Introducing competition in the European rail sector. Insights for a holistic regulatory assessment

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Introduction

In July 1991, after lengthy negotiations between European countries, EU Directive 91-440 was published, setting in motion the process of deregulating rail transport. As with other networked industries (power, telecommunications), the European Union (EU) was embarking on a new approach, separating infrastructure and operation, at least from an accounting perspective. Once again, the clear objective was to allow third parties access to the network and to make competition a key lever in the revitalisation of the sector.

This initial ambition had been pursued for 25 years, as demonstrated by the successive "Railway Packages" or the creation of the European Railway Agency (ERA), which plays an important role in questions of security and interoperability. Development of the role of the ERA is at the heart of the 'technical' pillar of the Fourth Railway Package approved at the end of 2015. This fourth package contains a 'market' pillar, which seeks to open up national passenger services to competition, from 2020 for on-track competition and 2023 for public service, off-track contracts.

The European Commission underlines the fact that the earlier rail packages have already substantially transformed the European rail transport sector. With this fourth package, the generalisation of competition should lead to a single European railway area, which needed if this mode of transport is to achieve the objectives set out in the 2011 White Paper. Given the success of the reforms of the last 25 years, this direction should be pursued. Presented in this way, the matter seems simple, but is it really? What has been the impact of introducing competition and notably on-track competition into rail transport?

There is not an easy answer to this question; there are various evaluation methods in response to the diverse objectives of the rail reforms. Thus, in the first instance we will present an overview of the new railway regulation and its objectives, relating them to the available evaluation methodologies (1). On this basis we will then examine the strengths and weaknesses of the Cost Benefit Analysis (CBA) and the need to also conduct Cost Efficiency Analyses, which are essential for benchmarking (2). These methods give summarised and numerical results but they are limited by the fact that they have only local value, centred on one aspect or one company. Therefore it is also necessary to develop a more general evaluation, making use of a multi-criteria approach (MCA) that seeks to make a more holistic (systemic) evaluation of the still largely imperfect competition we find when we examine freight transport, the only rail service where there is real on-track competition (3). Lastly we will concentrate on the evaluation of the role of infrastructure managers. They now play a key role in guaranteeing non-discriminatory access to networks, but their monopolistic position is worthy of examination (4).

1) Evaluating rail regulation: what indicators?

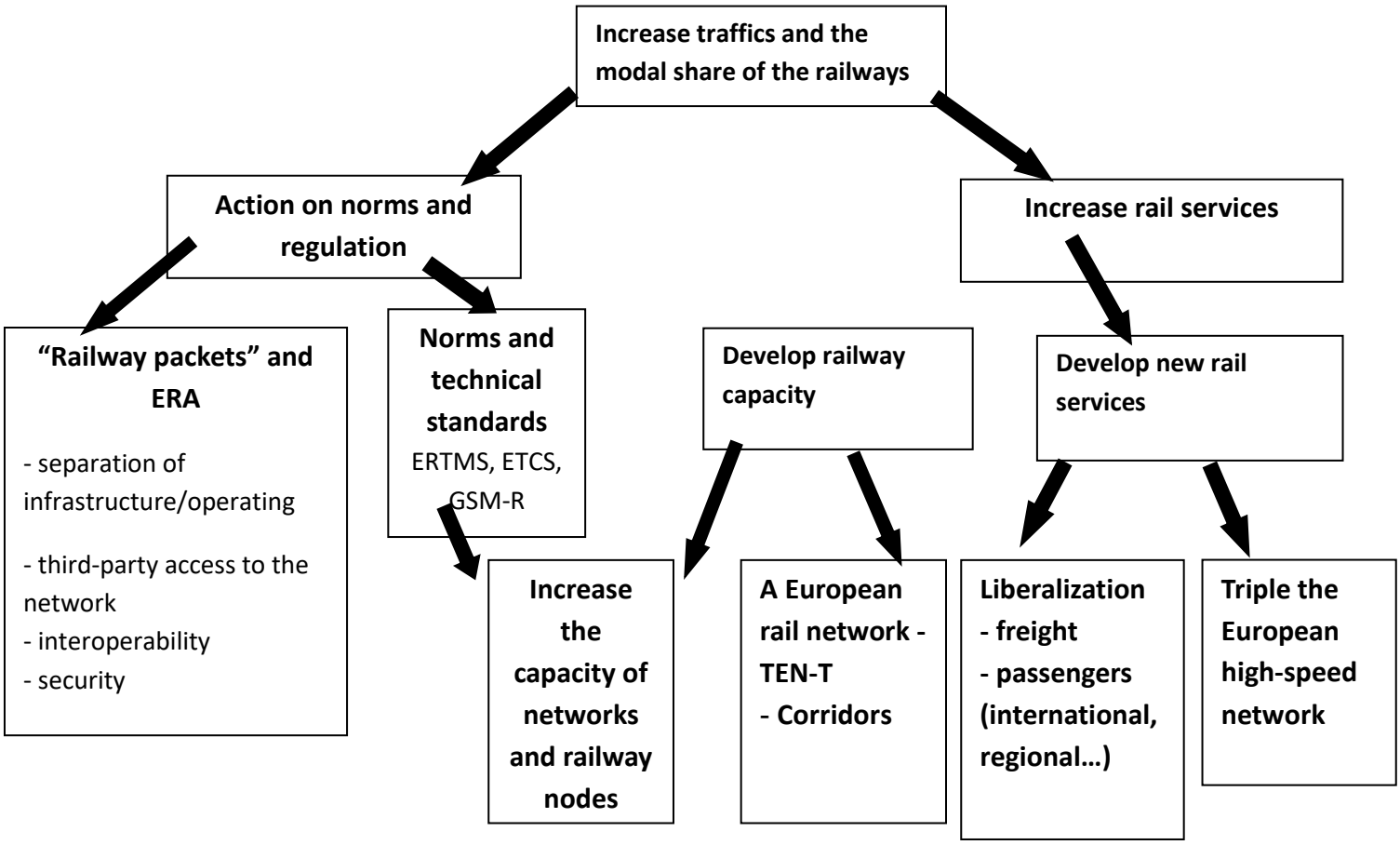
In its successive transport white papers (2001, 2011), the EU was seeking to rebalance transport flows in favour of rail transport. This initiative was based on the idea that rail transport has real advantages in terms of sustainable development. The negative externalities of rail transport are generally lower than those of road or air transport, notably in terms of greenhouse gas emissions. Rail transport is also primordial in densely populated areas where the road network is saturated in rush hour. The geography of Europe and the population density of certain countries are strong arguments in favour of this. In the Netherlands, but also in Belgium, Great Britain, large parts of Germany and in many of the large French, Italian and Spanish agglomerations, daily journeys would not be possible without the use of trains and tramways. Their mass transit capacity is essential to allow the mobility of people in large agglomerations.

