Track access charges: reconciling conflicting objectives

Case Study – France: logic and limits of full cost coverage

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1. Introduction

Track access charges (TAC) were introduced in France in 1997, when Réseau Ferré de France (RFF), the infrastructure manager (IM) independent of the train operator (SNCF), was created. The first pricing scheme, applied in 1998, voluntarily included very low rates in order not to destabilise the accounts of SNCF. However, that did not last. In just a few years, TAC levels were raised significantly, especially for high-speed lines (HSL). The objective was for infrastructure charges to cover the full cost of the infrastructure, including the financial burden. The full cost has thus become the horizon of the pricing for HSLs but also for regional and national trains using the conventional network. Only freight has escaped this logic, given the low payment capacity of this activity.

The result of this strategic choice is reflected in the accounts of the new infrastructure manager. It was formed in 2015 by bringing together the reduced staff of RFF (1,500 people) and the 50,000 people of SNCF-infrastructures, previously in charge of the maintenance of the network and traffic control. The new entity, SNCF-Réseau, is, like the train operator SNCF-Mobilité, a subsidiary of the holding company (SNCF). SNCF-Réseau, in charge of a network of 29,000 km, presented in 2016 an income statement where the turnover of toll revenues, under various forms, exceeded €5.7 billion, 20% more than DB-Netz, in charge of a network of 40,000 km. However, this was not enough to cover the total expenses of €10.5 billion. Nor is the turnover sufficient to cover the financial charges (€1.5 billion) of the debt (€43.6 billion) and the programs of investments: extension of the HSL network and regeneration of the classical network.

Thus, the manager of the national rail network (29,000 km) in France is in a paradoxical situation. Its debt has increased by 40% in 5 years. How can we explain this paradox that combines high tolls and chronic deficits? Is it simply due to the cost of the extension of HSL network? Or must we consider the perverse effects of the "quiet life" of the monopoly[1]? To answer this question we will firstly present the efforts made in France, from 1997 to the beginning of the 2010', to achieve full cost coverage. Despite the relative success of this ambition, we will see in a second part why the years 2016-2019 are a turning point. Step by step, ARAFER, the rail regulator, asked the IM to justify in a better way both the level and the increase of RAC. Finally, facing what it considers as a lack of explanations, the rail regulator refused the 2018 TAC scheme[2]. As a consequence, all the stakeholders have to change their perspective. This necessary change is barely begun, as shown in the IM's proposal for a renewed pricing scheme for 2019.

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[1] Crozet Y. Nash C. and Preston J. (2012), *Beyond the quiet life of a natural monopoly: Regulatory challenges ahead for Europe's rail sector,* Policy paper, CERRE, Brussels, December, 24 pages, *http://www.cerre.eu/new-policy-paper-regulatory-challenges-ahead-europes-rail-sector*
[2] ARAFER, Avis n°2017-06, 1 February 2017

2. Searching for full cost coverage

In 2012, RFF, the Infrastructure Manager, published the table below. In calculating the cost coverage ratio, it showed the road ahead to reach full cost coverage. Apart from freight, which covered only variable costs, passenger trains covered between 90 and 95% of the estimated full cost. The target set at the end of the 1990s was therefore close to being reached and the forecasted scheduled toll increases seemed to lead to a comfortable accounting situation for the infrastructure manager. The fact that freight was not supposed to cover the full cost, as the passenger trains should do, was clearly an issue.

Table 1: The cost coverage ratio in 2012

	Variable Costs (€/train-km)	Total Costs (€/train-km)	Average revenue (€/train-km)	Ratio
Paris, Ile-de- France	3.98	11.5	11	95%
Regional trains	2.35	12.0	11.5	95%
Intercity	3.64	15.0	14.0	95%
High-Speed lines	3.70	16.5	15	90%
Freight	5.49	17.0	6.0	35%

Source: RFF

Nevertheless, those figures were misleading for three main reasons:

- The first is that not all revenues collected by RFF came from tolls paid by rail operators. For regional trains and those circulating in Ile-de-France, a significant portion of revenue was, and is still in 2018, a package paid directly by the State in the form of an annual fee. The tolls paid according to the circulation represented less than half of the total.
- The second concerns HSLs. For them, the tolls paid by the rail operator represented effectively 90% of the full cost. This explains why these tolls are high. However, the full cost is not reached because of the financial expenses of the debts subscribed by RFF for the development of the network.
- Such figures rely necessarily on fragile assumptions about the allocation of fixed costs. The definition of the "*total costs*" has not been validated by Arafer. As a consequence, such a table has been now removed from SNCF-Réseau network statement.

These remarks reflect the difficulties encountered by the French rail infrastructure pricing system in making its principles and practices consistent.

2.1 The principles and the objectives of the price signal

Immediately after the creation of RFF in 1997, the chairman of this body, Claude Martinand, appointed a commission of experts to define the principles for calculating the TACs. Its two main members, the economists Alain Bonnafous and Jean Tirole (1998), thus laid the foundations for

a system where the price signal had to play a key role. The question of the price signal can be compared with the objectives assigned to the TACs. Six potential objectives can be defined for the infrastructure charging policy in direct relation with the objectives and the charging principles presented in the directive 2012/34.

1) Favour the best possible use of the rail network;
2) Cover all (or part) of the operating and maintenance cost of the rail network;
3) Reflect the level of service provided to the carrier;
4) Contribute to the costs of developing the rail network;
5) Encourage the use of rail transport in intermodal competition;
6) Contribute to a balanced regional development.

