



HAL
open science

An application proposal of yardstick competition for the regional markets of the French railway system

Julien Lévêque

► **To cite this version:**

Julien Lévêque. An application proposal of yardstick competition for the regional markets of the French railway system. AET. European Transport Conference 2004 – ETC 2004, 4 - 6 october 2004, Strasbourg, 2004, London, United Kingdom. 16 p. halshs-00091857

HAL Id: halshs-00091857

<https://shs.hal.science/halshs-00091857>

Submitted on 7 Jun 2007

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.

AN APPLICATION PROPOSAL OF YARDSTICK COMPETITION TO THE REGIONAL MARKETS OF THE FRENCH RAILWAY SYSTEM

Julien Lévêque

Laboratoire d'Économie des Transports CNRS, Lyon, France

1 INTRODUCTION

Inherited from the mid-20th century, the European organization of national railways in state-owned, integrated and few regulated monopolies is not relevant anymore. Although this has been an interesting answer to the problems of externalities, investments and regulation, changes have occurred in technology, demand and economical analysis. In particular, economists have proposed many regulation schemes, which lead the regulators to increase the efficiency of the firms operating on the market.

Because of the high costs of rail transportation, governments have decided to liberalize the market; in particular, the European Commission and the European Parliament wish the passenger rail market opening. However, some countries, still have not opened their passenger rail market, which is currently monopolized by the historic and national operator, the SNCF in France.

In this paper, we assume that for social, political and economic (economies of density, network externalities, transactional costs) reasons, the regional passenger traffic will remain operated by the SNCF, in the coming years. However, we propose a regulation framework, based on yardstick competition (comparisons of performances), which could encourage the SNCF to improve the efficiency of its regional services.

In the first part of the paper, we discuss the implementation of yardstick competition on the French market of regional rail transport operation. Sections 2 and 3 describe the institutional organization of the market and what is called yardstick competition. Then, section 4 discusses how it could be implemented on this market. We show that, paradoxically to the preservation of the SNCF monopoly, the market structure of the regional rail transport is suitable for such an implementation of yardstick competition.

In the second part, we examine some theoretical, economic models. On the one hand, sections 5 and 6 explain why the use of comparisons benefits to the rail regulators (reduction of uncertainty, reduction of its capture by the operator...). On the other hand, section 7 reviews and discusses some limits of the mechanism (collusion, and investment incentives).

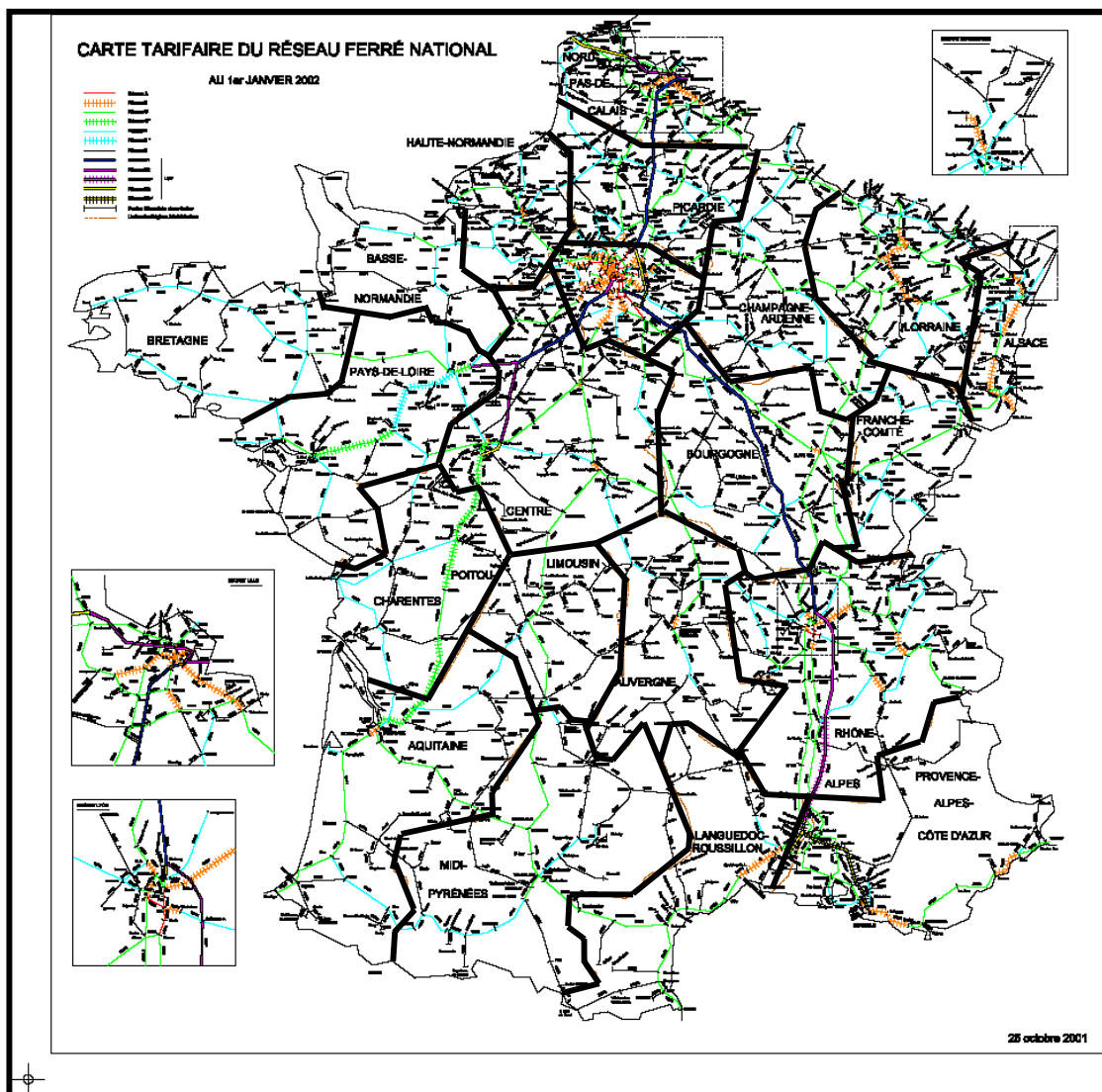
In the third part, we present the results of an econometric treatment, estimating the efficiency scores of the regional operators. Section 8 resolves the question of external heterogeneity between the operators. Then section 9 reports the followed methodology (cost frontier) and the outcomes of the model. It appears that the only explanatory variable of the external inefficiency is the delinquency rate: in some regions, the operator has to employ more ticket inspectors due to delinquency. Operators' corrected efficiency scores vary from 1 (for the best) to 1.18 (for the worst). Those internal inefficiencies

