International Internet Roaming

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Motivation

"When I was lost in Paris, knowing the high cost of roaming, I turned on the data service to locate myself on the map. I expected it would be expensive. What I did not expect is that a single viewing of the map would cost 100 euros – cleaning out my account and making my phone unusable in the process."

David K. Levine
(12/21/2010 on http://www.againstmonopoly.org)

Motivation

- David K. Levine's back-of-the-envelope calculations:
  - Data roaming: TIM \$10/MB; T-mobile \$15 per megabyte (typical business user 15 megabytes per day of email).
  - Local data prices: TIM \$25 per month for 5 gigabytes of data (\$0.005/MB). T-mobile in the US charges a similar amount for similar service;
- Why are international data roaming rates so high?
- Very little analysis on roaming; Salsas & Koboldt (2004); Lupi & Manenti (2006) and (2008); Stühmeier (2010); Roaming alliances: Buehler (2009);
- Common assumption: **Symmetry** in the setup of the countries.
- Do asymmetries across countries play a role? Can they be exploited by regulators?
- Related: Policy discussion on whether to make data roaming compulsory (LTE). Do we need compulsory roaming? When?

This paper

- We model international data roaming pricing of mobile operators taking into account
  - relative degree of competition in provision of roaming access;
  - possible cross-border integration of mobile operators;
- We argue that asymmetries in the competitive setup and the distribution of bargaining power between providers in different countries matter
  - for mark-up;
  - for how much international integration inflates roaming charges (c.f. Bühler, 2009 – symmetric competition and integration);
  - for whether integrated provider wants to have a roaming agreement with other providers.

Model 1

- Two countries, A and B;
- Country A: one provider, also A, provides roaming access to subscribers from country B;
- Country B: up to two providers, B_1 and B_2, provide roaming access to subscribers from country A;
- Subscribers of A pay retail roaming prices p_{AB_1} and p_{AB_2} per unit to A for using B_1's and B_2's network respectively;
- Subscribers of B_1 and B_2 pay retail roaming prices p_{B_1A} and p_{B_2A} per unit to B_1 and B_2, respectively;

Model 2

- Providing roaming services to the other country's users costs c per unit;
- Pairs of providers A and B_1 and A and B_2 have to agree on the roaming charge r_1 and r_2 per unit, respectively.
- Inverse demand for roaming services

$$\begin{aligned} p_{AB_1} &= \alpha - x_{AB_1} - \gamma x_{AB_2} \\ p_{AB_2} &= \alpha - x_{AB_2} - \gamma x_{AB_1} \\ p_{B_1A} &= \alpha - x_{B_1A} - \gamma x_{B_2A} \\ p_{B_2A} &= \alpha - x_{B_2A} - \gamma x_{B_1A} \end{aligned}$$

with $\alpha > c$

Scenarios

1. Symmetric scenario: Monopoly in both countries (providers A and B_1);
2. Asymmetric scenario: Monopoly in A, duopoly in B (providers A, B_1, and B_2);
3. Asymmetric scenario: Monopoly in A, duopoly in B (providers A, B_1, and B_2), and integration between A and B_1.

Timing

1. International roaming charges are set between pairs of providers across countries;
2. Retail roaming prices are set by providers in each country;
3. Users observe offered roaming prices by each operator and decide how much to consume of international roaming services, and providers' profits are realized.

Monopoly in both countries

- Providers A and B_1 only
- Provider A solves

$$\max_{p_{AB_1}} \left[\left(p_{AB_1} - r_1 \right) x_{AB_1} + \left(r_1 - c \right) x_{B_1A} \right],$$

- Provider B_1 solves

$$\max_{p_{B_1A}} \left[\left(p_{B_1A} - r_1 \right) x_{B_1A} + \left(r_1 - c \right) x_{AB_1} \right],$$

- $p^*_{AB_1} = p^*_{B_1A} = p^* = \frac{\alpha + r_1}{2}$; $x^*_{AB_1} = x^*_{B_1A} = x^* = \frac{\alpha - r_1}{2}$;

Monopoly in both countries

- Both providers preferred roaming charge solves

$$\max_{r} \left[x^* \left(p^* - c \right) \right]$$

- $r^* = c$.
- There is mutual moderation.

