Regulation without competition: how does the French Rail Regulator Monitor the Rail Access Charges?

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Abstract

Access charges to the railway infrastructures, and in particular of the high speed lines, poses many theoretical and practical questions. France is especially affected by this problem since access charges are particularly high while at the same time competition is non-existent. Is this absence of competition explained by the high level of access charges? How the French rail regulator (ARAF) is dealing with this lack of competition?

The paper shows that the first decisions of ARAF (newly created at the end of 2010) aims at protecting the rail companies from the temptation of the infrastructure manager (RFF) to increase sharply the rail access charges when the willingness to pay of the rail companies is high. By monitoring the RAC, the regulator is also addressing the monopolistic position of SNCF in order to facilitate the potential entry of a new competitor.

But finally, after building a model that summarizes the components of supply and demand on the Paris-Lyon journey, this paper shows that the considerations relating to demand (peak hour or off-peak hour) are more fundamental than access charges, which do not in themselves constitute a barrier to entry. Break-even points are proposed which show that SNCF's potential competitors have margins for maneuver. But other barriers exist, we can suppose that the response strategies of the SNCF is to engage in a preventive price war if it were threatened by the advent of a new operator.

It seems not at all unlikely that people in monopolistic positions will often be people with sharply rising subjective costs; if this is so, they are likely to exploit their advantage much more by not bothering to get very near the position of maximum profit, than by straining themselves to get very close to it. The best of all monopoly profits is a quiet life.

John R. Hicks
Annual Survey of Economic Theory: The Theory of Monopoly. *Econometrica*, January 1935, page 8.

I. Introduction

Competition is clearly encouraged by EU directives within the rail sector. Facing this new deal, France seems to be timid and even hostile to the principle of competition. The consequence is that until now, all passenger trains (except one) in France are operated by SNCF, the public company. Even more, potential competitors seem to consider that cooperation (Thalys, Eurostar, Railteam…) is better than competition and especially competition on the track that we address in this paper. We will particularly emphasize case of high speed rail, the most profitable market for SNCF but maybe the market with the highest barriers to entry. The wisdom of potential competitors can be explained by the high level of rail access charges (RAC), very often presented as the main barrier to entry. This issue has to be clarified because there is in France since December 2010 a new rail regulator, now in charge of approving every year, the RAC grid.

RAC are defined in France by the Infrastructure Manager (IM) called RFF. From an economic point of view, the IM is a natural monopoly whose role has been circumscribed by successive railway directives. Two main ideas lie behind this concept of a circumscribed monopoly:

- The first is that the railway sector must be open to competition wherever this is possible. Fixing the limits for the IM is therefore a matter of defining which activities are potentially competitive and should therefore be opened to competition. France, and namely HSR system is challenged by this perspective. How to open competition on HSR?.

- The absence of competition supposed that both IM (RFF) and Rail Company (SNCF) must be monitored. It is important to avoid the “quiet life” of the monopoly too often less interested by improving its productivity than by avoiding any subjective or internal cost

In order to well understand the regulator’s job in the domain of RAC, we will start with a quick overview of the roles of RAC (II). Then we present the situation in France and more precisely why it is possible to apply a Ramsay-Boiteux Pricing scheme leading to an important mark-up added to the marginal cost on a large part of the HSR network (III). Then, considering the first decisions of the regulator in 2011 and 2012, we observe an interesting trade-off between the official full cost objective of RAC for HST on one hand and the coming challenge of competition on the other hand (IV). But competition is probably not only limited by the level of RAC but also by the very complicated cross subsidisation, internal to the rail company, between peak and off-peak hours trains (V)

II. Rail Access Charges: tell me what are your objectives….

The objectives of RAC

The aim of track access charges is to make the cost of infrastructure and the scarcity of slots clear to users. But this general principle, which has the effect of substituting the market to the organization, may involve several possible goals. What potential intentions lie behind the introduction of a tariff?

- Is the aim just to pass on costs, essentially as an accounting exercise?
- Or, is the aim a more subtle one of managing demand in order to regulate flows and optimize infrastructure use? For example, by modulating tariffs in time and space it is possible to create powerful levers for encouraging the operator and the community to rationalize infrastructure use, to question the value of certain services, to review train operation graphs, technologies, maintenance costs, etc.
- Or is there also a more or less explicit attempt to draw revenue by taking account of users' contributive capacities and willingness to pay?

Therefore, pricing does not just aim at covering costs, but also at bringing about a selection between different types of traffic in the case where competition exists between different uses (HST, Regional Passenger Trains, freight...). It therefore provides a way of identifying where new investment is necessary and possible, and where it should be avoided! Decisions about investment and the management of train slots thus gradually become engineering and economic decisions of major importance. Once again, the changes that are made to infrastructure management, in this case of the introduction of track access charges, aim at putting pressure on the RCs and the public authorities which provide large scale subsidies to the railways. As they are obliged to pay access charges, the RCs, or the public authorities that commission services, are encouraged to rationalize the services they provide and improve productivity. The level of track access charges is therefore a central issue, primarily because the IM is a monopoly and the level of access charges must be controlled to avoid any discrimination between RCs and any abuse of its position, but also because the structure of access charges provides insight into the more or less explicit priorities of the IM and its public supervising authority. It is therefore important to be aware of, and to understand the decisions that are made with regard to access charges which differ greatly between European countries.