may be due to sub-optimal spatial organization or employee rotations, the operation of rural trains with two agents although one is sufficient, informational rent or local strikes.

Hence, we conclude that yardstick competition could be an original and efficient way of introducing “intramodal” competition in the regional passenger rail market, before competition for the market would be adopted in France.

2 INSTITUTIONAL ORGANIZATION OF THE FRENCH REGIONAL RAILWAYS

France is divided in 22 regions; the map below represents the French rail network, with the different regions.



In 1997, an “experimentation” period began: 6 regions became regulators of their rail transport services (TER - Regional Express Trains), which they defined (timetables) and subsidized. Since 2002, due to the SRU law (December 2000), the whole 20 French regions¹ were given the competence in regulating their TER; but they are currently faced with two linked difficulties:

- On the one hand, they cannot choose another operator than the SNCF, which keeps its legal monopoly for operating the whole French passenger network. So, the regions cannot use franchising (competition for the market).
- On the other hand, their expertise is still insufficient, compared with that of the historic operator. So, there is a strong informational asymmetry.

At the beginning of 2002, each region signed a contract with the SNCF, delegating its TER services for 5 to 10 years.

Some summary statistics describe the characteristics of an average regional network in 2002:

- number of passenger-kilometres (PK): 450 000 000
- number of train-kilometres (TrK): 7 080 000
- load factor: 63.5 passengers per train
- length of lines: 1157 km
- daily route length of a TER: 75 km
- average commercial speed: 70.7 km/h (in 1998)
- average cost coverage by the traffic revenues: 40 %
- rolling stock: 250 body shells
- operating income (tickets revenues and subsidies): 100 M€
- operating result: 3.7 M€

We now analyse what is yardstick competition and how it could be implemented within the regional rail regulation.

3 THE PRINCIPLE OF YARDSTICK COMPETITION

Through their reflection on the regulation of network industries (transport, energy, water, communication), economists have developed a theory of yardstick competition following three observations:

- there are (natural) monopolies, it is necessary to regulate in order to provide against abuses from the firm running the monopoly;
- an efficient regulation is faced with informational asymmetry;
- when several firms are running similar monopolies in separate markets, they emit informational externalities, of which the regulator can take advantage by comparisons between the firms. Collecting and processing data on production and costs lead the regulator to evaluate the relative performance of the firms. The results of those comparisons increase the expertise of the regulator and induce competition.

3.1 What is yardstick competition ?

There is no precise definition of what is called yardstick competition, given that the associated theory has led to various ways of implementation. However, we can distinguish two main senses given to the term “yardstick competition”.

On the one hand, this expression refers to a regulatory framework, based on comparisons. It is a virtual form of competition between similar regulated

firms, like Shleifer's proposal (see below). It consists in estimating what should be the best prices and subsidies, by comparing the performances of several similar and regulated firms, operating on several monopoly markets. If a firm seems to be relatively efficient according to comparisons, it has to be rewarded. On the contrary, an inefficient firm has to be punished, so that the comparison mechanism promotes competition.

On the other hand, yardstick competition refers to the basic and relatively informal use of comparisons by a regulator who wants to improve its expertise and reduce the informational asymmetry, he is faced with. In that sense, yardstick competition is an additional expertise tool used by the regulator to improve the efficiency of another regulatory framework (franchising, for example).