Monopoly in both countries

Proposition

Under symmetric domestic competition, the equilibrium roaming fee, retail international roaming prices and quantity demanded for international roaming are as follows: $r^{SC} = c$, $p^{SC} = \frac{\alpha+c}{2} > c$ *and* $x^{SC} = \frac{\alpha-c}{2}$.

Remark

Under symmetric domestic competition in the provision of international Internet roaming services between home and foreign countries, in equilibrium a mutual moderation effect prevails: providers entering reciprocal roaming agreements, reach a consensus about compensating each other using a common, and not inflated, roaming fee leading to mobile international retail data roaming prices and traffics to converge, as in Rey (2004).

Monopoly in A and Duopoly in B

- Provider B_i, $i = 1, 2$ solves

$$\max_{p_{B_iA}} \left[\left(p_{B_iA} - r_i \right) x_{B_iA} + \left(r_i - c \right) x_{AB_i} \right];$$

- Provider A solves

$$\max_{p_{AB_1}, p_{AB_2}} \left[\left(p_{AB_1} - r_1 \right) x_{AB_1} + \left(p_{AB_2} - r_2 \right) x_{AB_2} \right.$$
$$\left. + \left(r_1 - c \right) x_{B_1A} + \left(r_2 - c \right) x_{B_2A} \right];$$

- $p^*_{AB_i} = \frac{\alpha + r_i}{2}$, $p^*_{B_iA} = \frac{\alpha\left(2 - \gamma - \gamma^2\right) + 2r_i + \gamma r_{-i}}{4 - \gamma^2}$;
- $x^*_{AB_i}$; $x^*_{B_iA}$ follow.

Monopoly in A and Duopoly in B

- Provider A's preferred roaming charges solve

$$\max_{r_1,r_2} \left[\left(p^*_{AB_1} - r_1 \right) x^*_{AB_1} + \left(p^*_{AB_2} - r_2 \right) x^*_{AB_2} + \left(r_1 - c \right) x^*_{B_1A} + \left(r_2 - c \right) x^*_{B_2A} \right];$$

  leading to $r^*_{1,A} = r^*_{2,A} = r^*_A = \frac{2c+\alpha\gamma}{2+\gamma} \geq c$

- Provider B_i's preferred roaming charge solves

$$\max_{r_i} \left[\left(p^*_{B_iA} - r_i \right) x^*_{B_iA} + \left(r_i - c \right) x^*_{AB_i} \right];$$

  leading to $r^*_{i,B} = \frac{-c(-2+\gamma)^2(2+\gamma)+\alpha\gamma\left(4+\gamma\left(-6+\gamma+\gamma^2\right)\right)}{-8+\gamma(8-4\gamma+\gamma^3)} \leq c$

