- Asymmetry is multiplicative in the location term and consumer j utility is

$$U_x = v(p) - G + \eta x t$$

- Networks have marginal call cost of $c=2c_0+c_1$, and per-capita cost H.

- The game is solved backwards using subgame perfect Nash Equilibrium.
- Stage two:

Lemma 1 *Any best response of network i to network j satisfies*

$$\Pi^i(p_{on}^{i*} = c, p_{off}^i, G^i; \Xi^j) \geq \Pi^i(p_{on}'^i, p_{off}^i, G^i; \Xi^j)$$

for all $p_{on}'^i \neq p_{on}^{i*}$ in the support of the price vector space. Similarly, for given access charges $\bar{a}^i, \bar{a}^j$ any best response of network i to network j satisfies

$$\Pi^i(p_{on}^i, p_{off}^{i*} = c_0 + c_1 + \bar{a}^j, G^i; \Xi^j) \geq \Pi^i(p_{on}^i, p_{off}'^i(\bar{a}^j), G^i; \Xi^j)$$

for all $p_{off}'^i \neq p_{off}^{i*}$ in the support of the price vector space. The symmetric result holds for network j.

Proposition 2 *Any best response of network i to network j concerning its fixed charge must satisfy*

$$G^j = H + (1-4x)v(p^*_{on}) + 2xv(p^{j*}_{off}) + (2x-1)v(p^{i*}_{off}) + (2x-1)\pi^i_T(a^i) + (2x(\eta+1)-1)\,t$$

and any best response of network j to network i concerning its fixed charge must satisfy

$$G^i = H + (4x-3)v(p^*_{on}) + 2(1-x)v(p^{i*}_{off}) + (1-2x)v(p^{j*}_{off}) + (1-2x)\pi^j_T(a) + (2+\eta-2x(\eta+1))\,t$$

where from the 'Hotelling indifference condition' (5)

$$x = \frac{v(p^*_{on}) - v(p^{i*}_{off}) - G^j + G^i - t}{2v(p^*_{on}) - v(p^{j*}_{off}) - v(p^{i*}_{off}) - t(1+\eta)}$$

- Stage one:

Lemma 3 *For given access charges* $\bar{a}^i, \bar{a}^j$ *and sufficiently large* t*, the equilibrium scale* x^* *is strictly decreasing in* η *and has a strictly positive lower bound.*

Lemma 4 *Given the advantage of network* j $(\eta > 1)$ *is large, non-cooperative access charges can be approximated by*

$$\Delta^{j*} \equiv a^{j*} - c_0 \approx \frac{1}{2}(1-c) > 0$$

and

$$\Delta^{i*} \equiv a^{i*} - c_0 \approx \frac{2}{7}(1-c) > 0.$$

Lemma 5 *Given the advantage of network j* ($\eta > 1$) *is large we find that the components of the price vectors satisfy*

$$\Delta^j > \Delta^i$$

and

$$\pi_T^j(a^j) > \pi_T^i(a^i)$$

and

$$G^j > G^i$$

and

$$\Pi^j > \Pi^i.$$

Equilibrium

Lemma 6 *The equilibrium scale x^* is strictly increasing in a^i and decreasing in a^j for sufficiently large t.*

Proposition 7 *At the symmetric equilibrium $\eta = 1$ both firms will charge a strictly positive non-cooperative access charge markup. In a neighbourhood of the symmetric equilibrium both networks will optimally increase their access charge markups for $\eta > 1$ and the advantaged network has the higher increase.*

Second order necessary conditions are satisfied if either t or η are sufficiently large.

Conclusion

- We have analysed an asymmetric telecommunications industry with non-cooperative access charges.
- We find that firms will charge a strictly positive access charge markup as observed in practice.
- We find that it is the disadvantaged (and smaller) firm optimally sets a *lower* access charge (and a lower fixed charge) than the advantaged incumbent.
- Hence a downward regulation of access charges for entrants may in fact *improve* their competitive position.