As has been pointed out in a recent paper (Sanchez-Boras et al. 2010) there are several ways of determining the level of railway access charges. In addition to the traditional marginal cost (MC) method there are two others:

- Full Financial Cost minus subsidies (FC-): access charges are calculated on the basis of the difference between state compensation and the full financial cost.
- Mark-ups to Social Marginal Cost (MC+): a mark-up is applied to the social marginal cost in order to reduce or eliminate necessary state compensation.

If we consider those three alternatives (MC, FC-, MC+) in relation to the three main types of objectives outlined above we can see that the issue of covering costs is a central one. But is it sufficient to cover marginal costs, or should the attempt be made to recover total costs? It is important to remember that in the rail sector the marginal cost is generally very much lower than the average cost which means that marginal cost pricing requires public subsidies to make up the difference. Which alternative should be chosen? In a country like Sweden, the track access charges have been deliberately set at a very low level to encourage the use of railways. In France, on the other hand, the official goal is to recover the total cost, at least for part of the network. But might this potentially negatively affect traffic? Here too, a careful assessment is necessary and the incentive systems that have been put in place must be clarified.

Evaluating fare schedules in relation to potential traffic

The impact assessment of the IM's decisions about track access charges is conducted with a view to increasing rail traffic (White Papers 2001, 2010). The IM does not have the sole responsibility for changes in that area. The public supervisory body and the RCs also play an important role. The key indicators that we should take into account are therefore train-kilometres, tonne-kilometres and passenger-kilometres. Disparities between the number of train-kilometres and the number of passenger- or tonne-kilometres may appear, but they are not necessarily worrying. For example, the number of train-kilometres may fall at the same time that the number of passenger-kilometres or tonne-kilometres rises. In areas where traffic is dense, this is a sign that use of the track is being optimized by filling trains better.

However, track access charges can also be responsible for this situation. This is the case in France on some high speed lines. It has recently started to apply also to freight transport. This reveals a key function of access charges which clearly act as a signal to users (Holder 1999). Railway companies must take account of the fact that in the zones with the highest traffic, slots are scarce and must be used optimally. Access charges are therefore an encouragement to productivity. Where the pressure of demand is high, increases in access charges is a sound way of regulating demand and adapting supply. But is that also the case when the pressure of demand is weak?

The correct level for track access charges does therefore depend not only on the cost of production but also on potential demand. If the gradient of the marginal revenue curve is low, which occurs in the case of high price elasticity, the access charges should be close to the marginal cost. This is the solution that has been adopted in most European countries (apart from the Baltic countries) for rail freight. As rail freight is in direct competition with other modes any increase in access charges produces a marked reduction in demand and possible efforts on the part of the RCs to satisfy the demand. On the other hand, when the gradient of the marginal income curve is high and the price elasticity is low, access charges can be increased without any hesitation. This is so because such an increase provides a way of giving priority to the uses which create the largest community surplus and also because it discloses the actual level of capacity to pay of users or of those who ask the RCs to provide train services. It is a more transparent way than equilibrium subsidies for making all parties aware of their responsibilities. And public authorities are not the last ones to be in need of such awareness.

III. RAC and HSR in France: full cost and mark-up

HSR: a full cost rationale

In France, for HSR, the railway pricing system is aiming a full cost rationale, the primary aim of the public authorities, which control RFF, is to limit public subsidies. This is a particularly strong constraint as in spite of a major crisis in public finance, which is common to most European countries, the French state is firmly committed to extending the HSR network. The French HSR network already exceeds 1800km and a new line is due to open at the end of December 2011 between Dijon and Mulhouse. Several other lines scheduled for completion before 2017 are under construction: Bretagne - Pays de Loire, Tours-Bordeaux and Metz-Strasbourg.

In addition to the goal of protecting the public finances, the HSR pricing system also attempts, following a Ramsey-Boiteux approach, to take account of the elasticity of demand in order to achieve the best trade-off between efficiency goals and budgetary needs (Nilsson

1992, 2000, de Rus and Nombela 2007). To obtain the optimal mark-up, added to the marginal cost, a two-stage pricing scheme has been implemented.