Monopoly in A and Duopoly in B

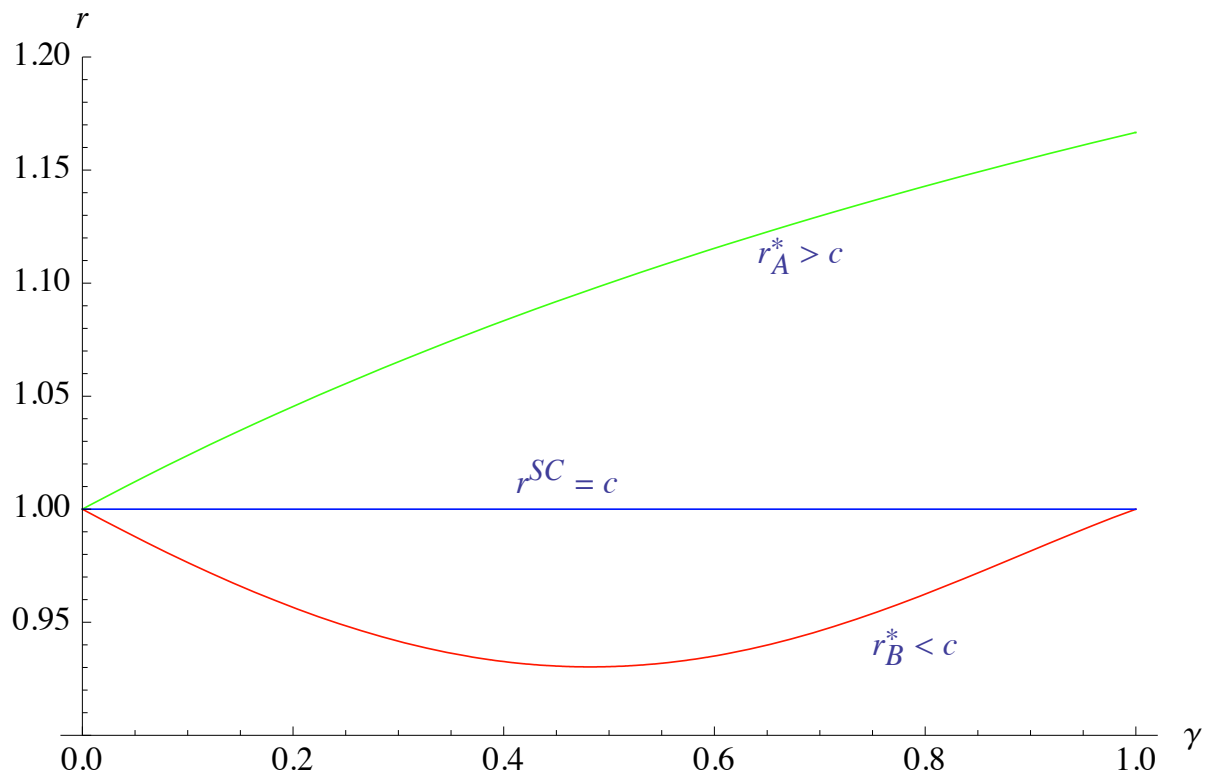

Figure: Preferred roaming fee with competition in B. $\alpha = 1.5$, $c = 1$.