In addition, high-speed rail has experienced real commercial success, such as on the Paris-Lyon route and to a lesser extent between Paris, London and Brussels. The specific features of European geography and history also tend to favour rail transport. Although it is clear that rail transport is not suitable for the very long distances between some European cities (such as Berlin – Lisbon or Paris – Athens), high-speed rail has demonstrated its usefulness for linking cities such as Paris, London, Brussels, Amsterdam and Cologne. At the national level, the French, German and Italian examples show that high-speed rail routes can be very successful. It is not surprising that in 2011 (the White Paper) the EU set itself the target of trebling the European high-speed rail network by 2030. Targets for rail freight are equally as ambitious: 30% of inland freight transport over distances of more than 300 km should travel by water or rail by 2030 and by 2050, this proportion should have reached 50%.

1.1 European railway programme

To achieve these objectives, the EU has not only considered competition as a lever for modernisation. As Figure 1 shows, it has intervened in a number of areas.

Figure 1: From objectives to resources: The EU's rail programme



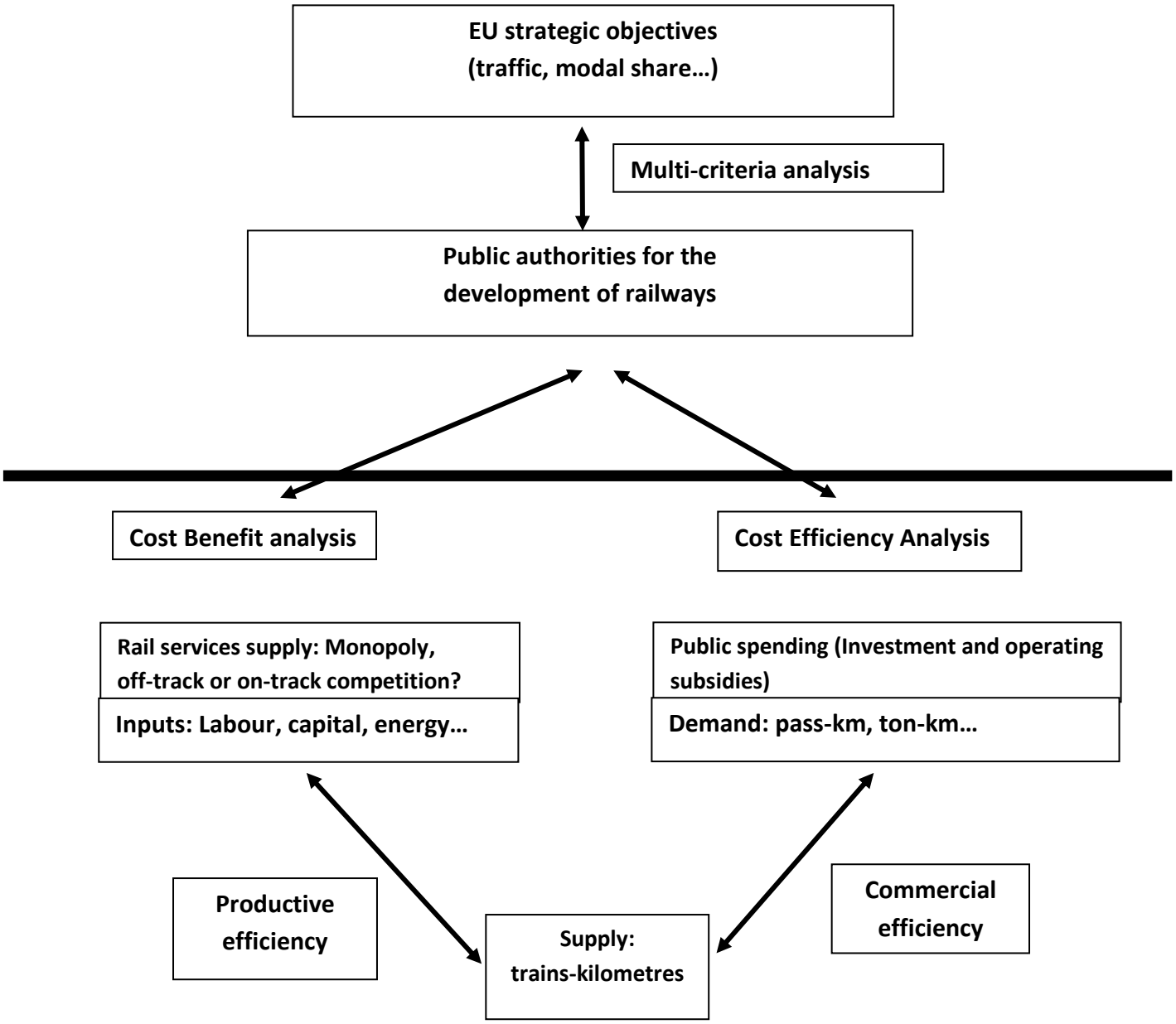
Assuming that the EU's ultimate objective is an increase in traffic and modal share by the railways, intermediate objectives were set, in the area of standards and regulation, as well as in the railway product offer.

- The first category includes the major decisions represented by successive directives and rail packages, but also the promotion of new standards for train control and command systems (ERTMS), and safety issues, with the creation of the ERA, which develops procedures for railway safety and interoperability.
- In the second category, we find measures designed to promote a trans-European rail network setting out the main corridors (TEN-T). In certain cases, the EU has provided funding, notably in order to build international relationships. On these new or upgraded infrastructures, competition is a way of developing the service offer.

1.2 Overview of rail performance indicators.

Thus, liberalisation is a mean of achieving the strategic objectives of increasing traffic and the modal share of railways. As Figure 2 shows, from an evaluation perspective, these objectives can be related to a certain number of performance indicators.

Figure 2: Performance indicators and evaluation of public rail policies.



In the lower section of Figure 2, we find the traditional indicators of production efficiency and commercial efficiency. These are generally established for one company, notably in order to compare its performance with that of other companies (benchmarking). In the upper section of the diagram, along with the cost-benefit analysis and the cost-efficiency analysis, we find traditional indicators that are not seeking to establish the performance of companies, but the costs and benefits for the community of such rail services. This latter feature depends directly on public policies, given that a large proportion of rail services are subsidised. But public policies are also directly implicated when there is competition in the market between companies who do not receive subsidies, because public policies are also affected by the national forms of regulation of the rail sector and transport in general. That is why on the basis of diverse performance indicators that we will present in the second part of this paper, it is also necessary to develop multi-criteria approaches that are more qualitative and which seek to evaluate the

impacts of competition and rail regulation, notably regarding the role of the infrastructure manager.

2) From company efficiency to cost benefit analysis

If we are to evaluate the impacts of competition on rail transport we must firstly refer to traditional indicators. We will therefore start with a reminder of the classic methods for measuring the productive efficiency of companies. (For an in-depth review of the measures of efficiency in rail operations and infrastructure managers, see ITF/OECD – Perkins et al., 2016). Then we will look at the cost-benefit and cost-efficiency analyses which are a first step towards a more global evaluation that seeks to measure impacts on the community.

2.1 Productive efficiency and commercial efficiency: the crucial role of organisations

Measuring the efficiency of a company, and particularly a railway company, is not an easy task, as many different types of indicators exist. To make matters clearer, we can distinguish between productive efficiency and commercial efficiency.