The first stage is to calculate, for a particular line, the total revenue which is required in order to cover RFF's investments. Taking this as a starting point, the second stage consists of calculating the pricing modulations that can be applied by varying the access charges over time. The elasticity of demand is not the same during off-peak and peak periods and it is possible to apply highly variable access charges. Logically, this analysis identifies situations in which demand is sufficiently strong, and sufficiently inelastic, to enable the charges that are put in place to bring in more than the initial target. The mark-up is not only based on the elasticity of demand. It also takes account of the opportunity cost of public funds, which justifies, from society's point of view, high access charges on some lines during peak periods (de Rus and Nash2009, Crozet 2012).).

It should be noted that when it adopts this approach with regard to SNCF, RFF is merely applying the same yield management approach which SNCF imposes on its clients. After all, the price of a ticket between Paris and Lyon varies by a factor of four depending on whether the journey takes place in the peak period or the off-peak period. The outcome is that, on the Paris-Lyon line, which is the line with the highest passenger traffic, the access charges can amount to six times the marginal cost. Paradoxically, in spite of the high access charges, this is also the most profitable line for the SNCF.

However, on lines with lower passenger traffic, access charges can only reach the marginal cost or twice the marginal cost. This reveals another function of access charges which clearly act as a signal to users (Holder 1999). Railway companies must take account of the fact that in the zones with the highest passenger traffic slots are scarce and must be put to the best possible use. Access charges are therefore an encouragement to productivity. Where the pressure of demand is high, it is quite healthy for the access charges to increase as it is a way of regulating demand and adapting supply. For example, in 2008, the average load factor of High Speed Trains (HSTs) in France stood at 77.5% in second class and 67.7% in first class. In the case of the Paris-Lyon line, the levels were respectively 80% and 70% above these, leading to the paradoxical situation that SNCF's most profitable line bears some of RFF's highest access charges.

Calculating the optimal mark-up on a Ramsey-Boiteux basis

A Ramsey-Boiteux pricing scheme can be used to conduct welfare analysis within the rail system (Oum & Tretheway 1988), maximizing social welfare subject to the budget constraint requirement, that is to say taking account of the opportunity cost of public funds. EU Directive 2001-14 authorises this approach which can be applied to HSR infrastructure charges by adding a mark-up based on the Ramsey-Boiteux principle. The standard Ramsey pricing argument would justify raising the price above marginal cost in inverse proportion to the elasticity of demand for the service in question. Thus, the Ramsey-Boiteux pricing rule can partly reconcile the two objectives of efficient use of the network and a profit constraint for the company (with a no congestion hypothesis). In theory, it maximises social welfare subject to the budget constraint requirement (equilibrium or minimum or maximum profits or deficit).

Formally, in a situation of natural monopoly producing n final products in quantities $q_1,...,q_n$

(or a single product on n parts of the market), the Ramsey-Boiteux prices are given by the following:

$$\max_{\{q_1,...,q_n\}} \{S(q_1,...,q_n) - CS(q_1,...,q_n)\}$$

$$subjectto \quad \sum_k p_k * q_k - C(q_1,...,q_n) \geq X \quad (\lambda)$$

where:

S, CS and C are respectively functions of consumer surplus, social cost and private cost

q are quantities and p are prices

X is the desired profit or authorised deficit

l is the Lagrange multiplier of the budgetary constraint, which indicates by how much the social profit would increase if X were decreased by one unit.

Assuming that the cross-elasticities between different products are null (independent demands) and with no externalities (social cost = private cost), we obtain the familiar rule of the mark-up that is proportional to the inverse of the price elasticity of the demand, i.e.:

$\frac{p_k - Cm_k}{p_k} = \frac{\lambda}{1+\lambda} * \frac{1}{\eta_k(p_k)}$ where $\eta_k(p_k)$ is the price elasticity of demand for good k

Let α be a parameter reflecting the opportunity cost of public funds λ, then $\alpha = \lambda/(1+\lambda)$,

And if we use ε to denote the price elasticity for traffic : $\eta_k(p_k)$

α/ε is the key ratio for determining the mark-up value. More precisely, if α is a constant, the relative price increase above marginal cost will become greater as demand is not sensitive to price.

So, Ramsey pricing provides a useful theoretical guideline (Nilsson 1992, Bonnafous 2010). However, it requires a great deal of information. Both the marginal cost and the elasticity of demand must be quantified with a certain degree of accuracy. We also need to take account of the opportunity cost of public funds, because RFF is subsidised by government. Applying this gives the following equation:

$(P - C)/ P = (a - Ci)/ P$ (1)

and

$(a - Ci)/ P = \alpha /\varepsilon$ (2)

where

P is the price of the end service, paid by train users, because we take account of the end user price elasticity.

a is the level of the infrastructure charge

ε is the price elasticity for traffic (absolute value)

$\alpha = \lambda/(1+\lambda)$, where λ is the opportunity cost of public funds.

