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# Pricing infrastructure – does the organizational model matter ?

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# Agenda

1. Introduction
2. A simple model
3. Main results
4. Case study: rail infrastructure
5. Conclusions

# The situation of great infrastructure investment in Europe

- EU reforms : market opening, frequent unbundling of infrastructure and operation
- High investment costs vs variable low returns & long lifetime → public funding
- Scarcity of public funds → balance between immediate and delayed spending?
- Acceptability issues → focus on pricing both from final infra users and taxpayers

# Situation of infrastructure managers

- Focus on « pure » IMs (infrastructure, no services for final users)
  - Whether public or private, accountability required, debt control  
→ more attention to financial balance for each new project
  - Sometimes imposed by the IM's statutes (ex: RFF)
  - Pushes toward « break-even » rules (costs= expected revenues with some kind of « rate-of-return » rule)
- For IMs : **Joint adjustment of infrastructure charge (IC) and IM's share of investment costs**

# Situation of public funding parties

- More concerned by their financial balance, too
- In the same time, public policies are concerned by user surplus
- Supposes attention to their investment costs, together with attention to the final clients
- Leaves room for joint negotiation of investment costs together with IC (IC impacts both the level of investment costs to be covered by governments, and, indirectly, the costs for final rail clients)

# Comparison of « perfect » organizational options

- No information asymmetry
- Perfect procurement process
- The IM does simply break-even
- Under these unrefined assumptions, what is basically the effect of organizational choices on pricing ?

# The downstream market

- Infrastructure charge (IC) does not impact directly the price paid by the final user
- Rail operators react to the IC : focus here on pricing reactions
- Reaction dependent on market power (monopoly vs perfect competition conditions)
- When public regulation of operator still takes place, reaction depends on type of regulation

# Types of pricing reactions

- Unregulated monopoly : 
$$\frac{P - C - t}{P} = \frac{1}{-\varepsilon}$$

- Regulated monopoly : Ramsey-Boiteux

$$\frac{P - C - t}{P} = \left(\frac{\lambda}{1 + \lambda}\right)\left(\frac{1}{-\varepsilon}\right)$$

- Perfect competition : 
$$P = C + t$$

- Cournot oligopoly : 
$$\frac{P - C - t}{P} = \frac{1}{n}\left(\frac{1}{-\varepsilon}\right)$$



# General formulation for price adjustment

- A general form can cover all previous cases, that adapts to many competition and/or regulation contexts :

$$\frac{P - (C'_0 + t)}{P} = - \frac{a}{\varepsilon} \quad (\text{E0})$$

$$0 \leq a < 1$$

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# The model (1)

- Economic actors : IM, public government, rail operator(s)

$$K = K_I + K_G$$

- Break-even rule for IM : 
$$K_I = \frac{(t - C'_I)Q(P)}{\theta} + \frac{L}{\theta'}$$

where  $\theta$  is the rate of return asked by IM, taking account of its characteristics and of risks incurred

we will use, for practical reasons, its inverse  $\eta \equiv \frac{1}{\theta}$

L is an annual public payment (=0 for public IM, concn)

since L does not bear risk demand:  $\theta' < \theta$

# The model (2)

- K may depend on the IM, as other items:  $K_i \theta_i C'_i$
- Utility function of public government:

$$W_i = \eta_0 S - (1 + \lambda)(K_i - \eta_i(t - C'_i)Q + (\eta_0 - \eta'_i)L_i) + \mu \eta_0 (P - C'_0 - t)Q$$

Where  $\lambda$  is the cost of public funds (CPF)

$\eta_0$  is the inverse of the discount rate used for government's investment decisions

$\mu$  is a relative weight given to operator(s)' profits

the public government is supposed to choose the IC level  $t_G$

# The model (3)

- Price adjustment by RO(s) :

$$\frac{P - (C'_0 + t)}{P} = - \frac{a}{\varepsilon} \quad (\text{E0})$$

- Demand curves :

$$\left\{ \begin{array}{l} \text{- linear :} \\ \text{- constant elasticity :} \\ \text{- .....} \end{array} \right. \quad \begin{array}{l} Q(P) = \beta - \alpha P \\ \varepsilon = \frac{P}{Q} \frac{dQ}{dP} = \text{const} \tan t \leq -1 \end{array}$$

- Constant marginal costs  $C'_I, C'_0$

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# Preferred IC for the government

- Linear demand :

$$t_G = \frac{\beta}{\alpha} - C'_0 - \frac{\frac{\beta}{\alpha} - C'_0 - C'_i}{(2 - R)}$$

With

$$R \equiv \frac{(1 + 2a\mu) \eta_0}{(1 + a)(1 + \lambda) \eta_i}$$

In case of perfect service market:

$$R \equiv \frac{1}{1 + \lambda} \frac{\eta_0}{\eta_i}$$

# Interpretation § comparative analysis

- R characterizes pricing (IC) § IM's financing share, and is independent from demand characteristics  $t_G$
- IC decreases as R increases as  $\theta_i$  increases:  $\frac{\partial t_G}{\partial \theta_i} < 0$  ... counter-intuitive?
- Beware: lower IC does not mean higher welfare (indeed, it does not here all else equal – envelope theorem -)