It is, however, clear that even a very sophisticated charging policy cannot aim at achieving these six goals simultaneously. An order of priority must be set. Some goals will be ignored or considered as secondary, while others will be favoured. This was the case in France. Goals 2) and 3) were put at the top of the agenda. In order to reach these goals, in accordance with the pricing system adopted in 1981 for the first high-speed service, it was decided that the track access charges should reflect the quality of service but also, and perhaps above all, the user's ability to pay, by the way of space and time modulations. These principles have been applied for HSL but also, in a different way, for other passenger rail services.

2.1.1 Track access charges and the cost of (over)investing in HSL

Several ways of determining the level of railway access charges have been used in Europe. In addition to the pure marginal cost (MC) method, there are two others (ITF, 2008):

- Some countries have calculated access charges as a simple allocation of the difference between state compensation and the full financial cost. This approach is not consistent with Regulation (EU) 2015/909 and is being abandoned.
- In some countries, a mark-up is applied to the social marginal cost in order to reduce or eliminate necessary state compensation. This is permitted under EU legislation provided that the mark-up is non-discriminatory and does not eliminate any market segment willing to pay direct cost.

In France, for HSL, the railway pricing system is a mixture between these two systems insofar as the primary aim of the public authorities, which own the infrastructure manager, is to limit the risk of an increasing level of public subsidies. This secondary objective was particularly strong because the French state was firmly committed to extending the HSL network. The French HSL network was close to 2,000 km in 2011 and is now close to 2,700 km. New HSLs have been opened in 2016 (Between Nancy-Metz and Strasbourg) and in 2017 (Bretagne - Pays de Loire and Tours - Bordeaux).

A good way to finance a project is to involve users directly. This has been done with tolled motorways in France since the 1960s, but also with HSLs. High-speed rail was considered a

commercial activity. Track access charges for HSLs, like motorway tolls, therefore had to cover the full cost of infrastructure by way of cross-subsidies between profitable and unprofitable sections. The risk of such a system is that a push for the construction of unprofitable sections requires more and more massive transfers from the old (profitable) sections. In other words it pushed the abandonment of the logic of full cost and the race for public subsidies without any incentives for the rail operator to reduce the cost. There is no competition for HSR services. We will see in the second part how the new French government is addressing this issue.

2.1.2   Freight, regional and intercity trains: don't forget the ability to pay!

As indicated, tolls are high for HSLs in France. If we take into account the amounts collected on high-speed trains in 2016, nearly €2 billion was paid to the infrastructure manager, including €1.6 billion for domestic traffic. This is a little more than all the tolls paid by other traffic combined: €0.76 billion for regional trains, €0.6 for Ile-de-France trains, and €0.18 for Intercity. This gives a total of €1.5 billion. If we compare this total to the traffic (table 2), the difference between high-speed trains and the rest of the traffics is clear.

Table 2: Track access charges and traffic (passenger trains 2016)

	Revenue €Mi.	RAC €Mi.	RAC/Revenue %	Train-km €Bi.	RAC/Train-km €
High-speed trains	4,593	1,605	34.9%	97.35	16.48
International & LD	1,146	375	32.72%	23.87	15.71
Regional	3,971	761	19.16%	167.1	4.55
Ile-de-France	2,733	605	22.13%	55.2	10.96
Intercity	927	186	20.0%	29.46	6.31

Source: ARAFER

The average toll paid by a high-speed train is €16.5 per train-km. The result is almost the same for international and long-distance trains, which also frequently use high-speed lines. The tolls paid by other traffic are much lower, but this result must also take account that the lump sum payment of the State is missing in Table 2. Called the access fee, this payment replaced what was initially considered a subsidy. In 2016, this payment reached €2 billion including €157.1 million for Ile-de-France, €440.25 million for intercity and €1,402.5 million for regional trains. If these amounts are added to the tolls paid by rail operators, then tolls per train-km become €12.94 per train-km for regional trains, €13.81 for Ile-de-France and €21.25 for Intercity. We thus obtain levels close to those of the high-speed trains and even higher for intercity trains. Such results confirm the overall goal of full cost coverage and explain the high coverage ratios observed in Table 1.

If we compare these revenues to the marginal costs indicated by the infrastructure manager for the year 2016, the difference is clear between the incomes and the marginal costs per train-km as shown in Table 3. The revenues are 3 to 4 times higher than marginal costs.

Table 3: Marginal costs per train (€ / train-km)

Marginal cost	High-speed lines	HS train on conventional network	Other main lines	Regional	Ide-de-France	Freight
Maintenance	1,449	1,670	1,513	1,025	2,812	1,315
Operating	0,119	0,153	0,180	0,173	0,343	0,206
Renewal	2,825	1,762	1,481	0,644	1,243	3,322
Total	**4,394**	**3,585**	**3,174**	**1,842**	**4,398**	**4,843**

Source: SNCF-Réseau 2016, ANNEXE 10.1.1, PRINCIPES DE LA TARIFICATION DES PRESTATIONS MINIMALES

Another lesson that can be drawn from Table 3 is that there is no proportionality between revenue per train-km and marginal costs. High-speed trains pay slightly less than 4 times the marginal costs and Intercity-trains pay 6.7 times the marginal costs. This ratio goes up to 7 for regional trains, but the Ile-de-France trains pay only 3 times the marginal costs.