C is the marginal cost which has two components,

Ci is the infrastructure cost

Cs is the train service cost

If we combine C = Ci + Cs with equation (1) , we obtain P = a + Cs and equation (2) becomes

$$(a – Ci)/ (a+ Cs) = \alpha /\varepsilon \qquad (3)$$

so

$$a = (Ci + \alpha /\varepsilon *Cs) / (1 - \alpha /\varepsilon) \qquad (4)$$

It is therefore interesting to see how the mark-up "a" varies with different values of α, ε, Ci and Cs . Table 3 below summarises the main results. Table 3 applies the official opportunity cost of public funds in France ($\lambda = 0.3$) which gives $\alpha = 0.23$. The different columns in Table 3 combine various levels of the elasticity ε with this fixed value of α. The lines show different combinations of Ci and Cs. We have given a value of 100 to Ci, and then assumed that Ci can be higher than, equal to, or lower than Cs. The impacts are very clear: the higher the elasticity and the ratio Ci/Cs, the lower the value of "a". On the contrary, when the elasticity and the ratio Ci/Cs fall, "a" increases. The mark-up may even be equal to ten times the value of Ci, but only when the elasticity is very low (0.3).

Table 1: The value of the mark-up "a" for Ci = 100

	$\alpha = 0.23$	$\alpha = 0.23$	$\alpha = 0.23$	$\alpha = 0.23$	$\alpha = 0.23$
	$\varepsilon = 0.3$	$\varepsilon = 0.5$	$\varepsilon = 0.8$	$\varepsilon = 1.3$	$\varepsilon = 2$
	$\alpha/\varepsilon = 0.76$	$\alpha/\varepsilon = 0.46$	$\alpha/\varepsilon = 0.28$	$\alpha/\varepsilon = 0.176$	$\alpha/\varepsilon = 0.115$
Ci/Cs = 1.5	**a = 625**	**a = 241**	**a = 164**	**a = 135**	**a = 121**
Ci/Cs= 1	**a = 733**	**a = 270**	**a = 177**	**a = 142**	**a = 126**
Ci/Cs = 0.5	**a = 1,050**	**a = 355**	**a = 216**	**a = 164**	**a = 138**

Concretely, this means that RFF's mark-up varies substantially according to the elasticity of demand. Consequently, in accordance with the Ramsey-Boiteux pricing principle, RFF can apply access charges that are higher than the marginal cost without causing a social loss. In this way, the modulation of access charges enables the HST system, considered as a whole, to cover the average cost and thereby reduce the scale of public subsidies to the railways.

IV. A shadow operator to help the French rail regulator

The regulator and a shadow operator

In order to assess the likelihood of entry for a new operator, it is possible to determine the cost function for a shadow HSR operator on the Paris-Lyon line and then relate this to a demand function. This will enable us to compute the potential market share of a new entrant and SNCF.

In order to capture the main costs borne by an HSR shadow operator, we have identified six types of charges. The cost structure that we propose below is directly based on that applied by SNCF. In other words, we have begun by considering that the shadow operator has the same costs as SNCF and then go on to consider hypotheses in which it could do better.

- The hourly cost of traction and the train crew expressed in €/hour
- The per kilometre cost, which takes account of the maintenance of the rolling stock and the energy required to run trains. This cost is expressed in €/km and is based on the SNCF's maintenance costs.
- The fixed cost associated with shunting trains. This is expressed in €/run.
- The passenger cost, which includes ticketing costs and station costs and which is therefore expressed in €/passenger. A new entrant could reduce its ticket distribution costs by selling tickets exclusively on the Internet.
- Structure costs which on average amount to 30% of the costs mentioned above. These include the cost of buildings and, for example, the creation of an outlet for a foreign operator who sets up in France when its head office is elsewhere in Europe. .
- Depreciation of the rolling stock which is expressed in €/km. This has been calculated on a linear basis, taking account of the purchase cost, the cost of mid-life renovation, and a zero residual value after 30 years. The purchase cost is €M 26.2/trainset. Mid-life renovation costs €M 7.0, the amortization period is 30 years and the residual value is zero. In this way, we were able to maintain the depreciation cost per day and per kilometre for each trainset used by the operator.

In order to integrate the totality of these costs in the final function, we have considered that they vary according to whether the train in question is a single trainset (8 cars plus locomotives) or a double trainset (16 cars). This is because during off-peak hours, a single trainset is sufficient while a double trainset is needed to meet peak hour demand. We have therefore made the hypothesis that the new entrant will apply this type of organization.