Monopoly in A and Duopoly in B

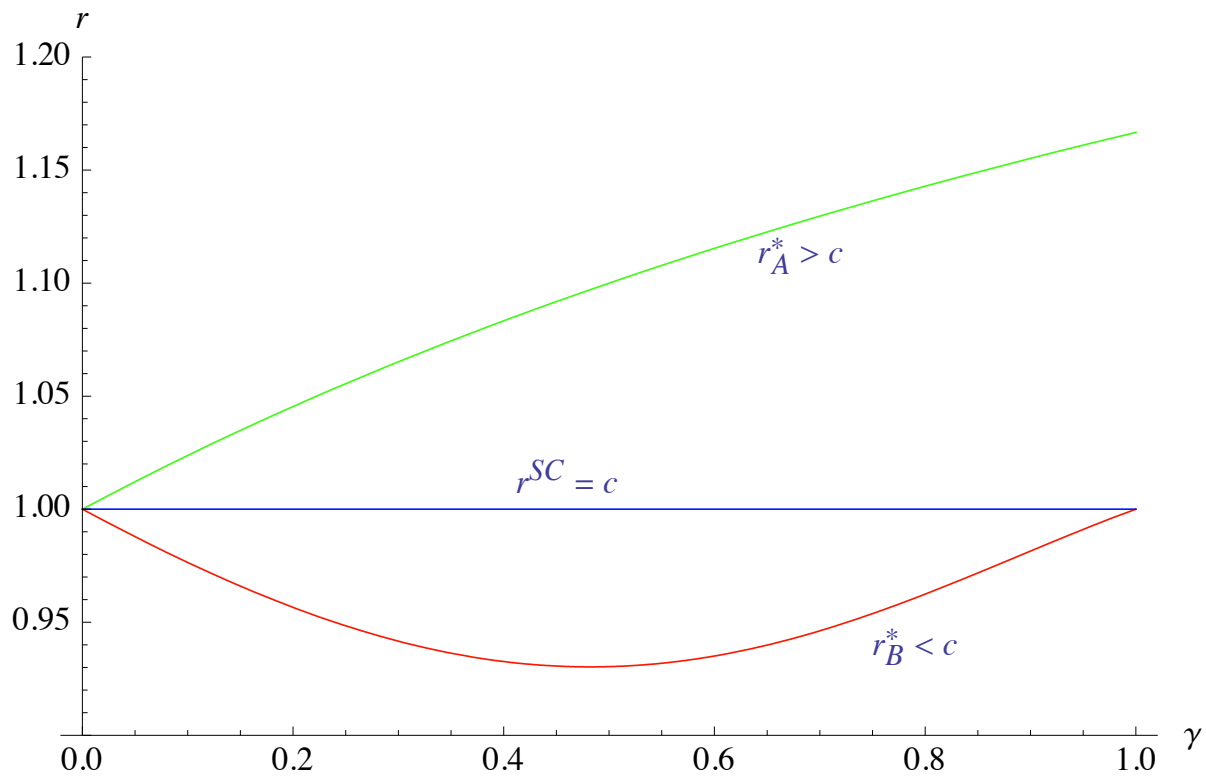

Figure: Preferred roaming fee with competition in B. $\alpha = 1.5$, $c = 1$.

- Let the operators in the more competitive country decide on roaming charge.

Monopoly in A and Duopoly in B

Proposition

Under asymmetric domestic competition, for any given γ, the equilibrium mutually agreed international roaming fee depends on the relative bargaining power of operator in country A as compared to that of operators in country B:

- *if all the bargaining power is with operator in country A, the equilibrium international roaming fees and retail roaming prices are larger and the quantities demanded for international roaming lower, than under symmetric domestic competition; and,*
- *if all the bargaining power is with operators in country B, the equilibrium international roaming fees and retail roaming prices are smaller and the quantities demanded for international roaming higher, than under symmetric domestic competition.*

Monopoly in A and Duopoly in B with Integration

- Providers A and B_1 are integrated;
- Provider B_2 solves

$$\max_{p_{B_2A}} \left[\left(p_{B_2A} - r_i \right) x_{B_2A} + \left(r_2 - c \right) x_{AB_2} \right];$$

- Integrated provider I solves

$$\begin{aligned} \max_{p_{AB_1}, p_{AB_2}, p_{B1A}} \left[\left(p_{AB_1} - r_1 \right) x_{AB_1} + \left(p_{AB_2} - r_2 \right) x_{AB_2} \right. \\ + \left(r_1 - c \right) x_{B_1A} + \left(r_2 - c \right) x_{B_2A} \\ \left. + \left(p_{B_1A} - r_1 \right) x_{B_1A} + \left(r_1 - c \right) x_{AB_1} \right]; \end{aligned}$$

- $p^*_{AB_1} = \frac{\alpha + c}{2}$, $p^*_{AB_2} = \frac{\alpha + r_2}{2}$, $p^*_{B_1A} = \frac{2c(1-\gamma) + 3r_2\gamma + \alpha\left(2 - \gamma - \gamma^2\right)}{4 - \gamma^2}$, and $p^*_{B_2A} = \frac{r_2\left(2 + \gamma^2\right) + (1-\gamma)(c\gamma + \alpha(2+\gamma))}{4 - \gamma^2}$;
- $x^*_{AB_i}$; $x^*_{B_iA}$ follow.

Monopoly in A and Duopoly in B with Integration

- r_1 is irrelevant as it does not affect profits;
- Provider I's preferred roaming charge solves

$$\max_{r_2} \left[\left(p^*_{AB_1} - c \right) x^*_{AB_1} + \left(p^*_{AB_2} - r_2 \right) x^*_{AB_2} + \left(p^*_{B_1A} - c \right) x^*_{B_1A} + \left(r_2 - c \right) x^*_{B_2A} \right]$$

  leading to $r^*_{2,I} > c$ for small γ and does not want to have a roaming agreement with B_2 for high γ;
- Provider B_2's preferred roaming charge solves

$$\max_{r_2} \left[\left(p^*_{B_2A} - r_2 \right) x^*_{B_2A} + \left(r_2 - c \right) x^*_{AB_2} \right];$$

  leading to $r^*_{2,B} \leq c$ for small γ and $r^*_{2,B} \geq c$ for high γ.