3.2 Yardstick competition versus benchmarking

Benchmarking is sometimes presented as a kind of yardstick competition, although both processes are different. First of all, benchmarking is undertaken by the firm itself in order to improve its own performance, whereas yardstick competition is undertaken by the regulator. Secondly, benchmarking is not only a comparison of key indicators, but also the whole process of improvement through the learning of others' good practices. On the contrary, the regulator using yardstick competition does not have to know what are the sources of inefficiency and how the firms can improve their performances.

3.3 The primary model of Shleifer

Shleifer's model (1985) is at the origin of theoretical mechanisms of yardstick competition and is subsequently relatively simple. He considers $N \geq 2$ similar firms, operating on geographically separated but identical markets and producing the same output. Each firm i is characterised by its marginal cost c_i and its investment in cost reduction $R(c_i)$, which are both observed by the regulator. For each firm i , the regulator sets the price p_i and distributes a subsidy (a lump-sum transfer), T_i . In order to set prices and subsidies according to the performances of the firms, the regulator compares each firm to its yardstick, defined as follows.

For each firm i , consider:

$$\bar{c}_i = \frac{1}{N-1} \sum_{j \neq i} c_j$$

$$\bar{R}_i = \frac{1}{N-1} \sum_{j \neq i} R(c_j)$$

Each firm i is assigned its own "shadow firm" which serves as the benchmark in yardstick competition. Shleifer shows that the regulator can achieve the economic optimum by setting:

- the price of firm i , equal to the average marginal cost of the other firms:
 $p_i = \bar{c}_i$
- the lump-sum transfer to firm i , equal to the average investment in cost reduction of the other firms: $T_i = \bar{R}_i$

Shleifer shows that each firm i is forced to compete with its yardstick, defined by the performances of the other firms. This incentive scheme implicitly defines the costs that firm i has to reach and the investments in cost reduction, it should make, in order to have a positive profit.

3.4 Correcting external heterogeneity

Given that each yardstick is defined by the costs and investments of the other firms, it is highly necessary to correct the external heterogeneity, as, actually, the assumption of identical environment is not acceptable. As the costs of the firms are influenced by factors associated to each environment, uncorrected external heterogeneity would distort the yardstick and, then, leads to an inefficient comparison mechanism. This important question would be discussed hereafter, in section 8.

4 IMPLEMENTATION OF YARDSTICK COMPETITION

At first sight, Shleifer's model with several similar firms seems far away from the real regional rail markets, which are nowadays still monopolized by the SNCF. Moreover, the regional rail operators do not have any particular status, for they are only geographically separated departments (as opposed to subsidiaries) of the historic operator. However, this paradox is not so important if we consider the current trend towards market opening. In particular, the recent reform of 2002, which regionalized the market, leads to an easy implementation of yardstick competition.

We believe that the implementation of yardstick competition at this regional scale by a common agency of regional regulators (within the GART – Transport Authorities Group or the ARF – French Regions Association) could underline some productivity gains, which the regulator will incite the operators to generalize. So, in our case, the “operators” would be the regional departments of the SNCF who have signed contract with a region; the regulator would be a common agency of regional regulators. This comparison process would lead both to increase the performance of the operators and the expertise of the regional regulators.

4.1 How to develop incentives ?

The theoretical models of the economic literature introduce a financial mechanism linked to the results of the comparisons to enforce a competitive pressure. Those models show that gains expectation and penalty threat generate such a competitive behaviour. However, as our operators are departments (without budgetary autonomy) of the SNCF, incentive gains and penalties would offset each other automatically within the global budget of the company. Thus, we can fear that the financial incentives would not have any impact, given the market structure: whatever the efforts of the regional operators, the central financial result of the comparison mechanism will be the same (an ex post reimbursement of the sum of the regional costs). However, the experience proves the relevance of such financial incentives, in this

context of region-SNCF contractualization ²: those mechanisms motivate, within the company, work teams and managers (who bring up a reputation effect) alike.

In practice, a financial mechanism is not the only way to lead to a competitive behaviour. In particular, the use of comparisons in addition to the current regulation scheme induces competition between the regulated operators for the two following reasons:

- a reputation effect arises: no operator can afford to have a much worse image than the others. This effect appears as soon as the regulator widely spreads the results of its comparisons;
- a belief effect plays: if the regulator can convince its operators of its attachment to the results of the comparative mechanism, he can create an additional competitive pressure. In particular, the threat of non-renewal of the contract when the market would be opened can induce such an effect.

Such an application of yardstick competition, which we propose in addition to the current regulation of the French regional rail transport, is thus in keeping with a regulation power exerted by regional, relatively benevolent regulators who wish to reduce their subsidies and to maintain the horizontal integration of the SNCF monopoly (and subsequently a relative social peace).

4.2 In the future, yardstick competition and franchising

It is foreseeable that in the near future, the European laws would force France to open its regional rail markets and to implement franchising (competition for the market) as a way to regulate these markets. Although the concepts of yardstick competition and competition for the market are clearly different, we pretend - following Bouf & Péguy (2001) - that those two ways of regulating operators are rather complementary.

Using yardstick competition in addition to franchising leads the regulator to improve the incentive scheme. First, yardstick competition contribute to prevent collusion between the bidders by reducing the benefit of it (which consists of a monopoly rent shared by the cartel members). Secondly, it provides performance incentives through the whole period of the franchising contract. Last, franchising allows the regulator to change the management of an operator which seems to be inefficient, according to comparisons.