On these bases, we have obtained the following recapitulary table:

Table 2: The operating costs ascribable to a rail operator

	Single trainset	Double trainset
Hourly cost (€/h)	470	684
Cost per kilometre (€/km)	5.27	10.5
Fixed cost (€/run)	184	184
Passenger cost (€/passenger)	7.09	7.09
Structure cost (€/run)	2780	3587
Depreciation (€/day)	3032	6064

In addition to these operating costs, we need to consider the rail access charges that the operator must pay RFF. In the case of the Paris-Lyon journey, the rail access charge, in 2011, was € 17.54 /km in off peak periods and €23.96 /km in peak periods. As the journey is fixed, we can assess the percentage that each of these costs represents in the operator's final accounts, using the same unit, €/km. Table 4 gives us the structure of costs in peak periods and off peak periods

Table 3: Cost structure during peak period and off-peak period

	Single trainset (off peak)	Double trainset (peak)
Hourly cost	4.6%	5.0%
Cost per km	11.2%	16.6%
Fixed cost	0.9%	0.7%
Passenger cost	28.7%	21.4%
Structure cost	13.6%	13.1%
Depreciation	3.7%	5.5%
Access charges	37.2%	37.8%

From the above, we can see that the components of cost do not vary in the same way in the case of off-peak period and peak period trains: only the cost per km and depreciation increase by a factor of 2. While the second of these only represents a small percentage of the total cost, this is not the case for per km cost. It is therefore apparent that the per-km cost will be an important parameter when the new entrant decides on its proposals and its policy with regard to undercutting SNCF's fares. It should be noted that the rail access charges account for practically the same percentage of total costs in off-peak and peak periods. The key issue for the operator is therefore depreciation, as the amount involved is closely linked to the number of trains running. The size of the train fleet and its use, i.e. the service frequencies, are key. Frequencies are also extremely important when it comes to attracting passengers

The first decision of the regulator

Increases in capacity and regulating how it is used, take on particular importance in view of the forthcoming introduction of competition on HSR lines. At present, this involves only international journeys, but ultimately we are heading towards the opening up of all types of service to competition. Will this lead to a profound change in the situation for HSR? Not necessarily according to some recent papers by Preston (2009) and Nash (2009), who point out that the higher the rail access charges the less likely it is that competitors will appear on an HSR line. In a way, high access charges protect the SNCF. When a railway company has to pay access charges that amount to 30 to 40% of its turnover, potential competitors know that this reduces their probability of deriving a profit margin.

So, at the beginning of 2011, the new rail regulator (ARAF) prohibited RFF from introducing pricing based on the length of the trainset which would enable it to double rail access charges during peak periods when SNCF uses double HST trainsets, i.e. 16 cars as opposed to 8. The regulator expressed concern about the potential adverse impacts on potential competition of the excessive modulation of rail access charges. It asked RFF to limit the modulation of RAC in relation with the number of travellers in the train. This decision seems curious but a detailed analysis of the opportunities of profit on the Paris-Lyon line shows that ARAF had the objective to reduce a specific kind of barrier to entry, the difficulty to implement a relevant cross-subsidisation between peak and off-peak hour's trains.

This brings us back to another lesson from Hicks, which was stated just before the quotation that opens this paper, namely that "the variation in monopoly profit (…) will depend on the

difference between the slopes of the marginal revenue and marginal cost curves". In the case of HSR, and namely between Paris and Lyon, the marginal cost is lower during the off-peak period because of lower RAC. But the cost change is weak in comparison with the demand change. We can show that by comparing the difference between the costs and revenues.

V. Cross subsidization between peak and off-peak hours

Modelling the demand for HSR trips between Paris and Lyon (Crozet & Chassagne 2012) and crossing the results with the cost function presented above, we have obtained the following results (Cost is a growing function and revenue is a declining function).