Monopoly in A and Duopoly in B with Integration

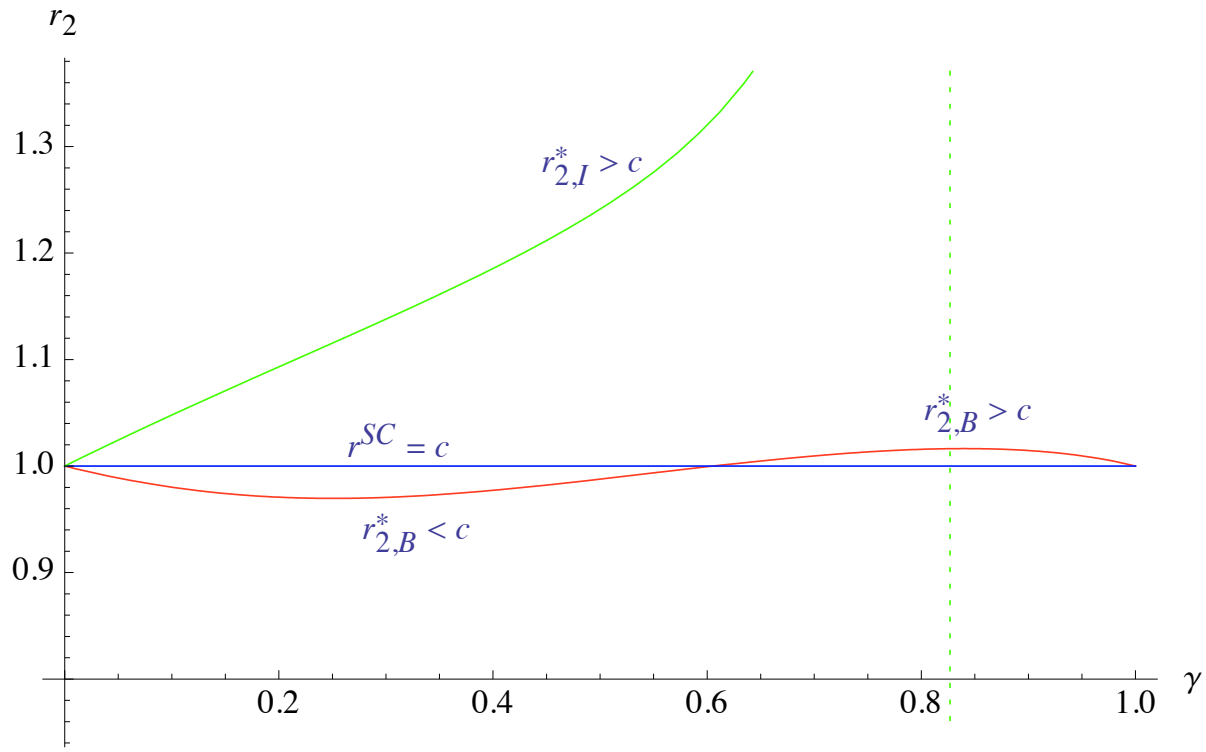

Figure: Preferred roaming fees with competition in B and integration. $\alpha = 1.5$, $c = 1$.