The general gap between marginal cost and TAC on one hand and the differences in the ratio RAC/marginal costs on the other hand are at the origin of the questions raised by the rail regulator. These differences had no clear economic explanation except the objective of full cost coverage. However, this is a vague objective if we keep in mind that the infrastructure manager and the rail operator are both heavily subsidised public monopolies. The levels of the costs are questionable. What we observe is mainly a transfer of money form one public "pocket" to another public "pocket". The levels of TAC are also questionable because there is no clear definition of the capacity of the market to pay the required RAC.

Thus, for high-speed trains, the amount of the tolls is calculated globally, in order to reach a certain amount (about €2 billion). The same goes for other passenger trains. The relationship between revenue and incremental costs depends on trade-offs guided by the overall revenue objective for the rail operator. As the density of trains per kilometre of network in Ile-de-France is high, the revenue per train-km may be lower. The opposite reasoning applies for regional trains. On some of the less densely used lines (UIC 7 to 9), there are sometimes less than 10 trains a day

The question of the ability to pay also explains the low infrastructure charges for freight. In order to foster this mode of transport, railway tolls paid by operators are lower than marginal costs. A compensation grant had been put in place by the government but it was reduced because of budget constraints. Thus, the trend showing a reduction in rail freight traffic in France (-40% between 2000 and 2016) is totally contrary to the objectives of public policies. However, it is rather good news for the infrastructure manager for whom freight is a source of losses, just as it is for SNCF, the incumbent operator.

2.2   The changing components of the track access charges

The infrastructure manager's pricing scheme has evolved since 1997. However, the basic principle has remained the same: modulation over time and space, in time to take into account

the potential risk of congestion in peak hour, and in space to adapt the charges to different types of rail service. High-speed lines have thus been distinguished from the rest of the network, but other subcategories have emerged, such as urban and suburban segments, which are structurally more heavily used than intercity segments. Among these, the less frequented lines in rural areas have not been treated in the same way as the traditional lines. After having shown how the tariff grid has evolved while maintaining the principle of space-time modulation, we will examine the particular case of high-speed trains.

2.2.1 Searching the optimal space-time modulation

At the very beginning (1997), the charges paid by the train operator (SNCF as a monopoly) were very low. However, they were already based on a multi-part tariff reflecting the objective of a space-time modulation.

Concerning the space modulation, the national rail network has been split in five categories:

- **R0** for urban and suburban tracks (766 km),
- **R1** for high-speed lines (831 km),
- **R2a** for high-speed lines with moderated traffic (in order to take into account the ability to pay)
- **R2b** for inter-urban lines (4483 km),
- **R3** for other lines (25500 km).

As regards time modulation, three time-periods were applied: peak period (6h30-9h00 and 17:00-20:00), normal (4:30-6:30, 9:00-17:00, 20:00-00:30) and slack periods (00:30-4:30). Three tolling components were also taken into account:

- **DA**: access right, which was a function of the distance in km covered by the operating company.
- **DC**: operating right, which is a function of the train-km covered.
- **DR**: booking right, which depends on the time-period taken into account for R0 and R1 and on the train-km covered.

After some slight changes, in 1999, the toll level for the French railway network was defined as indicated in Table 4 below.

Table 4: Track access charges in France in 1999

	DA (€/km/month)	DR (€/km)			DC (€/km)
		Slack hour	Normal hour	Peak hour	
R0	1,720	2.95	6.5	14.8	0.23
R1	1,497	2.25	6	7.2	0.23
R2a	1,497	2.25	4.5	6	0.23
R2b	6	0.33	0.33	0.33	0.23
R3	0	0	0	0	0.23

Source: RFF

We can notice that the access right (DA) was paid only by urban, suburban and high-speed trains. The booking right was equal to zero or was very low for the vast majority of the network. The price modulation was applied only for urban, suburban and high-speed trains. The operating right was very low for all trains, only €0.23/train-km. Then, step by step, RFF significantly increased the charges. The primary goal of this was to avoid pressure on SNCF's accounts so that it could present a balanced management account. Minor changes to this policy did not radically modify the system economy. Under the previously mentioned constraint, these changes led to increased differentiation of the infrastructure charges in space and time, depending on the service quality provided and on the operator's abilities to contribute. The result is presented in the table 5. Without any important change in the structure of the tariff, the global amount of infrastructure charges increased, especially the charges paid by high-speed trains and urban trains, the first because of the capacity of payment of customers, the second because of the capacity of payment of local governments. However, for all trains, the operating right (DC) was much higher in 2003.

Table 5: Track access charges in France in 2003

	DA (€/km/month)	DR (€/km)			DC (€/km)
		Slack hours	Normal hours	Peak hours	
R0	373.12	1.55 − 0.62	4.97 − 1.24	14.38 − 2.49	0.806
R1	4,475.91	4.813 − 0.806	9.78 − 1.68	11.54 − 3.2	0.806
R2a	3.11	0	0.08	0.08	0.806
R2b	0	0	2.17	0	0.806
R3	0	0	0	0	0.806

Source: RFF

The result has been a sharp increase in the IM's revenue. From a minimal level of €0.5 million in 1998, the revenue of the IM reached €2.1 million in 2005, €4.2 million in 2012 and €5.8 million in 2016. In 2016, the pricing scheme was the following.

The different categories of the network were renamed:

- The high-speed line network is split into 9 categories (North, South-East, East, etc.).
- The urban and suburban lines with heavy traffic represent the categories A and B.
- The inter-urban lines, with a maximum speed of 220Km/h, are named C and B.
- The rest of the network is category E.