So, yardstick competition could be interestingly implemented for the regulation of the French regional rail transport. Moreover, this form of regulation is flexible enough to be implemented through different ways: in connection with franchising or not, with a financial mechanism or not. We now discuss in the two following sections some more sophisticated models which illustrate how the comparisons lead to reduce informational asymmetry.

5 COMPARISONS REDUCE UNCERTAINTY

5.1 The moral hazard problem

In a moral hazard case, operators can be faced with a commercial risk (if demand decreases) or an industrial one (if costs increase more than prices). Due to hazard, the operator faces uncertainty which it can fear (risk-averse operator) or not (risk-neutral operator):

- consider a state-owned operator, running a public utility service which suffers no interruption. This operator is quite sure that it cannot go bankrupt, because of its public ownership and the necessity of ensuring the continuity of the service. It is ensured to be recapitalized sooner or later. Thus, such an operator does not fear uncertainty, knowing it is potentially ensured against risk. Such a behaviour toward risk is said risk-neutral.
- consider, now, a private operator. It cannot assume that its shareholders would accept every time the financial impact of random events. Hence, such an operator fears uncertainty. It is said risk-averse. In a regulatory framework, the regulator has to pay this operator a fixed incentive (a risk insurance), in order to offset the risk, the operator is faced with.

We now analyse, in this moral hazard case, how comparisons might reduce the uncertainty and then the risk insurance payment.

5.2 Modelling uncertainty

Many authors model the uncertainty which affects operator i 's production by the following elements:

- a common uncertainty parameter, η , which affects the whole operators of the sector. This variable includes mainly the situation of the sector (overall economic, social, political, competitive...situation).
- an independent particular risk, ε_i , which includes local impact on production (weather, difficulties caused by a third party...).

Thus, the risks $(\eta+\varepsilon_j)$, the operators are facing, are correlated to the extent that the firms are similar. Mathematically, $\text{var}(\eta) \gg \text{var}(\varepsilon_j)$ ensures a good correlation.

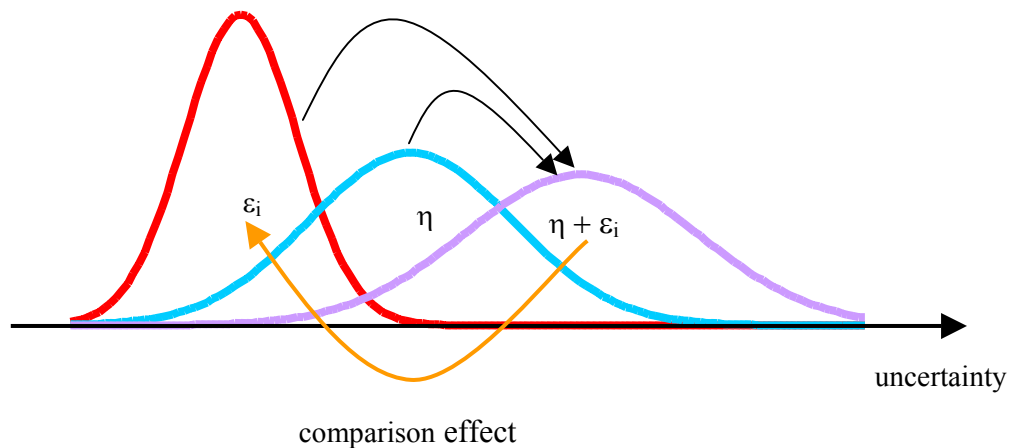
5.3 Theoretical results

Holmström (1982) shows that, in such a configuration, the use of comparisons improves the welfare. The results are the following:

- if operators are risk-neutral, yardstick competition is as interesting for the regulator as the other regulation schemes which do not use comparisons.
- if operators are risk-averse, the economic efficiency is improved by comparisons as soon as there is common uncertainty ($\eta \neq 0$). This improvement increases with the number of compared operators.

The underlying idea is rather intuitive (see figure below). Capturing all the relevant information about η , included within the outcome measures, leads the

regulator to neutralise the impact of common uncertainty. The outcomes then depend only on the ε_j 's and the efficiency of the operators (assuming that external heterogeneity is corrected). Thus the risk, an operator is faced with, is reduced from $(\eta + \varepsilon_i)$ to ε_i .



Following that result, the higher the ratio $\text{var}(\eta)/\text{var}(\varepsilon_i)$ is, the more the comparisons are relevant. The regulator who reduces by this way the uncertainty can then decrease its risk-insurance payment to the regulated operators.

5.4 Application to regional rail transport

Holmström's model can be perfectly applied to the regional rail transport: the homogeneity of the 20 regional environments ensures a high ratio $\text{var}(\eta)/\text{var}(\varepsilon_j)$, which guarantees the relevance of the comparisons in the moral hazard case.

The common element of the uncertainty, η , includes changes in the SNCF labour legislation, prices increase, national strikes, etc.

The idiosyncratic element of the uncertainty, the ε_j , takes into account the impact of regional traffic disruptions (due to the weather, local strikes and difficulties).