- With the former, this would involve comparing physical outputs, such as train-km with significant inputs such as the quantity of capital or work.
- Commercial efficiency is measured by comparing supply indicators (train-km) with demand indicators such as passengers-km or tons-km. It is possible for a company to have high productive efficiency but low commercial efficiency, if the load factor of the trains is insufficient.

We can also combine productive efficiency and commercial efficiency in a single composite indicator by bringing together traffic (Pass-km and Ton-km) and the workforce employed. Although it is only a rough measure, this indicator of what it is known as ‘apparent labour productivity’ is very instructive. Firstly let us take a look at what has happened in France, to understand how this indicator is constructed (Table 1).

Table 1: France, labour productivity

	1996	2008	2013
Passengers – kilometres (millions)	59 700	82 400	92 400
Tons-kilometres (millions)	48600	37 300	20 700
Kilometric units (millions)	108 300	119 700	113 100
Workforce	180 500	163 000	155 400
Millions of KU per capita	0.60	0.73	0.73

Source: National transport accounts

The last line of the table shows us that labour productivity has increased in France by 20%. It has improved from 0.60 to 0.73 million kilometric units (Pass-km + Tonne-km) per employee. This result cannot be explained by the rise in the numerator. Due to the sharp drop in freight traffic, the kilometric units fell between 2008 and 2013. The increase in passenger traffic is not enough to compensate for the drop in freight, as can be seen by the figures for 1996 to 2008. It is only the decrease in the workforce, i.e. the denominator that can explain the productivity gains. The situation is different in two neighbouring countries, Germany and Switzerland, which like France have maintained an integrated historical operator. Table 2 shows us that like France, Germany and Switzerland experienced the impact of the financial crisis on freight traffic from 2008 onwards.

Table 2: apparent labour productivity in Germany (DB) and Switzerland

Germany	1996	2008	2013	Switzerland	1996	2008	2013
Vkm (millions)	59 300	77 800	88 700	**Vkm (millions)**	11 600	16 150	19 200
TKm (millions)	67 400	113 600	104 300	**Tkm (millions)**	7 300	12 530	11 500
KUm (millions)	126 700	191 400	193 000	**KUm (millions)**	18 900	28 680	30 700
Workforce	260 000	240 500	200 000	**Workforce**	32 000	28 000	27 000
Millions of KU per capita	0,49	0,79	0,96	**Millions of KU per capita**	0,59	1,02	1,14

Source: DB and CFF

But in these two countries, passenger traffic continued to increase which, coupled with the reduction in workforce, allowed productivity gains to continue. Consequently, between 1996 and 2013, apparent labour productivity increased by 92% in Switzerland and 97% in Germany.

In other words, given the modest increase in traffic in France, much larger cuts to the workforce would have been needed in order to maintain productivity levels in line with those of its Swiss and German neighbours. Despite a context that favours commercial efficiency (230 passengers per train on average in France compared to a little over 100 in Germany) the efficiency of the French rail system is low when we compare outputs, namely passengers and

tons-kilometre with inputs, namely the workforce. Another way of formulating the same observation is to look at the number of trains-kilometre (output) per employee (input) in 2010 (data from UIC), which stood at 2983 in France and 3695 in Germany, some 24% more per employee!

France, unlike Germany, is a country where rail competition is almost non-existent. We could therefore be tempted to look for a relationship between low productivity gains and monopoly position. But things are not so simple: in Switzerland, the Federal Railway (CFF) does not have any competitors for passenger traffic, whether on-track or off-track. Therefore the efficiency of rail transport companies does not depend on competition. Organisational questions also play a key role. In Switzerland, a specific productivity agreement was signed between the Confederation and the CFF in the early 1990s. In exchange for generous public subsidies for the modernisation and development of the rail network, the integrated Railway Undertaking (the CFF) agreed to reduce its workforce by more than 30% although traffic increased by more than 60%.

Organisational change is therefore at the heart of railway revitalisation. It can, like in Switzerland, be the result of a contract between the public authority and the historical operator. It can also come from the constraint represented by competition, like in Italy. Since the beginning of the 2000s, rail transport in Italy has shown real vitality, the first demonstration of which was the development of high-speed trains. Covering an area between Naples and Turin, these trains now connect the largest Italian cities, with numerous services offering day return trips between them, to such an extent that we can now talk about an inter-urban metro system. High-speed train traffic is increasing, and this trend should continue in years to come because of the extensions that are underway or scheduled towards Venice, Bari, etc.

Extension of the network, competition for the high-speed train market, entrance of private capital – the Italian railway is on track for real renewal. Public policies have been largely inspired by the measures recommended in the EU White Papers: development of high-speed trains, implementation of the ERTMS, deregulation in the form of opening-up to competition and private capital.

Competition has played a key role in encouraging traffic development, taking the form of on-track competition rather than a system of franchises or competitive tendering. This is very rare, if not unique in Europe: since 2012 alongside the historical operator Trenitalia, there has been a new player on the market, NTV (Nuovo Trasporto Viaggiatori), operating under the trade name of "Italo" and offering services on the same routes. NTV is a private company owned by Italian investors (MDP Holding, IMI investimenti, Generali…). Its entry on the market received strong support from the Transport Ministry who saw it as a stimulus for reforming the historical operator. Everything has been done to ensure NTV has attractive track access, as well as access to the main stations, which recently included Termini, the main station in Rome. It should be noted that NTV is not the only new player in the peninsula. Another company, Thello, whose shareholders are Trenitalia and Transdev, operates trains from Milan to Paris and Marseille.

For NTV, the first years of operation were difficult. Despite a wide range of fares and very varied selection of services (including a "super premium" class with Pullman seats, its own staff and a meeting room), the load factor barely exceeded 50% and losses were accumulating. High-yield passengers were the hardest to attract. The results for 2015 are much more encouraging. The load factor now exceeds 70% and the annual number of passengers has leaped from a little over 6 million to more than 9 million passengers. What is more, in 2015 NTV generated a gross operating surplus for the first time, and the company is planning to develop its activity, including in coach transport. But it should not be forgotten that to achieve these results, the Italian infrastructure manager had to substantially reduce the track access

charges. The improved profitability of NTV and Trenitalia is mirrored by an increase in public funding.

In addition, an interrelation has been observed between the traffic on classic lines and that on the high-speed lines. The latter has grown rapidly: 8.6 billion pkm in 2011 (23.4 million passengers) compared with 11.09 billion pkm in 2015 (31.2 million passengers), an increase of some 29%. But at the same time, traffic on classic lines has dropped sharply, to such an extent that total rail traffic in Italy barely exceeds 50 billion pkm, the same value as in the early 2000s. The question has to be asked about the cost for the community of this substitution between customer bases. Users of high-speed rail lines have obviously increased their well-being, particularly as competition has seen prices come down on lines where it exists. But the public cost is high and it is necessary to compare the costs and benefits at the level of the community. That is the role of the economic calculation.

2.2 The economic calculation: cost-benefit and cost-efficiency analyses

The role of the economic calculation, the most commonly used tool being the Cost-Benefits Analysis (CBA), is to compare different possible choices of investment in terms of their costs and their various estimated benefits. The economic calculation makes it possible to assess the usefulness and the profitability of a project compared to other projects with the same objectives. The two main indicators of the economic calculation are the Net Present Value (NPV) and the Internal Rate of Return (IRR).