The components of the multipart tariff were the following:

- **Access fee**, paid by the state, only for Regional, Intercity and Ile-de-France trains (see above).
- **Booking fee** paid by commercial trains (high-speed and other main lines) per path-km
  The cost changed according to the categories: €5.618 for category A; €2.6421 for B; €1.673 for C, €0.506 for D and between €0.074 and €0.01 for E. For high-speed lines, the cost went from a maximum of €18.718 per path-km for the Paris-Tours segment to €3.293 for the East line. These huge differences were clearly related to the ability to pay. For all high-speed trains, there was also a time modulation: 0.5 times the booking fee of normal period for off-peak periods, and between 1.25 and 1.5 times the normal booking fee for peak and hyper-peak periods.
- **Operating fee** paid by all the trains went from a maximum of €4.398 per train-km for Ile-de-France and €4.394 for high-speed trains to €2.4 for regional trains.
- There was also a special fee for electric trains, €0.225 per train-km plus a fee for the transport of electricity, between €0.104 and €0.076 per train-km.

It is important to underline that the final objective of the pricing scheme was to keep a certain level of revenues for the infrastructure manager. If a rebate was decided for some kind of traffic, it was necessary to increase another kind of traffic. Finally, the pricing scheme was less and less consistent with the objective of a "scientific" definition of the track access charges as is the case within the Ramsey-Boiteux Principle.

2.2.2 Searching for an optimal mark-up for high-speed lines

In addition to the goal of protecting the public finances (see 1.1.1), the HSL pricing system also attempts, following a Ramsey-Boiteux approach (Annex 1), to take account of the elasticity of demand in order to achieve the best trade-off between efficiency goals and budgetary needs. To obtain MC+ pricing which is fully consistent with FC-, some principles have been determined.

The first principle is to fix, for a particular line, the total revenue which is required in order to cover the IM's investments. Taking this as a starting point, the second principle consists of searching 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. In this case, a general adjustment is carried out between the HSL and even with the rest of the rail network. As indicated in Box 1, 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 (Crozet & Chassagne 2013).

It should be noted that when it adopts this approach with regard to SNCF, the IM 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 (at least) 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 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 of congestion costs to users. 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 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 IM's highest access charges. However, is such a system sustainable?

3. Track access charges: towards a new deal?

At the end of 2017, The French rail regulator published a report on the French passenger rail market in 2015-2016. The data provided by this report helps to understand why the question of tolls becomes crucial, especially for high-speed trains, facing a fall in traffic (-0.3% per year from 2011 to 2016). In such a situation, it is no longer possible to continue to increase TAC as in the years 2000-2008 when traffic grew by 5% per year. This is one of the reasons why ARAFER announced at the beginning of 2017, after a clear warning in 2016[3], that it was rejecting SNCF-Réseau's proposed pricing scheme for the year 2018. This decision forced the infrastructure manager to overhaul its grid and how it measures operating costs. For 2019, SNCF-Réseau proposed a completely transformed pricing scheme, which remains dominated by its budget constraint.

3.1 The limits to increased track access charges

Despite the trend on increasing rail tolls, the infrastructure manager's accounts have deteriorated in recent years. SNCF-Réseau's debt now exceeds €45 billion and has increased by nearly €2.5 billion a year since the beginning of the decade. This drift is not only the result of new investments and renewal of the conventional network. It is also the result of a decline in cash flow. It is partly explained by the poor results of high-speed traffic, which is also causing difficulties for SNCF-Mobilités.

3.1.1 TAC and traffic: high-speed rail facing a scissor effect

Since the financial crisis, French high-speed rail is confronted by a scissors effect. Traffic practically stagnated from 2008 to 2016 as rail tolls increased steadily. This is shown in Figure 1. After a plateau in the early 2000s, tolls have increased from 2006 to 2013 by 5.5% per year while traffic stopped increasing in 2008.

[3] ARAFER, Recommandations n° 2016-06, 10 February 2016

Figure 1: Traffic and TAC for high-speed rail in France
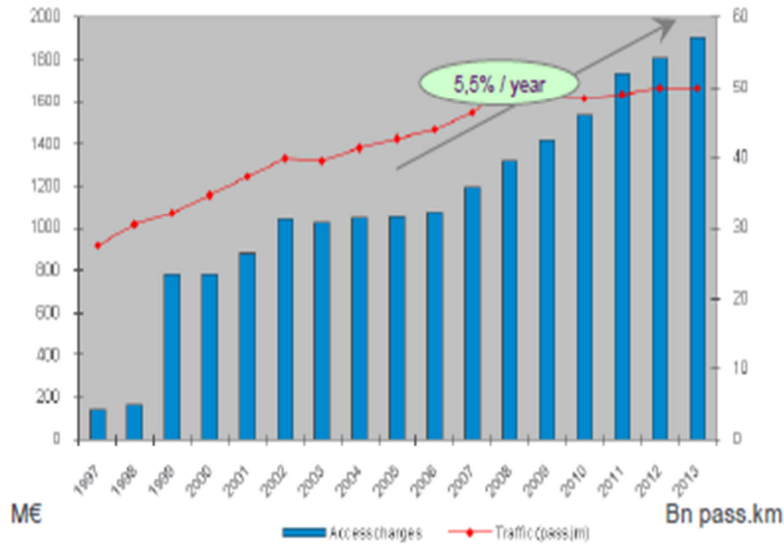
Source: SNCF

The TAC increase was decided in 2007-2008, when the State signed a new performance contract with RFF. Such a decision was, for the state, a way to reduce subsidies to the infrastructure manager. This allowed the replacement of the tax with a fee paid in turn by the users. This decision was all the more logical given that the new government launched new HSLs. Users had to cover the costs as much as possible. However, the economic crisis and competition from other modes of transport have decided otherwise (Crozet 2014). As shown in Figure 2, high-speed traffic stagnated as air and coach traffic continued to grow, despite weak economic growth.