In practice, we are few interested in the moral hazard case, because of the stability of the operator's environment (which ensures a low uncertainty) and because of the relative risk neutrality of the operators. However, we are rather interested in the adverse selection configuration.

6 COMPARISONS REDUCE INFORMATIONAL RENT

6.1 The adverse selection problem

In the adverse selection problem, the regulator cannot distinguish (because of informational asymmetry) the high-efficient operators from the low-efficient ones. Then it cannot costlessly force high-efficient operators to exert a lot of

efforts, rather than to have a quiet life. To prevent those operators from passing themselves off as low-efficient operators, the regulator has to encourage them to reveal their high-efficient identity; to reach this goal, it has to pay them an informational rent;

We now analyse, in this adverse selection case, how comparisons might reduce the informational asymmetry on operators' identity, and hence the informational rent.

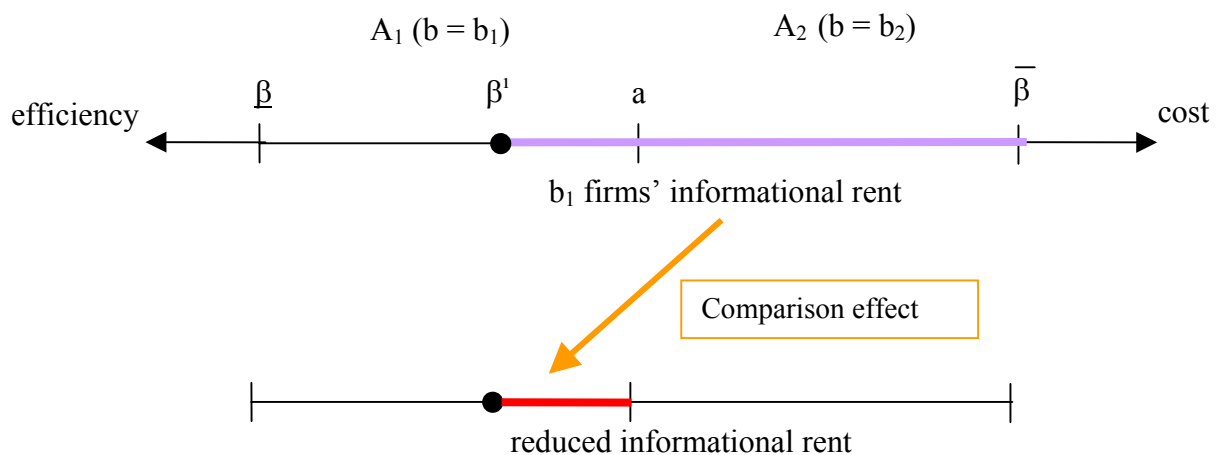
6.2 Modelling productivity

The operators' productivity model is designed like the uncertainty model: one distinguishes a common element (whose impact would be reduced by the comparisons) and a residual particular one. So, many authors model the productivity parameter, β^i , which characterises each operator i (assumed to be risk-neutral) by the following elements:

- a common part, $b \in \{b_1, b_2\}$, which is the same for every similar operator of the market. This variable reflects statutory, regulation, organisational... particularities of the market. b_1 corresponds to high-efficient operators, whereas b_2 refers to low-efficient ones.
- a particular part, ε^i . This individual characteristic includes the effects on the efficiency of operator i 's decisions (investments, management...).

6.3 Theoretical results

Auriol (2000) proves that, in such a configuration, the use of comparisons improves the regulation efficiency. She considers that the regulator proposes the operators a revealing menu of contracts. She shows that operators choose the contract which corresponds to their productivity parameter, β^i . Hence, they reveal their common part, b_1 or b_2 . Knowing this information, the regulator is able to reduce the informational rent of the high-efficient operators, b_1 (see below).



6.4 Application to regional rail transport

Regional rail transport presents such a large homogeneity that Auriol's model seems very suitable. The operators are highly correlated (α close to 1, we lead to Shleifer's model) and the operators' risk neutrality assumption is quite rational. Moreover, the threat of exclusion from the market is more and more credible given the future rail market opening.

In this adverse selection framework, the common part of the efficiency, b , reflects the average cost of the service. It includes SNCF rules which guarantee the same operation processes and the same wages whatever the region.

The idiosyncratic part, the ε 's, reflects the regional management efficiency: spatial organization, resources optimization, bargaining power, etc.

7 SOME THEORETICAL LIMITS

We now analyse yardstick competition in a dynamic context, since, actually, the robustness of a regulation framework has to be considered through time. We discuss two common limits of a regulation framework: collusion and investment incentives

7.1 The collusion between compared operators

Collusion is the co-operative behaviour between operators which should – on the contrary – compete against each other. A collusion threat arises when operators are regulated by yardstick competition because they foresee, they get zero rent from the mechanism proposed by the regulator if they play non co-operatively. Hence, they are willing to co-ordinate their messages to countervail the regulator's power.