The NPV takes into account the investment made by the operator and the financial costs of the project. This is always a value that is actualised to a base year. It is a notion that seeks to estimate the global financial surplus of the project (See Annex 1). But it must not only take into account monetary flows. It is therefore necessary and possible to calculate a "socio-economic" NPV and IRR which take into account non-sales costs and benefits. Factors that are accounted for include time savings but also the variations in the usual transport-related pollutions, safety and noise levels. The monetary estimation of these various benefits is by definition uncertain, due to the non-tangible nature of these effects. And yet, in a socio-economic assessment, they are often preponderant in the results. The values used to calculate these benefits in value terms are therefore chosen by the public authority and can be assessed with sensitivity analyses.

The economic calculation has been used for many years in the transport sector. Thus, in France it is possible to establish ex-post IRR for the country's high-speed lines, which can be compared with the forecast ex-ante IRR. As Table 3 shows, the profitability falls as the network expands.

Table 3: *Ex-ante* and *ex-post* "socio-economic" IRR values

	Ex ante	Ex post
LN 1 (Sud Est)	28,0%	?
LN 2 (Atlantique)	23,6%	12,0%
LN3 (Nord Europe)	20,3%	5,0%
Interconnexion	18,5%	15,0%
LN4 (Rhone-Alpes)	15,4%	10,6%
LN5 (Med)	12,2%	8,1%

The high-speed lines offered the community good levels of socio-economic IRR, thanks to the time savings and reduction in polluting emissions. The figure is not known for the first high-speed line, but it is very probably in excess of 20%. For the TGV Nord, the low IRR comes from the fact that the traffic, notably towards London, took a very long time to grow. Today, 20 years after the Channel Tunnel opened, traffic has finally reached levels that have allowed Eurostar to become a profit-making company. But there was a long wait for the new line to be open on the British side and access to be given to St Pancras station. The *ex post* evaluations of the first 25 years of high-speed trains (TGV) in France showed that the net surplus gain for the community stood at 45.9 billion euros for line 1 (Sud-Est), 23.8 billion for the Atlantic line (Sud-Ouest) and 4.9 billion for the Nord line. This gives a total of 74.6 billion in constant 2005 euros, the vast majority of which come from time savings for passengers. This progressive reduction in profitability suggests that caution should be exercised with regards to the many network extension projects.

Partly, but not only, for reasons of caution, the economic calculation has recently undergone a number of changes which have resulted in new elements being included in the NPV.

- In recent years, inspired by the work of T. Venables and D. Graham, it has been suggested to include "wider economic benefits", taking into account the possible impact of new transport infrastructures on productivity and ultimately on economic growth. But the results are still uncertain and generally poorer than the project promoters expected. Thus, D. Graham has evaluated potential gains from the British high-speed train project known as "High Speed 2" in a much less optimistic manner, which could be described as more realistic, than the report from the consultants (KPMG 2013) because there are high risks that the traffic levels will not live up to expectations.
- The question of risks is therefore on the table and it is now possible to take this into account in various ways, notably by increasing the discount rate (see Annex 1). But despite this, it is not unusual to find the public authority remains the insurer of last resort. Even when concession contracts have been signed with private partners, for example for the launch of new high-speed lines, it is public funds that have been used to save the project.
- For this reason, and given the growth in public deficits and debt, the recommendation has been to take into account the scarcity of public funding. This is logical in the railway sector, which requires heavily subsidy.

When looking at the cost to the community of rail services, we should not only take into account a simple cost-benefit calculation. A cost-efficiency analysis is also required. This is a good way of comparing various options, but also, from a benchmarking perspective, a way of comparing the cost to the community of various choices. That is why in the fourth railway package, the 'markets' pillar clearly mentioned the objective of reducing the costs of the railway for the community. It is a question of improving the cost-efficiency ratio and value for money for taxpayers. If competitive tendering is to become the norm for awarding public service contracts from 2023, this is in order to provide the best price for subsidised passenger rail services, which represent the majority of rail services. It is therefore important to measure how much a train-km costs in absolute value terms and what it costs in subsidies. Once again the comparison between France and Germany is instructive.

In Germany from 1996 to 2009 (Guihéry 2011), regional rail traffic increased by 55% (to 47 millions pass.km) but train-km only increased by 26% (to 630 million train-km). Therefore demand grew much more than supply. Thanks to on-track competition for this type of service, contract prices fell by 26%, to the benefit of the organising authorities. This allowed federal subsidies to be reduced by 6% in constant euros from 1996 to 2009. For a constant euro, the Länder offer 37% more services (2010/1996). Another comparison places train-kilometre subsidies in the area of public service obligations (European Commission 2014b, part 2, p.53). In 2012, the subsidy per train-kilometre stood at 17 euros in France against 9 euros in Germany[1].

In contrast, in France, not only has public support increased substantially (+80% between 2002 – 2011), but almost the same applies for the subsidy per train-kilometre, as the cost of the train-kilometre has increased by 60%, some 5.3% per year, which is three times faster than inflation! This has all occurred as if the organising authorities, for a variety of institutional and political reasons, were incapable of stopping costs getting out of control. As a comparison, in Switzerland over the same period, total public contributions increased slightly then stabilised. But as a result of the reduction in costs per train-km, the corresponding subsidy dropped sharply (-22%).

A potential avenue of research is put forward in recent work by the ITF/OECD (Casullo, 2016). The work suggests that the impact of open access is evaluated through comparative econometric techniques such as difference-in-differences estimators. The first step of this analysis requires matching rail networks with similar characteristics to control for exogenous factors. Next, a meaningful dependent variable is selected (such as operating cost per train-km) and the evolution of this variable before and after market opening is observed. Initial findings suggest that there is no evidence of cost reductions at the system level in the immediate years after market opening.

3) Multi-criteria assessment of rail freight liberalisation

The indicators shown in the previous sections are characterised by their one-dimensional nature. In one way or another, they seek to capture the relative efficiency of a company or a transport project in a single value. But is it possible to do the same when assessing an entire