Monopoly in A and Duopoly in B with Integration

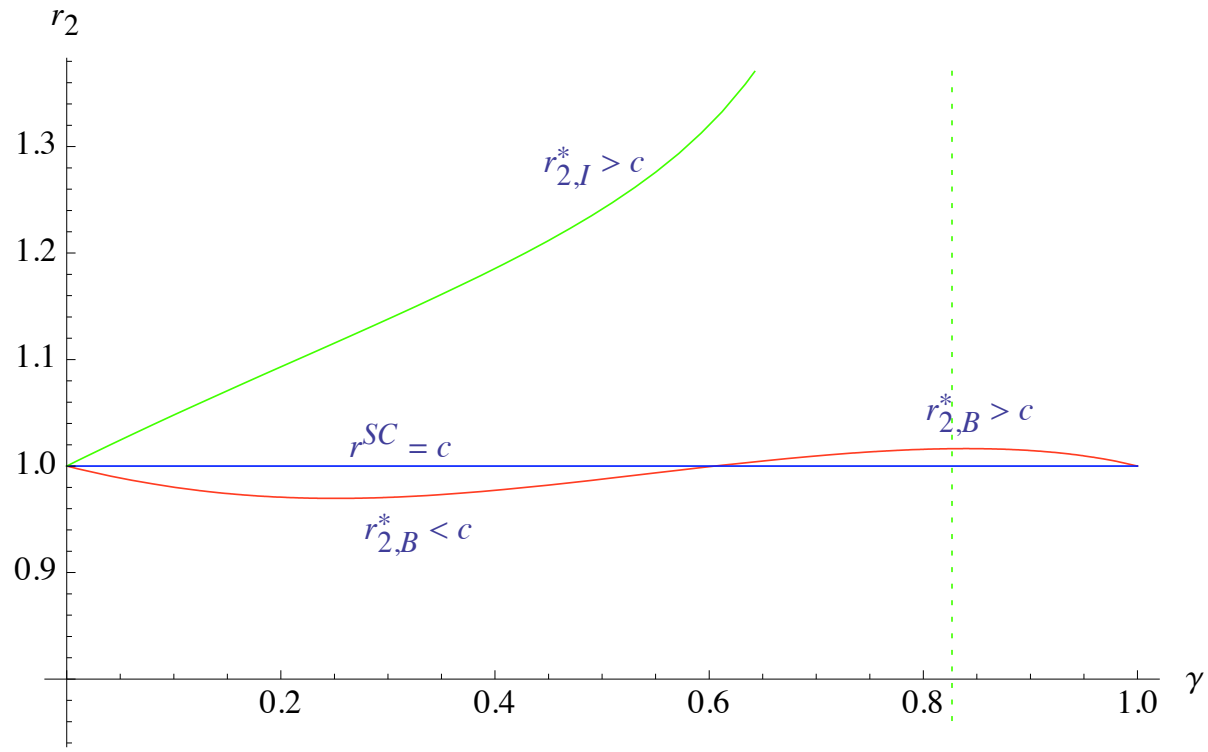

Figure: Preferred roaming fees with competition in B and integration. $\alpha = 1.5$, $c = 1$.

- Again: Let the non-integrated operator in the more competitive country decide on roaming charge.