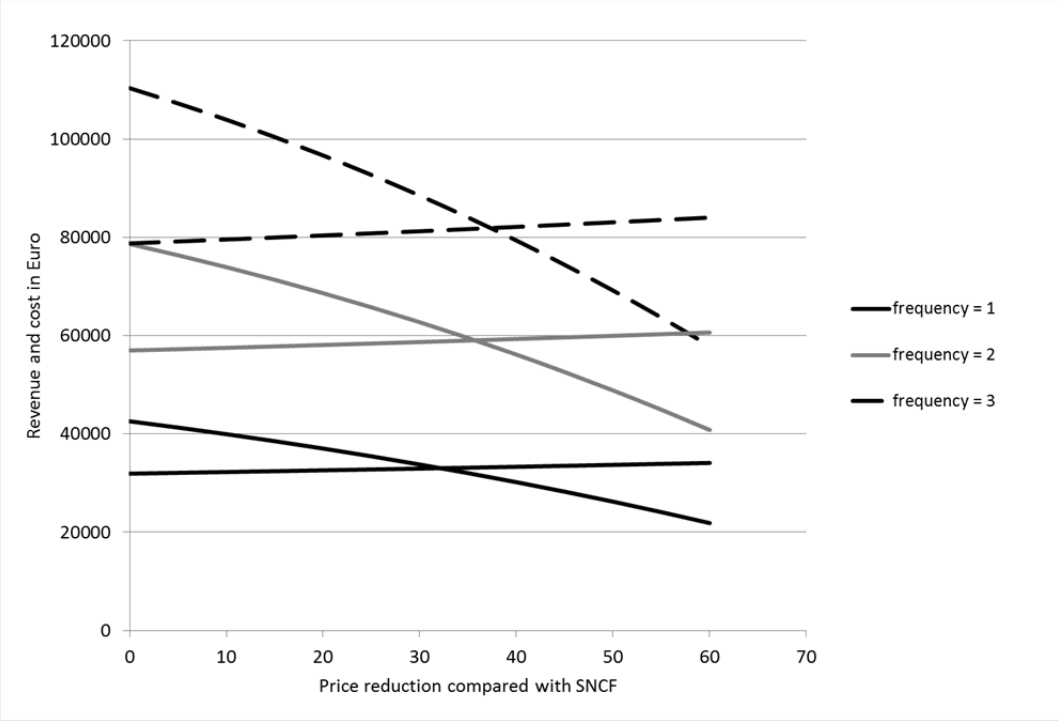

Figure 1: Peak period break-even points

Figure 1 shows that the new operator makes a real profit during peak periods. But this profit is directly linked to the fact that ARAF has prohibited RFF from doubling its access charges when the operator uses double trainsets and therefore maximizes revenue because of strong peak period demand. If access charges were at the level desired by RFF, the profit during peak periods would be three times lower. The new entrant can achieve a maximum reduction in ticket prices compared with SNCF of 34, 35 or 37% respectively if it offers 1, 2 or 3 peak period return services only if the modulation of peak period access charges is not excessive. But the difference between revenue and costs is much larger than three return journeys than for one. The break-even points therefore vary with service frequency, and profits would be limited if the operator offered just one return journey. However, the new operator needs to make considerable profits in peak periods as its off-peak services are unable to cover their total costs. But an operator cannot avoid offering off-peak services because if a train makes the Paris-Lyon journey in the morning peak period, it must return in the off-peak period to be able to run in the evening peak period, unless the rolling stock remains unused between morning and evening peak periods.

Figure 2 shows the deficit that results from operating trains in off-peak periods. With the hypothesis that the new operator has the same costs as SNCF, there is no "zone of profitability" and the deficit increases with service frequency. In order to achieve overall profitability, therefore, peak period profits must compensate for off-peak period losses.

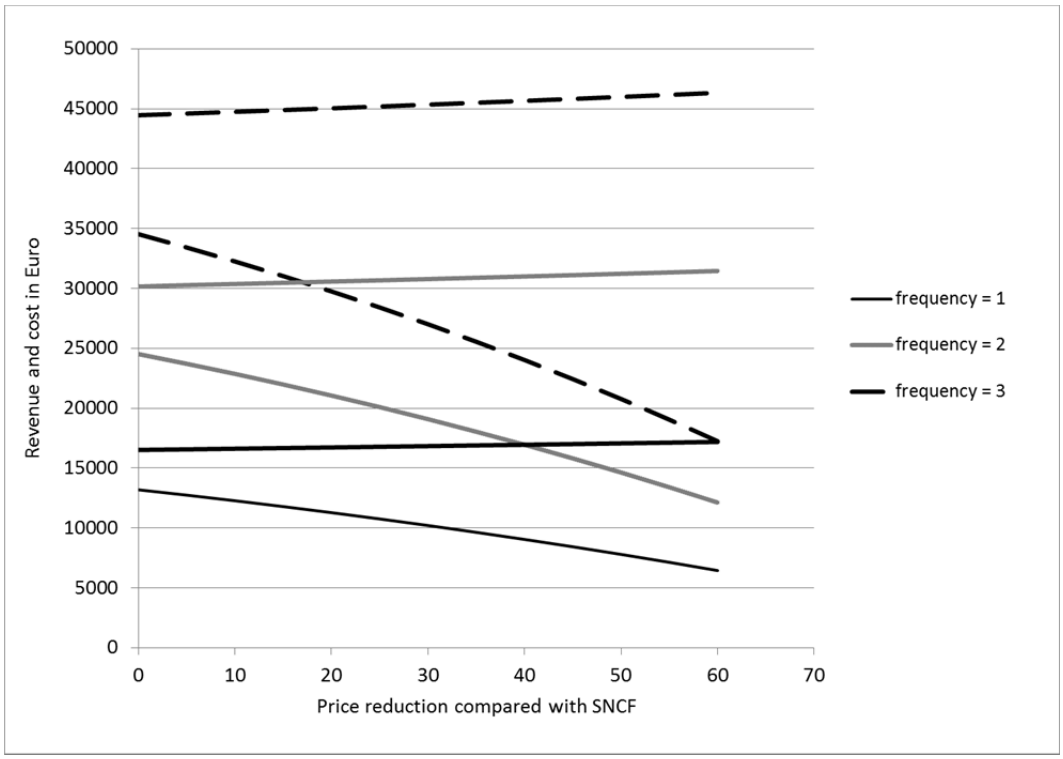

Figure 2: Off-peak period revenue and costs

SNCF's reactions

The principal lesson to be learnt from our modelling of the entry conditions for a competitor on the Paris-Lyon line is that rail access charges may act as a barrier to entry, but they are not the only one we should consider. The reason for this is that potential profitability results from the ability to meet peak period demand, while off-peak services tend to generate losses. The successful entry conditions for a competitor therefore depend on the type of service. There are therefore a great many other barriers to entry, the most important of which are listed below.