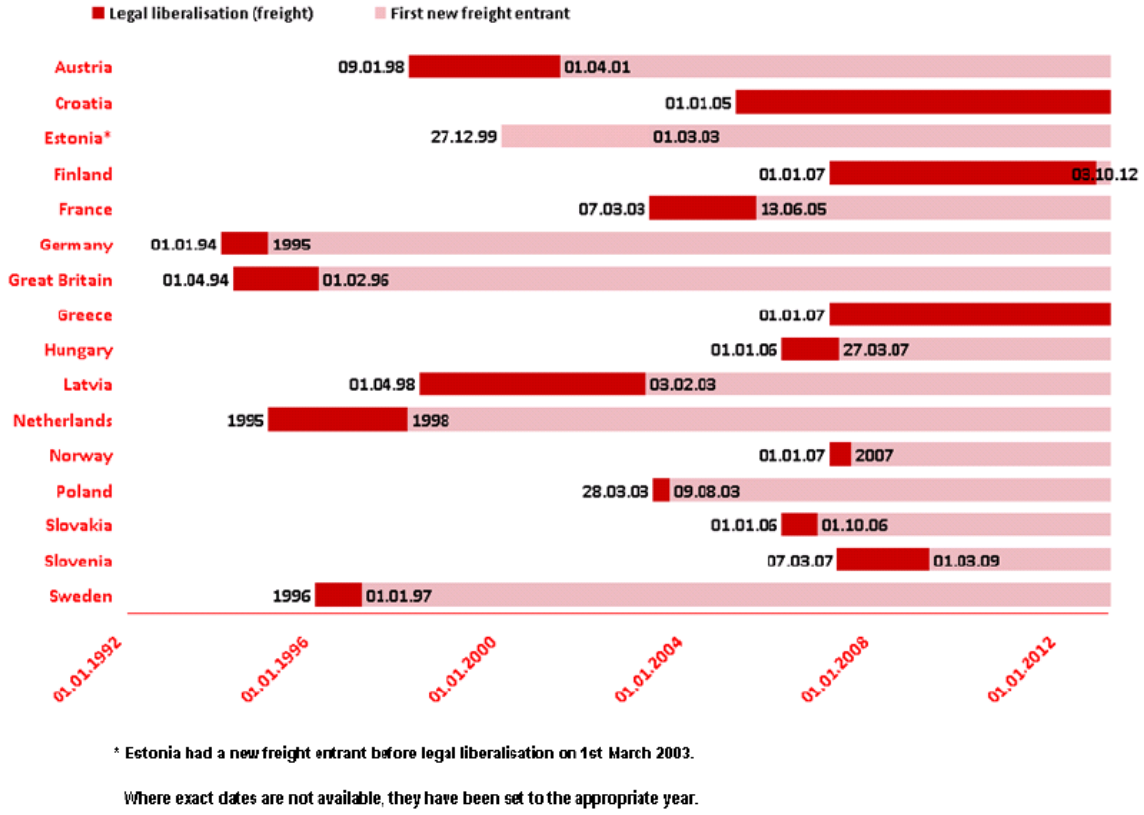
[1] Precision from Commission: The "net public support" to a 140 tons suburban train in France is estimated to amount only to 7.1 EUR/train-km, as 10.9 EUR/train-km serve to pay track access charges. The "net public support" to a 140 ton suburban train in Germany is estimated to amount to only to 4.8 EUR/train-km (deducting track access charges).

public policy, such as on-track competition in rail transport? We are going to attempt to answer this question by focusing on rail freight, an area which was liberalised a relatively long time ago and where competition is now quite widespread throughout Europe. But before attempting an assessment using the Rail Liberalisation Index (RLI), it is important to bear in mind that we are in the presence of imperfect competition.

3.1 Rail freight: structurally imperfect competition

Since the first and second railway packages liberalised rail freight, in 2001 and 2004 respectively, important changes have been seen in most European countries. In general, markets are more open and competition is increasingly a reality. The first phase of deregulation took some time, but it has now been accepted throughout Europe, although the extent of liberalisation is not the same from one country to another, as shown in Figure 3.

Figure 3: Rail freight liberalisation in European countries



* Estonia had a new freight entrant before legal liberalisation on 1st March 2003.

Where exact dates are not available, they have been set to the appropriate year.

Source: Independent Regulators' Group – Rail, 2013

In terms of liberalisation, EU countries are in very variable situations. Some, like the Netherlands, Sweden, Germany or Great Britain, legally liberalised the market in the mid-1990s and new market players moved in. In other countries, legal liberalisation only occurred after the publication of the European railway packages, in the first half of the 2000s. The first competitor only emerged much later, often many years later, and in some cases even later still, in Finland, or never as in Greece. Liberalisation of rail freight is therefore not a tidal wave; it is a slow movement that is gradually taking place throughout Europe.

Even when competition has been put in place, the sector remains heavily concentrated, which leads to the persistence of strong market powers. In traditional competition analyses, economists closely examine the market structure, i.e. the number of competitors. They consider

that this largely determines the behaviour of companies in terms of innovation and ultimately their overall efficiency. To evaluate the market structure within a sector of activity, the most frequently used reference is the Hirschmann-Herfindahl Index (HHI) which is defined as the sum of the square of market shares (Shepherd 1984). The value of the index increases when the number of companies decreases. Thus, in the United States the number of rail freight companies fell from 36 to 7 between 1978 and 2004, which resulted in the HHI increasing from 589 to 2263, well above the value of 1000 which is considered to be the critical value beyond which there is a risk of powerful market powers emerging. (Mac Cullough 2005).

At first glance, the EU is in the opposite situation. The liberalisation of the market is currently producing a reduction in the HHI. When there is a single operator, the HHI reaches its maximum level, of 10,000[2]. In the case of Great Britain, the growth in market share of the competitors of the principal operator HWS, gradually brought the HHI down, to around 4250 in 2012 compared with 7450 in 1997. The tendency is going in the right direction, but these are still the same very high levels of concentration that can be found in most European countries. In Germany, the HHI is greater than 6300; it is more than 5000 in France[3].

By comparing the development in North America and Europe, we can therefore ask ourselves whether there is not a specific feature in rail freight that structurally maintains the HHI, and thus the market powers at a high level. To understand this, we must bear in mind that an HHI of 1000 represents a situation where 10 operators each hold 10% of market share. Is this a reasonable objective for rail freight? Are we not in a sector where in order to develop certain activities such as the transport of wagon load traffic, or powerful corridors for container transport, it is necessary to hold a much higher market share than 10%?

Competition in the rail freight transport sector is clearly a situation of imperfect competition. Entering the market has a cost for the new participants. If they do not succeed in obtaining a return on their investment, they have to restructure or leave the market after a few years of operation. As there are many sunk costs, it is not possible to practice the “hit and run entry” so dear to the theory of competitive markets (Baumol, Panzar & Willig, 1982). A clear indication of this is that, in addition to the low number of players, there is a high number of new participants leaving the market after failing to sustain their activity. Thus in Sweden, after liberalisation of the market in one of the pioneer countries in this approach, between 2000 and 2004, eight companies left the market, including Ikea Rail. To date, there are just 10 operators remaining (B. Hylen 2005).

We are therefore in a sector characterised by multiple barriers to entry, which manifest themselves either in the entrance costs or the exit costs. As a result, competition is only legitimate if it leads to an overall improvement in sector efficiency. This is measured by a number of indicators such as the share of the rail freight market, the development of costs of the sector, productivity, etc. An assessment of market liberalisation must therefore take into account medium and long term effects. The players in the market are all different. There is no ‘representative company” as there is in pure and perfect competition. Each company will adopt a strategy and target markets adapted to its specific assets. As these are neither of the same nature nor of the same importance, the market powers must be closely monitored in order to find out whether competition has really changed the situation.

[2] 10 000 is the market share assessed at between 0 and 100, but 1 if the market share is given as between 0 and 1.

[3] The 2013 HHI is over 6500 in France if we consider VFLI (10% market share), subsidiary of the SNCF, as a stakeholder of the historic operator.