Monopoly in A and Duopoly in B with Integration

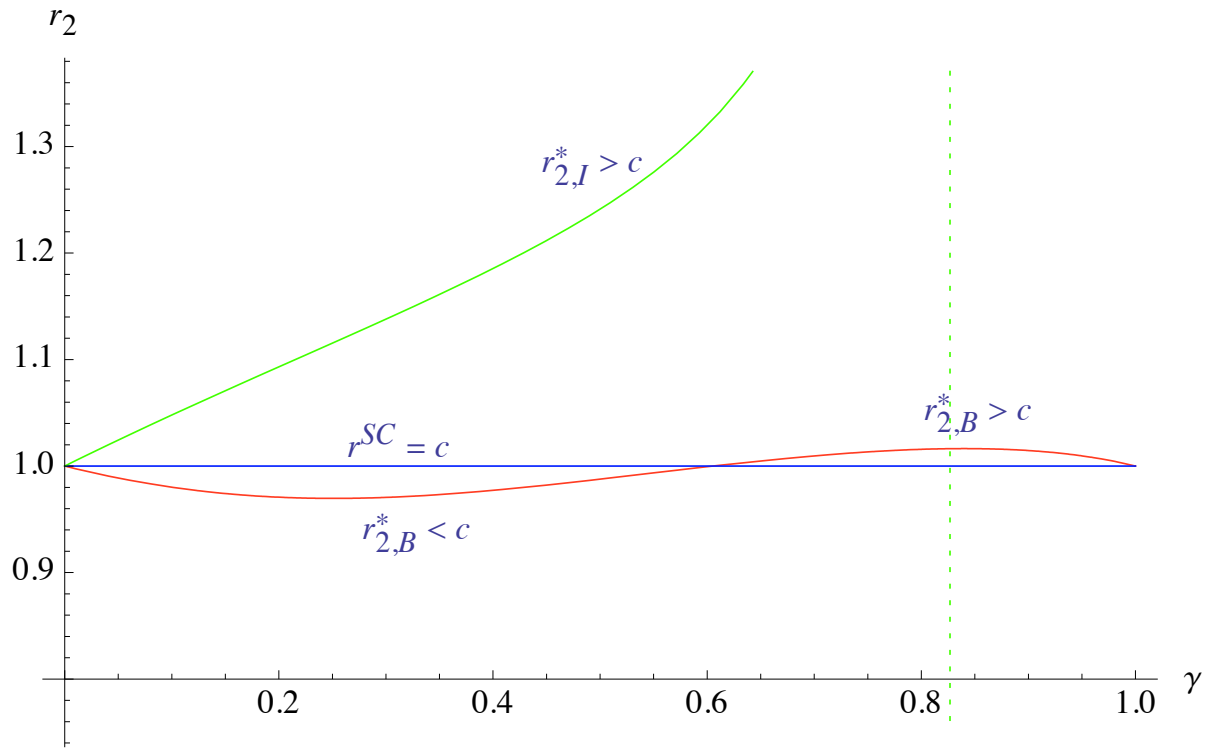

Figure: Preferred roaming fees with competition in B and integration. $\alpha = 1.5$, $c = 1$.

- Again: Let the non-integrated operator in the more competitive country decide on roaming charge.
- Force roaming.

Monopoly in A and Duopoly in B with Integration

Proposition

Under asymmetric domestic competition with international integration the equilibrium international roaming fee depends on the relative bargaining power of the integrated structure and non-integrated operator in country B as well as the degree of competition between operators in country B.

- *For a sufficiently low degree of competition between operators in country B, $\gamma \in [0, \gamma^*[$,*
  1. *if all the bargaining power is with the integrated structure, the equilibrium international roaming fees and retail roaming prices are larger and the quantities demanded for international roaming lower than under symmetric domestic competition; and,*
  2. *if all the bargaining power is with the non-integrated operator in country B, the equilibrium international roaming fees and retail roaming prices are lower and the quantities demanded for international roaming larger than under symmetric domestic competition with international integration.*

Monopoly in A and Duopoly in B with Integration

Proposition

Under asymmetric domestic competition with international integration the equilibrium international roaming fee depends on the relative bargaining power of the integrated structure and non-integrated operator in country B as well as the degree of competition between operators in country B.

- *For an intermediate degree of competition between operators in country B, $\gamma \in]\gamma^*, \widehat{\gamma}[$, the equilibrium international roaming fees and retail roaming prices are larger and the quantities demanded for international roaming smaller than under symmetric domestic competition.*
- *For a sufficiently high degree of competition between operators in country B, $\gamma \in]\widehat{\gamma}, 1]$, the integrated structure will effectively foreclose the non-integrated operator.*

Monopoly in A and Duopoly in B with Integration

Corollary

If in the case of a bilateral monopoly one country's operator enters the other country, social welfare is worsened

1. *for intermediate degrees of competition between operators in the competitive country, i.e., for* $\gamma > \gamma^*$;
2. *for sufficiently low degrees of competition between operators in the competitive country, i.e., for* $\gamma \leq \gamma^*$, *if sufficient bargaining power is with the integrated structure.*

Corollary

If, in the case of competition in one country, the monopolist from one country acquires one of the competitors in the other country, social welfare is worsened irrespective of the distribution of bargaining power between the integrated and the non-integrated operators.

Conclusion

- Asymmetry in the competitive setup in the two countries and bargaining power between providers matter
  - for roaming charges and retail roaming prices;
  - for deciding how much international integration of (alliances between) operators inflate roaming charges and retail roaming prices and whether there is an incentive to conclude a roaming agreement at all.
- Mediated bargaining over the roaming charges may help alleviate the problem of inflated roaming charges.
- Force roaming whenever competition in the more competitive regions (countries) is too strong, as interregional operators could foreclose small operators in those regions.
- Next step: Explicit modeling of the bargaining.