In particular, the “revealing principle” used by Auriol may become inefficient if operators collude. Consider the model of the operators' productivity in the case of adverse selection, with a parameter $b \in \{b_1, b_2\}$, distinguishing high-efficient operators from low-efficient ones. At first sight, high-efficient operators seem to be able to collude and announce a low-efficient characteristic. This would permit them to exert a lower effort than the optimal one. In this case, collusion, directly distorting the comparison yardstick, reduces the incentive effect of yardstick competition.

However, Auriol's particular model is so designed that the mechanism suppresses any collusion incentive. The best choice for the operators, whatever their productivity characteristic is, consists in choosing the contract corresponding to their productivity.

Paradoxically, although our operators are departments of the same monopoly firm, the collusion threat does not seem very credible, as we propose to use comparisons in addition to the existing regulation framework. Moreover, given the number of operators (20) and the complexity of the internal cost structure, the agreement possibilities are reduced. All the more because SNCF costs begin to be known and supervised, any convergent change can be easily

detected. Last, collusion should not be the best strategy for rail operators, while the market is opening.

7.2 Reaching an adequate investment level

Although, some authors – see Dalen (1998) – show that yardstick competition could reduce investment incentives in some cases, this limit should not be a problem in practice, given the characteristics of the regional rail regulation. The main reason for this is that the operators finance a very little part of the investments: the infrastructure manager and the local authorities finance infrastructure and station renewals, whereas the regions finance the rolling stock investments.

So, we believe that these theoretical dynamic limits are problematic. It remains to resolve the question of the external heterogeneity.

8 CORRECTING EXTERNAL HETEROGENEITY

After having presented Shleifer's model, we noticed the need to control for the external heterogeneity which influences operator's performances, and then the yardstick they are compared to. We now illustrate how external heterogeneity impacts on the operator's performances and how it can be corrected. One usually distinguishes the two following types of heterogeneity:

8.1 Endogenous heterogeneity

This section refers to Bivand & Szymanski (1997) who analysed this effect of endogenous heterogeneity, which they define as "spatial dependence effect".

What is endogenous heterogeneity

Endogenous heterogeneity may arise as soon as the regulatory framework differs between the compared operators. If yardstick competition is implemented by a unique, centralised regulator, every regulated operators are faced with the same requirements. In such a case, there is no endogenous heterogeneity. However, if there is decentralisation, each operator is faced with its own regulator's requirements. Endogenous heterogeneity arises from particular policies of each regulator.

For example, a regulator (1) could require a very high quality of service from its operator 1 and pay the (relatively high) associated price. In this case, operator 1 seems inefficient (because of its high costs) if the service quality is not taken into account. Another regulator (2) could be financially benevolent toward its operator 2. This operator would appear relatively inefficient, for its costs are high, due to the benevolence of its regulator. If comparisons done by a third regulator (3) cannot take into account those particular policies, they would be distorted in favour of operator 3, which would be compared to apparently inefficient operators.

Such policies generate externalities which influence the operators' performances and, subsequently the comparison yardstick.

How to correct endogenous heterogeneity in our case

As we explained it in section 2, each regional operator faces a regional regulator, what leads us to prevent endogenous heterogeneity. We consider that our regional regulators are too captive and thus not benevolent enough to pursue a featherbedding policy. However, the different regulators' involvement in the development of their TER services would be a major source of endogenous heterogeneity.

Contrary to other network industries (water and energy supply, communication) which have to serve the whole population, always and everywhere, the access rate to regional rail transport is defined by the regional regulator, knowing that it is not possible to serve the whole regional population. So, particular political choices concerning rail transport can distort the results if we compare traffics: If a region wishes to develop rail services on structurally low traffic lines, its operator would appear less efficient than that of a region which develops rail only on major axes. This is the very reason why, following Nash (2000) ³, we consider, as the operators' production, the number of train-kilometres they operate, in order to reduce endogenous heterogeneity.

Moreover, to reduce the impact on costs, it is highly necessary to correct this heterogeneity by including the corresponding factors (quality and/or frequency of service, rolling stock investments...) required in the estimated cost function, as it should be done to correct exogenous heterogeneity.

8.2 Exogenous heterogeneity

For rail transport services, exogenous heterogeneity is caused by the environment. That kind of heterogeneity is due neither to the operator nor to the regulator. This environmental heterogeneity arises from the infrastructure supply (track and slot quality, network spatial structure...), social particularities (delinquency rate) and many others...

In order to correct those sources of distortion, the solution consists in introducing a measure of those factors in the estimation of the cost function. It means that the accounting cost of the service has to be regressed through an econometric process before being used in the comparisons. This is what we present now.

9 A COST FRONTIER ESTIMATION OF EFFICIENCY SCORES

9.1 Data and methodology

Although we focus on the current structure of the regional markets, regionalization happened too recently (2002), for us to have enough data. This is the very reason of our using data of 1997 and 1998. The data base we use comes from the regional accounts of the SNCF. For each year and each

region, several data are given: average speed, number of Train-kilometres, traffic, investments and detailed costs. In this section, we show there is efficiency heterogeneity which yardstick competition could reduce.

According to what we exposed before, we estimate operators' efficiency through a panel cost frontier, based on their operating costs (C_{it}). The operating cost is the sum of the following charges: driving, ticket inspection, energy, maintenance, ticket selling shunting, management, structure; it does not include charges which the SNCF does not control (infrastructure fees). So, we consider the productive and cost efficiency.