- The first are external to the operator. They relate to the ability to obtain peak period slots, station facilities and passenger information etc. from RFF
- The second are specific to the organization of the competitor. Can it easily purchase, or even better, hire HST trainsets? How and by whom will maintenance be performed? And at what price? Should access to maintenance workshops be defined by the regulator as an essential facility?

These questions relate to the fact that the high speed rail market is not a contestable market (Baumol 1982). In this sector there are a large number of sunk costs such as the purchase of rolling stock. There is no market for hiring HST trainsets. Moreover, as railway standards vary from one European country to another, HST trainsets that run on one line cannot easily be used on others. This increases both the costs of entering the market and the costs of leaving it.

In addition, the historical operator can react by lowering its prices, either preventatively or by engaging in a retaliatory price war. As shown by Figure 3, if SNCF lowers its fares by 20%, the new entrant's profitability is considerably reduced, becoming practically non-existent with a fare reduction of 30%, while at the same time off-peak period trains continue to make a loss.

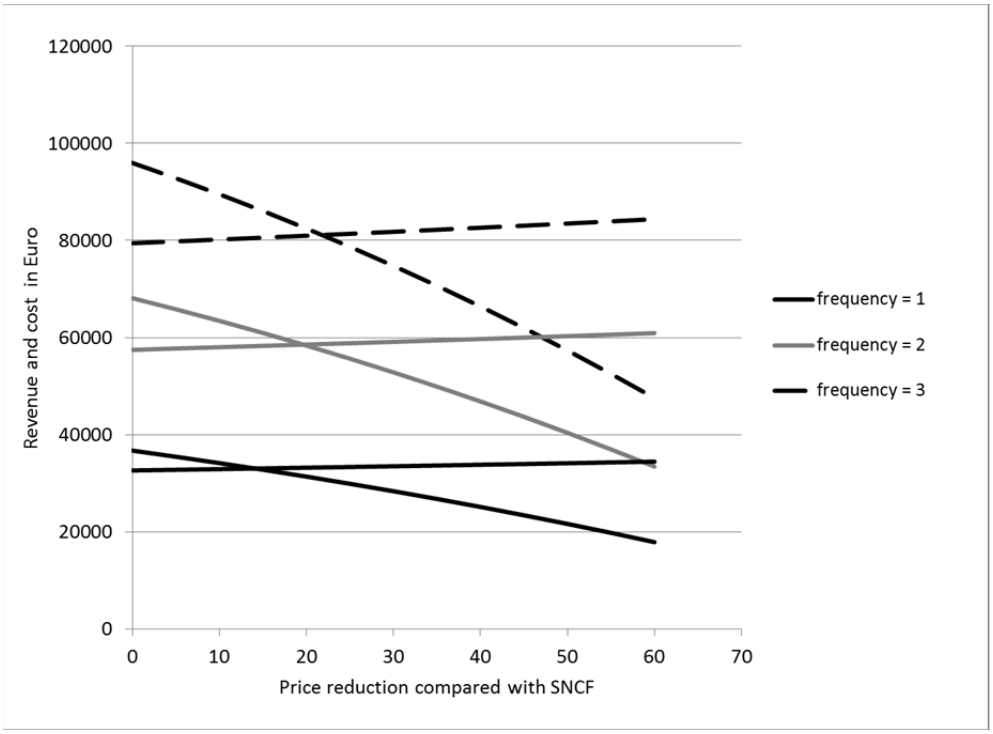

Figure 3: The break-even points for the new entrant in the case of SNCF reducing its fares by 20%

It is therefore clear that it would be difficult to introduce competition on the French TGV network. The historical operator can easily do away with the potential competitor by engaging in a price war which will be particularly easy as the new entrant would have difficulty reducing its operating costs. May be a way to avoid a price war would be to set up a system of revenue sharing between the two operators. For instance if the purchased tickets can be used on either service. But this solution does not fit with the present ticketing system where a passenger between Paris and Lyon is obliged not only to pay the ticket but to book a seat in advance. This obligatory booking system is crucial for the yield management applied by SNCF.

But we hope that we have shown in this paper that access charges do not really constitute barriers to entry. If access charges were lowered, the results that we set out here would be modified, but not the key mechanisms, namely the considerable difference between peak period and off-peak periods, and the historical operator 's ability to engage in a price war. Thus, in the area of rail transport, for the TGV and conventional passenger transport, the idea of competition on the market is frequently delusory in view of the scale of the non-recoverable costs and other technical or regulatory types of entry barrier. As Nash (2010) has shown, a better way of introducing competition on high speed rail networks is probably therefore to introduce a franchise system.