Figure 2: Long-distance passenger traffic and GDP in France (2000 = 100)
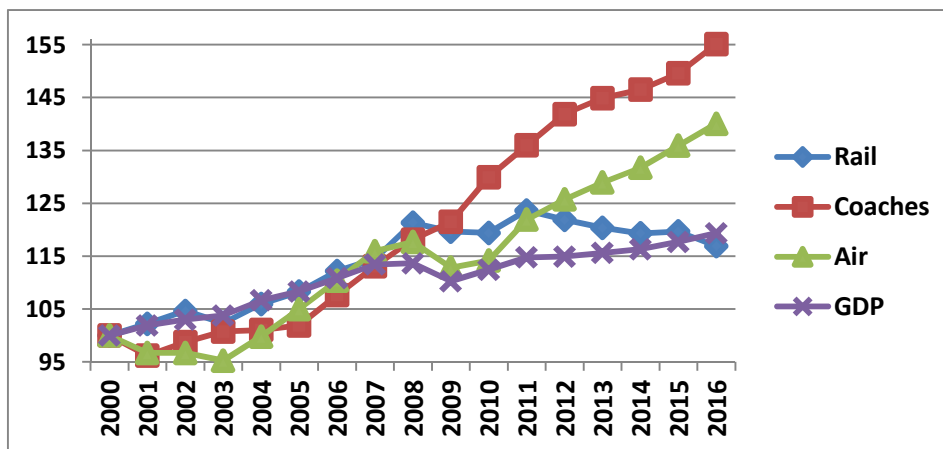
Air Traffic = Passengers in Airports; Rail and Coach Traffic = billion pass-km; GDP = euro
Source: Ministry of Transports

This development posed problems for SNCF-Mobilité, as the load factor of high-speed trains decreased to 64% in 2015 compared to 70% before the crisis. SNCF had to reduce its offer so that high-speed trains remain a source of profits. Thus, in 2016, supply fell by 5.3% in terms of train-km. This made it possible to increase the load factor again to 66.8%. However, to achieve this it was necessary to win customers with attractive prices. From 2015 to 2016, the average revenue per passenger decreased from €48.7 to €47.2. As the average distance has remained stable at 496 km, this represents for the rail operator revenue of 8.8 eurocent per passenger-km, down 4.2% year-on-year.

With the opening of new lines and economic recovery, the results have been better for high-speed in 2017. However, the TACs remain high, especially on the 300 km of the new HSL between Tours and Bordeaux, a 50-year concession awarded to VINCI. In addition, one simple fact must be taken into account: the more the HSL network is expanded, the lower the potential customer base, since the most profitable lines were built first. This is shown in a simple calculation. At the beginning of 2016, the HSL network in France reached 2,000 km and it carried 53 billion passenger-km. At the beginning of 2018, the network is 2,700 kilometres. To maintain the same traffic intensity, traffic would eventually have to reach 71 billion passenger-km, an increase of 35%. To achieve this increase in volume, SNCF-Mobilité decided to continue developing its low-cost high-speed rail services, called OUIGO. However, to support it in this process, it claims for several years a decline in TAC on HSL, which also require new potential entrants in this market, open to competition from 2020. However, who will finance this decline in tolls? Should taxpayers finance the mobility of higher social categories, those who use high-speed the most?

3.1.2 ARAFER's requirements

It is in this troubled railway landscape that the rail regulator announced, on February 2017, that it would not validate the 2018 toll grid. At the same time, the infrastructure manager was facing a deteriorated situation of its accounts, summarised in Table 6.

Table 6: From RFF to SNCF-Réseau, the key data

	2012	2013	2014	2015	2016
Balance sheet, total (€ billion)	61.9	69.3	75.7	73.1	77.6
Net financial debt (IFRS € billion)	33.5	35.9	39.7	42.3	44.9
Turnover (€ billion)	5.6	5.7	5.9	6.3	6.4
EBITDA (€ billion)	2.0	1.9	2.1	2.0	1.9
EBIT (€ billion)	1.4	1.2	1.2	0.8	1.0
Financial charges (€ billion)	-1.4	-1.3	1.4	-1.2	-1.2
Net result (€ billion)	0.0	-0.1	-0.2	-0.4	-0.1
Investments (€ billion)	5.4	7.8	5.9	6.2	5.2
Employees	1,495	1,600	1,678	53,694	54,027

Source: SNCF-Réseau

This table first shows the big change that has been the passage of RFF to SNCF-Réseau. The number of employees has increased dramatically with the integration of SNCF's infrastructure branch. However, what has also increased significantly is the debt, even as EBITDA deteriorated slightly. In such a situation, the ARAFER decision was intended to show that the status quo was not possible. The number of train kms circulating in France, for high-speed as well as for freight or regional transport, has been decreasing for several years. This decline in volumes cannot be offset by an increase in prices.