3.2 "Rail Liberalisation Index": can we evaluate the effects of competition?

To evaluate the effects of competition, the competition has to be measured, in order to establish a degree of intensity. That is what IBM attempted to do, at the request of the Deutsche Bahn. On the basis of a multi-criteria method, a synthetic index was constructed to monitor the degrees of liberalisation. This is the Rail Liberalisation Index (IBM 2011). Before we look at the results, it is important to describe the evolving structure. In 2011, the general index took into account two large categories of indicators known as LEX and ACCESS.

- The indicators contained in LEX represent 20% of the total. As shown below, they take into account how the sector is organised and notably the vertical separation between the infrastructure manager and the Railway Undertaking (RU). But the main weight is given to the regulation of access to the market and the power of the market authorities.
- The ACCESS indicators are those that have the most weight in the indicator (80%). They assess the various barriers to entering the market (information-related, administrative, and operational) but also the proportion of the domestic market that is accessible, and in a more marginal manner, the question of passengers ticketing.

The scores obtained for each indicator are then added together, taking into account the weightings shown in Table 3. Thus, the higher the score of the RLI, the more open the rail market of the country can be considered to be. When the Index is above 800 points, liberalisation is considered as "advanced" (Austria, Germany, Denmark, the Netherlands, Sweden, and the United Kingdom). At between 600 and 800 the country is considered to be "on schedule" (13 EU countries including Italy, France, Belgium) While countries are considered to be behind schedule if they score between 300 and 600 points (6 EU countries including Spain and Luxembourg). The annex includes the scores obtained for the various years and their overall development for all of the EU countries plus Norway and Switzerland.

The score for each country is interesting but we should avoid according too much importance to detailed results, insofar as they depending on changing weighting and measuring tools that can still be perfected. But three things are worthy of mention.

Table 4: The Makeup of the Liberalization Indices in 2011

LEX (20% of overall index) (25% in 2002, 30% in 2004, 20% in 2007)		
Organizational Structure	**25**	
Incumbents' independent status with respect to the state		5
Degree of vertical separation - network/operations		80
Degree of horizontal separation - freight/passenger transport		15
Regulation of Market Access	**45**	
Market access regime for foreign RUs		40
Market access regime for domestic RUs		40
Legal controlled access to operational facilities		20

Regulatory Authority Powers	**30**	
General aspects of the regulatory authority		30
Scope of regulation		30
Powers of the regulatory authority		40
ACCESS (80% of overall index) (50% in 2002, 70% in 2004, 80% in 2007)		
Information barriers	**5**	
Duration for obtaining information		40
Quality of non-personal information provided		30
Quality of personal information provided		30
Administrative barriers	**20**	
Licence		35
Safety certificate		25
Homologation of rolling stock		40
Operational Barriers	**45**	
Track access conditions		25
Infrastructure charging system		50
Other service facilities		25
Share of domestic market accessible 2009	**25**	
Method of awarding transport contracts		20
Compliance with transparency provisions		10
Percentage of the accessible market for RUs		70
Sales services in passenger transport	**5**	
Rental of space ticket sales offices		50
Access to sales services		50

- The first is that the tendency is for all countries to see a gradual improvement in their RLI. In less than a decade, this is a major result that tells us that the "competitive solution" is at work.
- The second is that the very fact of changing the weightings reveals that liberalisation is a complex process which adapts its ambitions to the changes observed. Thus the ACCESS indicators (evaluating barriers to entry) went from representing 50% to 80% of the total of the RLI between 2002 and 2011.
- The third, which is an extension of the previous point, is that the growing importance of the ACCESS indicators is primarily linked to the fact that other indicators have been removed from the general index, gathered under the name of COM. And yet, these last indicators illustrate the effects of liberalisation in relation to the EU's general objectives, notably the evolution of modal share for railways and the proportion of new entrants.

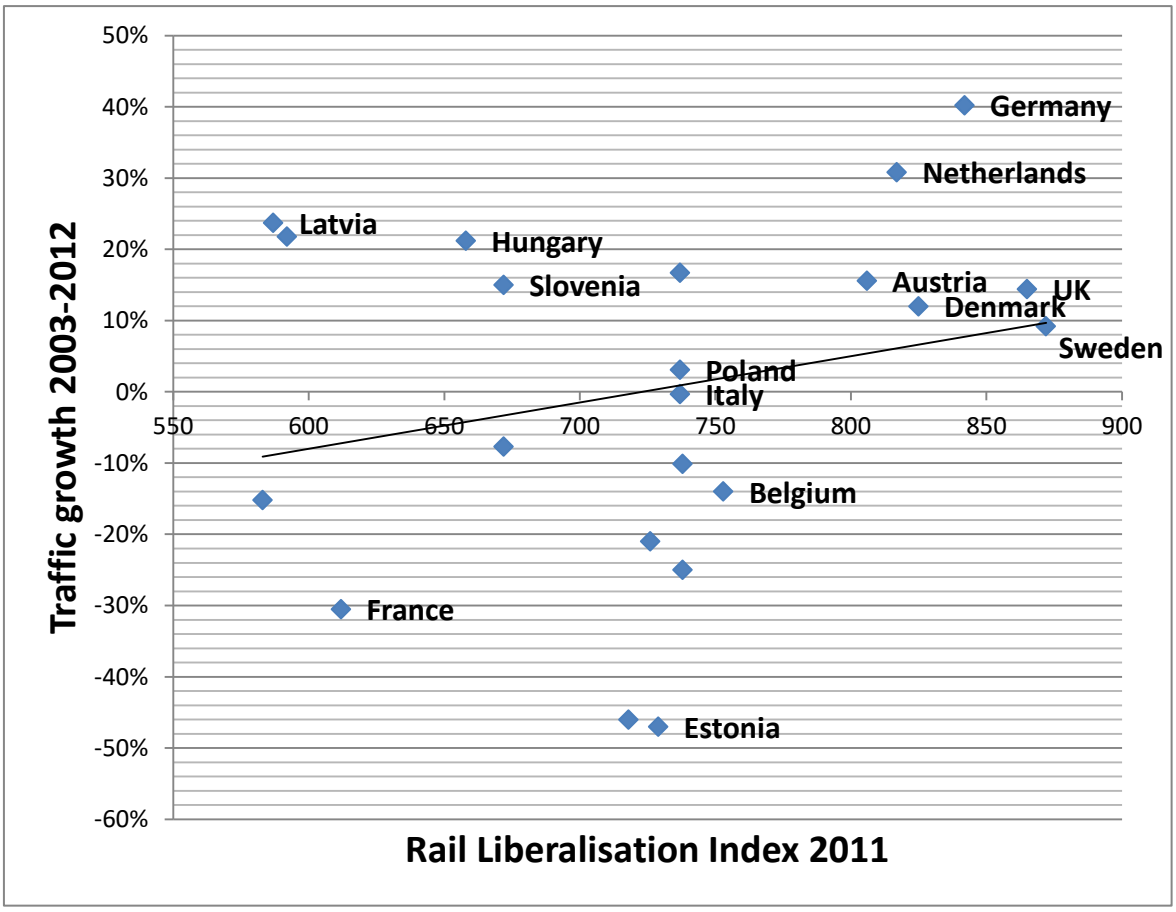
Table 5: content of COM indicators (RLI – IBM 2011)