# Interpretation § comparative analysis

- Impacts of parameters on IC :

$$\frac{\partial t_G}{\partial \lambda} > 0, \quad \frac{\partial t_G}{\partial \mu} < 0, \quad \frac{\partial t_G}{\partial \theta_i} < 0 \quad ; \quad \frac{\partial t_G}{\partial a} < 0 \quad \text{iff} \quad \mu > \frac{1}{2}$$

- IM financing capacity:

$$K_i(t_G) \geq 0 \quad \text{iff} \quad R \leq 1$$

- Very strong public budget constraints: tested by high value of  $\lambda$ :  $R$  gets down to 0 whatever demand characteristics or IM preferences

# Organizational models: price level

- PFI: less private risk ie lower  $\theta_i$  // concession, similar costs

$t_G^{PPP \text{ no demand risk}}$  is likely to be higher than  $t_G^{\text{concession}}$

- public IM is supposed to be less risk adverse (lower  $\theta_i$ ) and, often, to have higher costs than a concessionnaire:

$t_G^{\text{publicIM}}$  is likely to be higher than  $t_G^{\text{concession}}$

# Organizational models: differentiation

- PFI: less private risk ie lower  $\theta_i$  // concession, similar costs

$\Delta t_G^{PPP\ no\ demand\ risk}$  is likely to be higher than  $\Delta t_G^{concession}$   
ie higher differentiation

- public IM is supposed to be less risk adverse (lower  $\theta_i$ ) and, often, to have higher costs than a concessionnaire:

$\Delta t_G^{publicIM}$  is likely to be higher than  $\Delta t_G^{concession}$

# Orders of magnitude

- Common values for CPF and other parameters:

$$\lambda = 0,2 \text{ to } 1 \quad (0,3 \text{ France; HEATCO: } -0,38 \text{ to } 0,75\dots)$$

$$\mu = 1 \text{ or possibly, before market opening: } (1 + \lambda)$$

$$\left. \begin{array}{l} \theta_0 = 3\% \text{ to } 8\% \\ \theta_i = 6\% \text{ to } 8\% \end{array} \right\} \begin{array}{l} \text{in most devpd countries,} \\ \text{before the crisis ...} \end{array}$$

- $R \leq 1$  requires  $\theta_0$  to be not too  $< \theta_i$

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# Pricing of a public rail IM

- RFF:

- Increased and more differentiated ICs: why?
- Submitted to harsh budget constraints
- Tries to get part of the surplus, without “killing the market”
- Rates of return asked are similar to private (0,5%-1% difference)

## Vs DBNetz :

- Regional differentiation (fairness more than surplus hunt?) but overall less differentiated; still, general trend=IC increase

→ Behaviour of public IMs may be variable (depends on operator's pricing behaviour, SNCF has more differentiation than DB), not so strong differences with private IMs

# PPP experiences

- PFI high speed line Bretagne-Pays de la Loire
  - 3,4 billion euros ; 200 km
  - Financing : 43% RFF, 28% local public authorities, <1% EU, 28% State but pre-finance by private partner compensated by annual State rent
  - Same pricing hypotheses taken for organizational comparisons; estimation of  $\theta$ : 7% RFF (with demand risk) vs 6% PFI (no such risk), consistent with the model for moderate gains in marginal infrastructure cost
  - Explanations: intangible budget constraint? Discount rates quite different from those used for project assessment (about x2)? Hyperbolic discounting (consistent with weight of 0,6 for future expenses) – linked to EU accounting rules-? Higher real CPF ?

# PPP experiences

- Concession HSL Tours-Bordeaux (« SEA »)
  - “the biggest PPP in Europe for the last 10 years”
  - 300 km ; 8 billion euros ; 50 years; > 50 public authorities
  - Pricing specified ex-ante in procurement process, likely to be similar to RFF pricing behaviour (other comparisons between organizational choices seem to refer to a single pricing scheme)
  - Consistent with the model if similar  $\theta$  and low difference in marginal infrastructure costs (but “forced neutrality in comparison” may be another hypothesis) ... but alternative hypothesis of high public budget constraint, leading to IM profit maximisation whatever the organizational choice
  - Specific(??) problem: network effects and consequences on RFF profits on complementary § competing parts of its network



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# Conclusions

- A rather convenient model for analysing organizational choices for « pure IMs » and a wide range of service market competition situations; helps to analyse respective behaviours (actual public CPF or discount rates)
- Conjectures on pricing comparisons are hard to test on real cases; in practice organizational choices are compared ex-ante with same prices, whereas optimization of each choice leads to different prices levels (similar to the frequent bias in marginal congestion cost calculation): recommendation= include comparisons with differentiated prices, at least as sensitivity tests
- Public and private IM behaviours may indeed converge when budget constraints get very strong

THANKS FOR  
YOUR ATTENTION

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