On this basis, ARAFER pointed out a number of problems:

- The level of the TAC is adjusted year after year to improve the revenues of the infrastructure manager. However, they have less and less relation to the costs of operating and maintenance. An increase of 3% per year, higher than the retail price index, was not justified. This message was addressed to both the infrastructure manager and the state. The first had to review its cost model. The second had to abandon the idea that the main purpose of TAC is to limit public subsidies to the infrastructure manager. This questioning was all the more necessary as the state asked the infrastructure manager to incur significant expenses to expand the HSL network and to accelerate the renovation of the conventional network, which was previously neglected.
- The very high toll increase proposed for Eurostar (+ 6%) was considered unacceptable. More generally, the rail regulator wondered about the way in which the ability to pay of railway operators was estimated. Was the mark-up applied on most HSLs also based on the sole need to find resources?
- ARAFER also wondered about the relationship between TAC evolution and the productivity of the infrastructure manager. A question based on a simple comparison with DB Netz, the German equivalent of SNCF-Réseau. Why are 56,000 people needed in

France for a network of 29,000 km while the 40,000 km of the German network, which generate profits, are maintained by 44,000 employees (DB Netz track)?

- On this basis, many working sessions took place between ARAFER and SNCF-Réseau. They led the infrastructure manager to change its pricing scheme significantly. But at the same time, the new performance contract signed between SNCF-Réseau and the state showed that the latter did not wish to change its policy with regard to the IM.

3.2 A new pricing scheme subject to the IM's budgetary constraint

Following criticism from ARAFER, SNCF-Réseau has started a complete reform of its pricing scheme. For that, it was necessary to rely on the bases that constitute the directives of the European Union. On this basis, the recommendations published by ARARER in February 2016 were underlining two main necessary improvements:

- Concerning the cost directly attributable to the operation of the railway service, a new model is necessary in order to obtain a better justification of maintenance and operating costs.
- Concerning the mark-up, it is necessary to give a clear definition of the market segments and how their ability to pay is calculated.

To define marginal costs, the cost model has been completely revised. The new pricing grid has been submitted to ARAFER, which is due to deliver its opinion shortly. Uncertainties remain because the overhaul of the tolls was made under the constraint of not reducing the resources of the infrastructure manager. The applied mark-ups are still defined in an obscure way.

3.2.1 Back to EU directives

In order to establish a new pricing scheme, SNCF-Réseau referred to the European directives.

The EU Directive 2012/34 defines four main objectives of infrastructure pricing:

- Ensure the balance of the infrastructure manager's accounts over a reasonable period of time, taking into account public subsidies.
- Ensure that the different railway undertakings have the conditions for fair and non-discriminatory access.
- Provide clear and coherent signals for railway undertakings to make rational decisions in terms of network usage and help the infrastructure manager to optimise the use of its infrastructure.

These objectives form the basis of Section 2 "Pricing of Infrastructure and Services" of chapter IV of Directive 2012/34. Article 31.3 states that "[...] *the fees collected for all minimum services and for access to the infrastructure connecting the service facilities shall be equal to the cost directly attributable to the operation of the railway service*".

The methods for calculating the cost directly attributable to the operating of the railway service were defined by the Implementing Regulation 2015/909 of 12, June 2015. It defines the directly chargeable cost as a marginal cost: "*according to a well-established economic principle, marginal cost infrastructure utilization charges ensure that infrastructure capacity is used optimally*". In addition to the marginal cost, Article 31.4 states that basic charges may also recover the costs of scarce capacity offered by the infrastructure manager. In addition, in some cases Article 32.1 provides for the possibility of surcharges if it is acceptable for the market. As the French tariff grid makes extensive use of this possibility, it is useful to quote the text of the directive.

"*A Member State may, in order to fully recover the costs incurred by the infrastructure manager and, where appropriate, collect increases on the basis of effective, transparent and non-discriminatory principles, while ensuring optimal competitiveness of the rail market segments. The pricing system respects the productivity gains made by the railway undertakings. However, the level of charges does not exclude the use of infrastructure by market segments that can at least pay the cost directly attributable to the operation of the rail service, plus a rate of return if it is acceptable by the market*".

The principle of a two-part tariff is thus set and SNCF-Réseau therefore proposes two components in its new pricing scheme:

- A fee to charge the network user for the marginal cost to SNCF-Réseau, i.e. the cost incurred when an additional unit of traffic is carried on the network. These fees can integrate the costs related to saturation.
- Increases aimed at recovering the fixed costs borne by SNCF-Réseau. They must be sustainable by the railway undertakings concerned.

These European tariff principles were transposed into French law in Decree No. 2003-194 on the use of the railway network amended by Decree No. 20151040 of 20 August 2015:

- The "direct chargeable cost" pricing principle is laid down in Article 30 of this decree.
- The possibility of levying increases for particular market segments, in order to fully recover the costs incurred and provided the market is suitable, is defined in Article 3.
- The possibility of pricing the scarcity of capacity is included in Article 33-1.

On this basis, SNCF-Réseau has redefined its cost model. In the previous model (see Table 3) the marginal costs were established by econometric treatments carried out on the data from the years 2007 to 2009. The amount of the expenses observed for different parts of the network had been linked to the traffic in order to define a cost function. The derivative of this cost function makes it possible to define the marginal cost. The methodological choices were then based on the conclusions of academic work, notably carried out within the framework of the European CATRIN research program.

In the new cost model as in the previous one, the scope of costs includes the following items:

- Maintenance of the track, turnouts, signs and catenaries. These are cost data. During its work conducted in 2015 and 2016, SNCF-Réseau used more recent (2013) and richer data. The databases thus constructed allow the introduction of many additional variables into the cost functions. In total, more than a hundred variables were collected.
- The renewal of the track and lane equipment whose costs are derived from simulated renewal schedules. SNCF-Réseau has used a new tool that has made it possible to reconstruct the cost of future renewal operations, over a long period of time, based on observed unit cost data and life expectancy assumptions in line with the policies implemented.
- Operational management of traffic.