COM (not included in overall index) (25% in 2002, not included in 2004, 2007 and 2011)		
Modal split changes	**20**	
Change in the modal split for rail freight transport (2001 - 2008)		40
Change in the modal split for rail passenger transport (2001 - 2008)		40
Share of modal split for rail freight transport 2008		10
Share of modal split for rail passenger transport 2008		10
Number of external RUs 2009	**20**	
Certified RUs (excl. incumbent) in relation to network length		40
Ratio of active RUs to certified RUs		50
Number of active RUs providing passenger services on a regular basis		10
Market share external RUs 2009	**60**	
Market share ext. RUs in terms of transport performance in %		75
Increase in market share of ext. RUs between 2006 and 2009 in %		25

The question of the market share of new entrants takes centre stage once again here because a longitudinal approach is required. What happens to new entrants? In a number of sectors of activity, such as air transport, it has been seen that competition, after a phase of multiplication of operators, results in a period of consolidation and finally, increased concentration. This is very similar to what is happening in rail freight, as the HHI shows us. But can we consider that, despite the low number of operators, greater liberalisation goes hand in hand with a larger growth in traffic? Figure 4 partially answers that question.

The countries with the greatest liberalisation (Great Britain, Sweden) are those where the growth in traffic has been the most pronounced. But for all the countries represented, this relationship is not obvious, as is shown by the wide dispersion of points around the regression line, which also reveals a very weak correlation between the variables. It is therefore clear that competition may be a necessary condition but it is not an adequate condition. Aspects such as the level of intermodal competition should also be taken account, but not only from road transport. It is not widely known that the strong rise in rail freight in Germany (+40% since 2003) was entirely offset by a fall in waterway traffic. The market share of road freight transport has remained almost unchanged over recent years.

Figure 4: Degree of liberalisation and growth of rail freight traffic



Source: Author

In general, competition has not had a particularly significant impact on rail freight traffic. Across the EU as a whole (28 countries), freight traffic grew once again after the sharp fall experienced in 2008 as a result of the financial crisis. In 2014, total EU rail freight reached 422 billion tons-kilometre. But if we look at modal share, rail freight has taken almost nothing away from road freight, which represents more than 4 times more traffic than rail. Thus, in 2014 road freight transport represented 74.9% of land traffic in the EU, against 18.4% for rail. In 2009, the figures were 77.1 and 16.9 % respectively. There has been an improvement but it is modest. Could it be any different?

Probably not, because rail freight has to accept that it has only a niche market.

- This firstly comes from a problem of relative cost. For a shipper, transport is a cost that can be broken down into monetary cost and time cost. Competition between modes of transport depends on both components. Road transport has taken such a predominant position in recent decades because it has succeeded in reducing the trends of its monetary costs (in constant money terms, sometimes in nominal terms at certain periods) and also in making the most of time savings made possible by improved road infrastructures and major technical progress included in the vehicles.
- Changes in the nature of products being transported is also a key factor in this relative decline. Which products use the rail mode of transport and which offer real prospects for development? This is what the British Department for Transport has sought to identify (DfT 2010). The main products that are transported are assessed in terms of their degree of market maturity. Coal, for example, like aggregates or metals, represents

mature and potentially stable or declining markets. It is difficult to build upon such markets to envisage a significant development in rail transport. What then are the products with the highest added value per ton, transiting across long distances, which could interest rail freight? The transportation of automobiles and parts for the automobile industry is a potential target as there are few production plants in Europe, each one specialised in certain models. But car makers are demanding in terms of regularity and service quality. The same applies to intermodal traffic and notably container transport. Growth perspectives are strong in this area but would require track to be available across the network with track access charges that are not too high. This leads us to evaluate the role of the infrastructure managers.

4) Infrastructure managers and competition: - current state of play

The concept of a separate infrastructure manager did not exist in the European railway sector before Directive 91-440. In almost all countries, an integrated historical operator dominated. Train paths were allocated without any being charged. The separation between the rail and the wheel, even if it is only at the accounting level, was firstly designed to contain the monopoly, on the recommendations of economists (Katz and Shapiro 1985). But the aim was also to introduce a fee for use of the railway, in order to reflect the relative scarcities, notably in cases of congestion, as well as rail companies' readiness to pay. This commercial logic has played a large part in modifying how networks are managed, but it also has its downside. Isn't a monopoly, even one that is contained, likely to abuse the situation? If this is the case, how can we evaluate the risks, notably those related to an excess of public interventionism and how can we deal with it?

4.1 Access to the network, track access charges, risk of double marginalisation

The question of network access is fundamental when we want to understand the difficulties experienced by the competition in developing in the rail sector. The rail network is much less dense than the road network and, other than locally, it is not being extended. In addition, freight trains are in competition with passenger trains for the allocation of train paths. In general, in Europe, unlike in the United States, systematic priority is given to passenger trains.

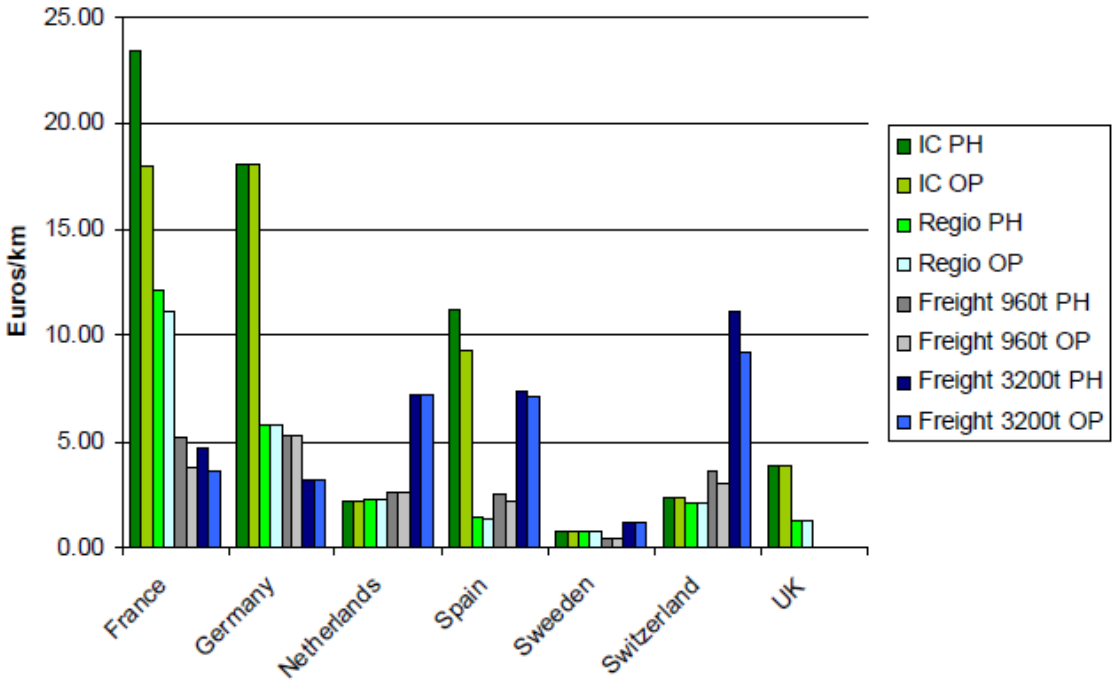
- This is seen when train paths are allocated, with the scheduled timetables of passenger trains taking precedence. Freight trains have to fit into the gaps left free by the passenger trains.
- The priority for passenger trains also often applies in the operating phase; In the event of disruption, it is generally passenger trains that get moving again first. This means that freight trains often experience long delays, which can accumulate because they cover large distances and can encounter a number of disruptions.