We use a stochastic cost frontier regression model and a Cobb-Douglas cost function:

$$\ln C_{it} = \beta_0 + \beta_1 \ln \text{TrK}_{it} + \beta_2 \ln \text{LL}_{it} + \sum_{k>2} \beta_k \ln w_{k,it} + v_{it} + u_{it}$$

where TrK_{it} is the production (number of train-kilometres) of operator i in year t and LL_{it} is the length of the regional rail network.

$w_{k,it}$ is the unit cost of the k^{th} input for operator i in year t . Given that all our operators are faced with the same unit costs, which are defined for the whole SNCF, whatever i is, for a given couple (k,t) , all $w_{k,it}$ are equal. This allows us to simplify our cost function which only depends on the production.

v_{it} is the stochastic term, corresponding to random shocks on each operator i . u_{it} corresponds to the logarithm of the cost inefficiency.

We add to those variables the six Z_k variables which correct external heterogeneity: $u_{it} = \delta_0 + \sum_{k \geq 1} \delta_k Z_{k,it} + \varepsilon_{it}$

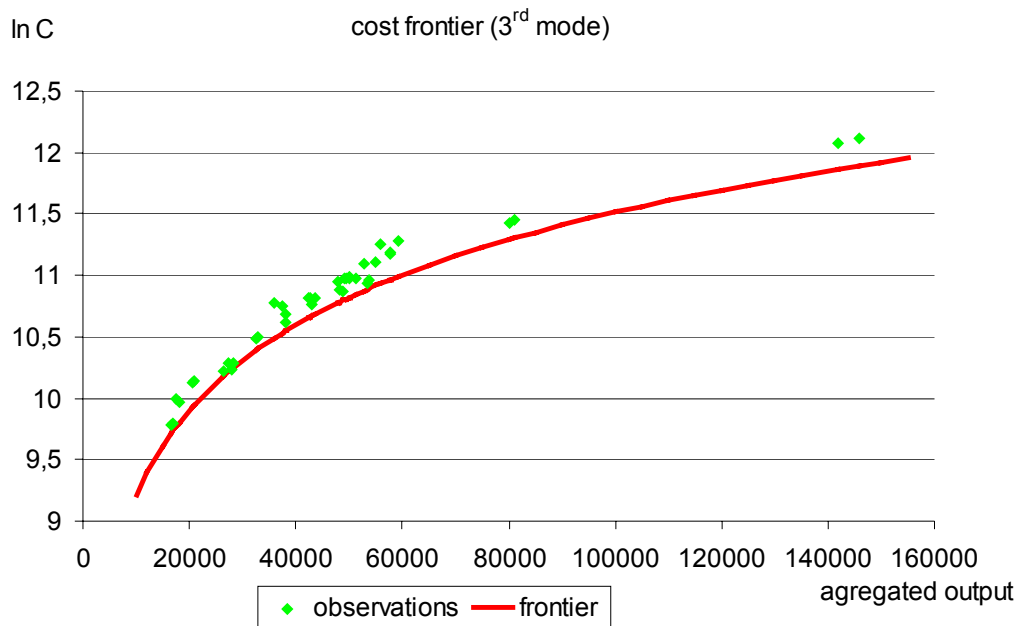
- Delinq: the delinquency rate
- Load: the load factor increases costs
- PK: the traffic should increase costs
- Exp: a dummy variable if the operator faces a regional regulator ⁴
- Speed: the average speed
- K: the rolling stock capital

9.2 Efficiency scores

The results ⁵ of the frontier models are the following:

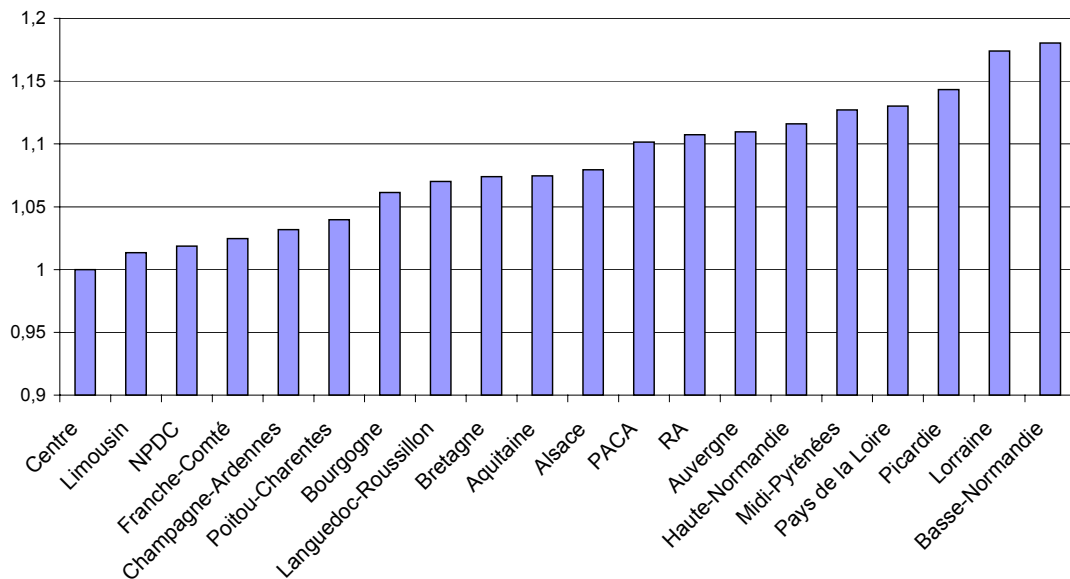
Dependent variable: ln C – Observations: 40						
Variables	1 st model		2 nd model		3 rd model	
	Coefficient	t-test	Coefficient	t-test	Coefficient	t-test
Constant	1.266	5.45	0.8948	62.1	2.460	12.4
ln TrK	1.177	35.0	1.226	78.2	1.033	39.0
ln LL	-0.08707	-1.88	-0.09949	-3.46	-0.08723	-2.01
Constant	0.05309	0.16	-0.05082	-1.07	-0.03764	-1.98
Delinq	2.088	2.02	2.555	3.41	3.584	4.91
Load	0.01014	5.39	0.005219	14.1		
PK	-0.8762 ^{E-3}	-2.63	-0.7097 ^{E-3}	-118		
Exp	-0.06364	-1.04				
Speed	-0.005289	-1.50				
K	0.1998 ^{E-5}	0.23				
γ	0.966	19.8	0.999	688	0.999	237
Log-L	63.94		71.76		63.38	