A counter-expertise of all the work of SNCF-Réseau was conducted under the control of the regulator. It resulted in the choice of a functional form different from that initially proposed. A Translog cost function is now used to estimate marginal maintenance and renewal costs. One of the main interests of the Translog forms, compared to the Box-Cox forms, initially tested, lies in the easier interpretation of the coefficients. It has also resulted in lower marginal costs.

3.2.2 The proposed new pricing scheme

The marginal costs of maintenance, renewal and operation were defined for conventional lines, HSLs and freight trains. They are calculated for the route per thousand gross ton-km (kGT-km) and no longer for train-km. Train-km is still the reference for the cost of maintenance of the signalling. Table 7 summarises the results.

Table 7: Marginal Cost Components for 2019 Service

	Marginal cost of tracks maintenance € 2019/ kGT-km	Marginal cost of signalling maintenance € 2019/ train-km	Marginal cost of tracks renewal € 2019/ kGT-km UIC 2-6	Marginal cost of tracks renewal € 2019/ kGT-km UIC 7-9	Marginal cost of operating € 2019/ train-km
Conventional lines	1.499	0.223	1.669	0	0.204
High-speed lines	0.673	0.114	5.088	NC	0.120
Freight	0 .677	0.217	1.669	0	0.223

Source: SNCF-Réseau

By aggregating these different elements, we obtain another presentation of marginal costs, summarised in Table 8. The "total" marginal cost thus includes two components, one according

to the weight, to take into account the wear of the tracks; the other according to the distance travelled.

Table 8: "Total" Marginal Costs for 2019

	Marginal cost Total 1 **€ 2019/ kGT-km** UIC 2-6	Marginal cost Total 1 **€ 2019/ kGT-km** UIC 7-9	Marginal cost Total 2 **€ 2019/ train-km** UIC 2-6	Marginal cost Total 2 **€ 2019/ train-km** UIC 7-9
Conventional lines	3.168	1.499	0,427	0,427
High-speed lines	5.761	NC	0.235	NC
Freight	2.346	0 .677	0.439	0.439

Source: SNCF-Réseau

The Infrastructure Manager calculated that the circulation charge represented only 22% of the total renewal cost, 18% of maintenance costs and 10% of operating costs. To avoid completely destabilising SNCF-Réseau's operating account, it was necessary to add a market charge to marginal cost. A booking fee no longer exists.

- For PSO trains, under contract with an organising authority (Regional, Ile-de-France, Intercity) a market fee per train-km has been established, ranging from €2 to €3 per train-km for regional trains; €7.07 for Ile-de-France and €3.32 for Intercity trains. These values have been calculated so that the tolls paid by these trains remain at the same level. The same applies to the access fee paid by the State (see § 1.1.2).

- For commercial services, the same objective of stability of total revenue from tolls has emerged. Under this constraint, the network was segmented according to the payment capacity of the trains. For all conventional trains, the market fee has been set at €3.09 per train-km. For HSLs, as in the previous system, important modulations have been introduced. The highest levels are on the following axes: Paris-Lyon (€22.78 per train-km), Brittany-Pays de Loire (€22.16), and North (€20.99). On the other hand, for high-speed trains which do not have Paris as either an origin or destination, the market charge is only €9.72 per train-km.

- For some international services, such as those provided by Thello, the rule given by SNCF Réseau's budget constraint has not been applied: the mark-ups for the route between Paris and Venice have been set to zero.

In order to remedy the downward trend in the number of train-km, discounts are envisaged. For a new rail service, which does not replace an existing service, a reduction of the market charge is

possible: -20% for HSL and -40% for conventional lines. These tariff reductions are only possible if there is an increase in train circulation.

As a result, the infrastructure manager has completely redesigned its pricing scheme for passenger trains but also for freight trains. It clarified the bases of calculation and simplified the structure of the pricing. In this the IM responded to the demands of ARAFER, which now has a shared vision of costs. However, not all the remarks of the ARAFER were taken into account:

- The budget constraint has not been modified. The objective of covering costs remains and this practice remains unquestioned.
- If this had been the case, it would have been necessary to look at the production costs of the infrastructure manager and how to introduce productivity incentives into the tariff grid. At the end of February 2018, the Prime Minister announced a new rail reform putting pressure on SNCF to increase productivity. What will be the impacts?
- One of the surprising impacts of the reform could be a weaker role for the rail regulator, perhaps because the contradictory injunctions of the State with regard to SNCF-networks have not disappeared. The infrastructure manager is asked to make large investments, but there is no funding plan. As indicated by ARAFER, the revenues of the infrastructure manager cannot increase in time either by a significant increase in volumes or by unit price growth.
- It will therefore be necessary to find other resources, public subsidies or a partial recovery of the debt that could reduce the financial costs. This can give the infrastructure manager room for manoeuvre. However only if, at the same time, SNCF-Mobilités does not obtain the lower tolls on HSLs, which it has been demanding for several years. We are still in a system where public money is moving between public entities without any clear incentives on productivity.
- The state itself cannot decide whether it wishes to keep the entire national network in its hands or if it wants to close some lines, or transfer them to the regions, especially the lines where the traffic is particularly low. In the first case it should significantly increase the subsidies to SNCF-Réseau, in the second case it faces the claims of the local decision makers.

4. Conclusions

Our examination of the TAC issue within the French rail system outlines the extent of the difficulties that arise from the paradoxical nature of the situation. In some ways, the French rail system is viewed with envy from neighbouring countries, because of the development of an intensely-used HSL network. In addition, regional trains and Ile-de-France trains are more numerous and more reliable than 20 years ago, when the regionalisation of rail transport began. But these successes have been achieved at the expense of a growing debt for the infrastructure manager, as well as for the State and local authorities.