VI. Conclusion

The French high speed rail network is characterized by high infrastructure access charges, in particular in the case of the busiest lines. These high access charges enable the State to limit the subsidies per kilometre of high speed line, which is consistent with the goal of extending this network (by 2000 km before 2020). But these lines with high access charges and heavy traffic are also the most profitable for the SNCF. Therefore, is it possible for competitors to enter the HSR markets?

The response depends not on the level of access charges. By developing a model for a shadow operator, that includes the supply and demand components of the high speed rail market between Paris and Lyon, we have shown that the level of access charges at peak periods is not an obstacle to the entry of new competitors. It is even at peak periods, when the access charges are at their highest, that it is easy to achieve profitability by lowering fares without reducing costs in relation to the SNCF. But the problem is that during off-peak periods, the load factor remains insufficient to obtain profitability. Cross subsidies are necessary between peak and off-peak periods. It is therefore necessary to reach a high profitability during peak periods and the SNCF knows that. We can suppose that the response strategies of the SNCF, in whose interest it would be, as Selten (1978) has shown to engage in a preventive price war if it were threatened by the advent of a new operator.

I. References

Adler N., Pels E. & Nash C., 2010. High-speed rail and air transport competition: Game engineering as tool for cost-benefit analysis. Transportation Research Part B, January 2010

Barci E., Bernusset A., Coulombel N., (2004) Concurrence TGV- avion: Cas du TGV sud-est," Ecole Nationale des Ponts et Chaussées , Retrieved June 8, 2011 from http://www.enpc.fr/fr/formations/ecole_virt/cours/lenoir/ConcurrenceTgvAvion.pdf

Baumol W.J., 1982, « Contestable Markets : an Uprising in the Theory of Industry Structure », *American Economic Review*, vol. 72, n° 1, 1982

Crozet Y., 2010. Rail access charges: searching the optimal mark-up. in Applied Transport Economics, a management and policy perspective (E. Van de Voorde & Th Vanelslander ed.), de Boeck, pp. 307-320

Crozet Y. & Chassagne, 2012, Rail access charges, beyond the opposition Financing versus Competition, Retrec Review

De Rus G. and Nash Ch. 2009. In what circumstances is investment in HSR worthwhile? in de Rus G., ed, Economic Analysis of High Speed Rail in Europe, Fundacion BBVA, Madrid

de Rus G. and Nombela G. 2007. Is investment in high speed rail socially profitable? Journal of Transport Economics and Policy 41(1) 3-23

European Commission, 2001. Guideline 2001/14 on the allocation of railway infrastructure capacity and the levying of charges for the use of railway infrastructure and safety certification, Brussels

Holder, S., 1999. Recent developments in rail infrastructure charging in the European Union, Journal of Transport Eco and Policy, Vol 33, 1, pp 111-118.

Nash, C. & Matthews B., 2002. Implementing rail infrastructure charging reform – barriers and possible means of overcoming them, paper for the IMPRINT-EUROPE Thematic Network, Leeds 2002

Nash. Ch., 2009. When to Invest in High Speed Rail Links and Network? Discussion paper, International Transport Forum (ITF-OECD)18th Symposium, Madrid, 16-18 November, 24 p. *www.internationaltransportforum.org*

Nash C., 2010, European rail reform and passenger services – the next steps, Research in Transportation Economics, Volume 29, Issue 1, 2010, Pages 204-211

Nilsson J-E. , 2000. "Towards a welfare enhancing process to manage railways infrastructure access", Centre for Transport Economics, Working paper.

Nilsson, J-E 1992. "Second-best problems in railway infrastructure pricing and investment".Journal of transport economics and policy, September .

Oum T. and Tretheway, 1988. « Ramsey pricing in the presence of externality costs », Journal of Transport Economics and Policy, September

Preston. J. 2009. An analysis of the potential for on-track competition in the British passenger rail industry, Journal of Transport Economics and Policy, Volume 33, part1, pp 77-94

Preston J., 2009. Competition for Long Distance Passenger Rail Services: The Emerging Evidence, Discussion paper, International Transport Forum (ITF-OECD) 18th Symposium, Madrid, 16-18 November, 23p. www.internationaltransportforum.org

Quinet E. and Gaudry M.,2003. « Rail track Wear-and-Tear Costs by traffic class in France », ENPC, Université de Montréal, Novembre

Sanchez-Borras, M., Nash, C., Abrantes P., Lopez-Pita, A., 2010. Rail access charges and the competitiveness of high speed trains. Transport Policy, Volume 17, Issue 2, pp 102-109.

Selten R., 1978. "The Chain Store Paradox" Theory and Decision Vol. 9, pp. 127 – 159