The first model corresponds to the complete estimation, although many variables are not significant. We reject the second model because of the negative sign of the coefficient corresponding to the traffic variable (PK); a positive coefficient would have had sense. Finally, in the third model only the delinquency rate is kept as a Z_k variable; this is due to the relatively high delinquency in the South of France, what leads the SNCF to employ more ticket inspectors and people in the stations to prevent delinquency. The corresponding frontier is drawn bellow:



The efficiency scores of each regional operator i are calculated by the average of the $\exp(\varepsilon_{it})$ and are normalized to 1 for the best operator ⁶. For the third model, they vary from 1 for the region Centre to 1.18 for the region Basse-Normandie (see the graph bellow). It means that, in this region, there is 18 % of cost overrun. The resulting inefficiency may be due to spatial organization, sub-optimal employee rotations, operating rural trains with two people although one is sufficient, informational rent, local strike...

efficiency scores



10 CONCLUSION:

Finally, we can briefly conclude with the following remarks:

1. Although the SNCF monopoly with its regional departments seems far away from the yardstick competition models, we showed that it is possible to induce the same incentive effect by comparing regional performances. Comparisons lead to reduce both uncertainty and informational rents.
2. The main difficulty when implementing yardstick competition is the control of the external heterogeneity. We proposed three cost frontier models based on a sample of panel data, in order to measure the efficiency of the regional operators.
3. The econometric results show that the return to scale are rather constant. The efficiency scores – varying from 1 to 1.18 show that the regional heterogeneity in terms of efficiency among the operators is quite important.

So we believe that implementing yardstick competition could be an interesting way of improving the TER performances, given the current regulatory framework.

11 BIBLIOGRAPHY

Auriol, E. (1993) Monopole ou duopole : l'effet de comparaison, *Annales d'Economie et Statistique*, **31** 1-31.

Auriol, E. (2000) Concurrence par comparaison : un point de vue normatif, *Revue économique*, **51** 621-634.

Bivand, R. and Szymanski S. (1997) Spatial dependence through local yardstick competition : theory and testing, *Economics Letters*, **55** 257-265.

Bouf, D. and Péguy P. Y. (2001) Is yardstick competition desirable for western European railways ?, *International Journal of Transport Economics*, **28** (2) 205-227.

Dalen, D. M. (1998) Yardstick competition and investments incentives, *Journal of Economics and Management Strategy*, **7** (1) 105-126.

Holmström, B. (1982) Moral hazard in teams, *The Bell Journal of Economics*, **13** 324-340.

Nash, C. (2000) Modelling performance: Rail, in Hensher D.A. & Button K.J. (Eds.), *Handbook of transport modelling*, Pergamon, pp. 565-575.

Shleifer, A. (1985) A theory of yardstick competition, *Rand Journal of Economics*, **20** 41-58.

Notes

¹ Île-de-France (greater Paris) and Corsica, whose regulations are specific, are excepted.

² Similar financial incentives have been introduced in the current contracts, so that the operator offers a good quality service.

³ Nash (2000) developed such an analyse concerning railways : "Governments [...] frequently intervene in the pricing and output decisions of railways. Performance measures for these railways then typically provide information on a mixture of the performance of the management and of the institutional setting in which it operates. For passenger services it is not uncommon for governments to effectively control the timetable as far as the frequency of service on each route [...]. In this situation, arguably the government becomes the customer, and the output the railway produces is a certain level of service, rather than transport for a number of people."

⁴ 1997-1998 corresponds to the "experimentation" period, defined section 2.

⁵ We use the software Frontier 4.1 of Coelli.

⁶ This does not mean that the best operator cannot improve its efficiency.