The objective of full cost coverage was to limit this drift, to make the user more aware of the cost and to avoid unnecessary and costly investments. However, the opposite has happened. It was as if the objective of full cost coverage had served as way to justify another drift: higher and higher track access charges. It is therefore not a surprise that the rail regulator did not validate the 2018 TAC grid. As a result of the long discussions between ARAFER and SNCF-Réseau, we now have a better view of the costs. The main improvements associated with the reform are the following:

- The new econometric estimation leads to a major decrease of direct costs and the introduction of a new charging unit (tonne-km), improving the relationship between charges and cost
- Concerning the mark-up, there is a major simplification of the charges design, which provides greater predictability to railway undertakings. There is also a better alignment to the charging principles given by directive 2012/34/UE. For commercial activities, mark-ups rely on a segmentation using origin-destination criteria. For activities under a PSO contract, the market segments have been defined according to the scope of competencies of the organising public authority.

But a lot of issues remain, especially around productivity gains. One of the provisions of the new contract between the state and SNCF-Réseau is a cost reduction objective of approximately €1.2 billion (excluding inflation) over ten years. This objective is consistent with Arafer's econometric benchmarking of European infrastructure managers (Annexe D of Arafer's opinion 2017-036), which evaluates the productivity gains achievable by SNCF-Réseau in line with the best European practices. If fulfilled, this objective will impact costs and thus will reduce cost-reflective charges such as the charge reflecting the direct costs. But what if this objective is not fulfilled?

In March 2017, Arafer released a negative opinion on the draft contract mainly because it did not provide any proper incentive to SNCF-Réseau to fulfil the cost reduction objective of €1.2 billion (inflation excluded). For instance, the contract does not provide any incentive (e.g. bonuses to managers or employees) or give rise to any penalty (e.g. administrative or financial penalty) in case SNCF Réseau misses the objectives set out in the contract.

Also, the draft contract provided for a sustained revaluation of the charges for passenger trains (on average +2.8% per annum over the period 2018-2026). Arafer stated that the approach to setting charges taken in the draft contract seemed to be dictated with no connection to the economic realities and most notably to the current context marked by fierce competition between different modes of transport. In its opinion, Arafer reaffirmed the scope of its binding opinion on charges and that the performance contract should not depart from the principles of European and national law, in particular regarding the requirement that market segments be able to bear any charges above the "direct cost".

However, the contract between the state and SNCF-Réseau was signed without any major modification. It is as if the decisions were founded on budgetary considerations and not on the content of the EU directives and their economic basis. It is therefore not a surprise that the government seems to be considering reducing the power of ARAFER in regulating track access charges.

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Annex 1: Ramsey-Boiteux pricing, opportunity cost of public funds and price elasticity

Formally, in a situation of natural monopoly producing n final products in quantities $q_1, \ldots, q_n$ (or a product on n parts of the market), Ramsey-Boiteux prices are solving the following:

max {S(q₁,….qₙ) − CS(q₁,….qₙ)}

Subject to S $p_k * q_k$ − C(q₁,….qₙ)} ≥ X (λ)

With

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

q, quantities and p, prices

X amount of desired profit or authorized deficit

λ Lagrange multiplier of the budgetary constraint: it indicates by how much the social profit would increase if X were decreased by a unit.

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

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

Let us call α = λ/(1+λ), a parameter reflecting the cost opportunity of public funds λ

And if we call ε the price elasticity of traffic: $\eta_k(p_k)$

We find that α/ε is the key ratio to determine the mark-up value. More precisely, if α is a constant, the relative price increase above marginal cost is all the higher as demand is not sensitive to prices.

So, Ramsey pricing provides a useful theoretical guideline. However, it requires a great deal of information. Both marginal cost and elasticity of demand must be quantified with a certain degree of accuracy. And we also must take into account the opportunity cost of public funds, according to the fact that RFF is subsidized by government. If we try to apply such reasoning, we obtain the following formula:

(P – C)/ P = (a – Ci)/ P   (1)

and

(a – Ci)/ P = α /ε   (2)

With,

P, Price of the final service, paid by train user, because we take into account the elasticity of final user.

a, Level of infrastructure charge

ε, Traffic price elasticity (absolute value)

α = λ/ (1+λ), λ = opportunity cost of public funds

C: Marginal cost with two components,
    Ci = infrastructure cost
    Cs = Train service cost

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

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

so

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

Therefore, it is interesting to observe the variations of the mark-up "a" in relation with the various values of, α, ε, Ci and CS. The table below summarizes the result by taking into account the official value of opportunity cost of public funds in France (λ = 0.3) which leads to α = 0.23. Columns of the table below combine various level of elasticity ε with this fixed value of α. The lines show different combinations of Ci and Cs. We give the value of 100 to Ci, and then we suppose that Ci can be higher, equal or lower than Cs. The impacts are very clear: the higher the elasticity and Ci/Cs ratio, the lower the value of "a". On the contrary, when elasticity and ratio Ci/Cs decline, "a" increases. The mark-up is even equal to ten times Ci, but only if elasticity is very weak (0.3).

Value of the mark-up "a" for Ci = 100

	α = 0.23 ε = 0.3 α/ε = 0.76	α = 0.23 ε = 0.5 α/ε = 0.46	α = 0.23 ε = 0.8 α/ε = 0.28	α = 0.23 ε = 1.3 α/ε = 0.176	α = 0.23 ε = 2 α/ε = 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