Therefore, the development of rail freight involves offering quality train paths at an accessible price.

- The quality of train paths firstly depends on the average speed they allow. This is a major factor in efficiency as the lower the speed of the train, the higher the capital costs (locomotives, wagons) and the work costs. In contrast, a high average speed allows more goods to be transported with the same quantity of factors of production. The reliability of train paths is another aspect of their quality. When, as is the case in France, more than 20% of freight trains experience substantial delays, shippers tend to move away from the rail mode.

- The question of the level of track access charges is delicate. Infrastructure charges did not exist before the rail reforms. They have now become more or less generalised, even when rail companies have remained integrated. Whether or not they are independent, the infrastructure manager provides rail companies with a service whose cost is reflected in the charges. But does the level of the track access charges really reflect the costs? This is not apparent when we look at Figure 5. Not only are there notable differences between passenger trains and freight trains, but also from one country to another, freight trains pay very different charges. This can stem from the actual differences in the operating costs and track maintenance costs, but it is also a reflection of strategic choices taking into account the users' willingness to pay. That is why the charges for freight trains are very high in Estonia for example and in contrast very low in Sweden. In this country, like in many others, track access charges have been deliberately reduced to encourage this mode of transport.

Figure 5: track access charges in Europe



Source: Vidaud M. & de Tilière G., 2010

We can note that the charges are relatively low in Great Britain and very low in Sweden. In contrast, they are relatively high in France and in Germany, particularly for high-speed trains. However, they are also high in Poland but there rail freight traffic has increased, and is now second only to Germany. The high charges are therefore not always an unbearable cost for rail operators, but they can be. This is what work on "double marginalization" has shown. When, like in France, the infrastructure manager, who is seeking to completely cover the costs of the high-speed lines, operates a differential price structure relating to the ability to pay of the rail operator, the risk is that the level of the traffic will end up being sub-optimal (Sanchez-Boras et al 2010). This is even more true if the rail operator is in a monopoly position and able to practice yield management. This is the case of the SNCF on French high-speed lines. There is therefore a high risk of seeing a classic monopoly position being created by the combined

actions of the infrastructure manager and the rail operator (Messulam & Finger 2015), deliberately reducing demand in order to increase income to the detriment of users.

In reality the risk is limited as the SNCF does not have a monopoly on transport services. In addition to the high-speed lines, there are air routes, coaches, car-sharing services and, of course, private cars. But there is a risk of seeing a growing proportion of the rail operator's turnover absorbed by the charges. This is why the presence of an independent regulator is essential to control the infrastructure manager. What is the current situation in Europe in the area of railway regulation?

4.2 What room for manoeuvre do regulators have?

There is not a European railway regulator but the European Commission has been very active in this area. It has launched infringement proceedings against a number of countries to encourage them to develop greater competition. It has also strongly emphasised the need to put in place national regulators capable of ensuring respect for free entry on to the market, access to train paths and non-discrimination in charges. But in the same way that each country has applied the rail reforms in their own manner, sector regulation also takes very different form from one country to another.

- In the mid-1990s, Great Britain opted for an independent and powerful rail regulator, which was logical for the architecture chosen after the disappearance of British Railways. The ORR (Office or Rail and Road, formerly Office of Rail Regulation) has statutory duties towards freight (ORR, 2013d). The ORR performs these duties in three key ways (ORR, 2013e):
    - To "regulate Network Rail's stewardship of the national rail network"
    - To "licence operators of railway assets"
    - To "approve track, station and light maintenance depot access".

  ORR carries out periodic reviews of Network Rail's financial structure, usually every five years. This process establishes track access charges for each type of freight locomotive and wagon for different commodity types, together with a range of other charges such as a coal spillage charge and a freight-only line charge (ORR, 2008). The ORR has published a detailed account of the proposed charging principles for 2014-2019 (Control Period 5, ORR, 2013h).

- More recently (December 2010) France created an independent sector regulator. Its duties are more limited than those of the ORR but they were extended with the rail reform law of 2014. Thus, each year ARAF (the railway activity regulatory authority, now known as ARAFER since 2016) must approve the track access charges proposed by the infrastructure manager. But ARAFER does not set the charges. In 2015, it refused the price rises announced for 2017 by putting forward the argument that they did not demonstrate an effort to achieve productivity gains by the infrastructure manager. Germany also has this same form of generally *a posteriori* intervention from the regulator.

- In the case of Germany, the rail regulator is not a sector regulator. Regulation of the rail sector is the responsibility of an independent regulator covering a number of network industries. Since 2006 the Federal Network Agency for Electricity, Gas,

Telecommunications, Post and Railway (Bundesnetzagentur, BNetzA) is the regulator responsible for the regulation of the German railway market. Its responsibilities are based on the General Railway Law (Allgemeines Eisenbahngesetz, AEG) and the Regulation on Railway Infrastructure (Eisenbahninfrastruktur-Benutzerverordnung, EIBV), which determines its main task as monitoring and controlling the non-discriminatory access of all railway operators to infrastructure, especially the processes granting access to networks and service facilities, time-table schedules as well as non-discrimination of access fees (BNetzA, 2013). The regulatory remit of the BNetzA does not include an *ex-ante* approval of infrastructure charges. Rather, it comprises preventive as well as *ex-post* measures: it examines the network statement and initiates investigations as a reaction to complaints. If necessary, it is able to take action ex officio (BNetzA, 2013; LIB-Index, 2013). Decisions by the BNetzA are then immediately effective and an objection has no effect of delay. In addition to its monitoring responsibilities, the BNetzA has the authority to order coercive measures up to 500 000 EUR, without being able to impose fines. Since 2006, the regulatory authority has initiated around 600 investigations and taken about 150 decisions (BNetzA, 2013, LIB-Index, 2013).

- Although the railway liberalization process in Italy was one of the earliest in Europe, paradoxically the responsibility for regulation of the railway companies was for a long time retained by the Government (Senn and Cini, 2011). From 11 August 2004 to 14 January 2014, an independent office of the Ministry for Transportation, called Ufficio per la Regolazione dei Servizi Ferroviari (URSF), played the role of the Italian Regulatory Body (Stanta, 2013), established to comply with EU legislation (Directive 14/2001). The Italian rail regulator was only made truly independent from government through the creation of ART (Transport Regulation Authority) on 17 September 2013 by the decree-law 6 December 2011 n. 201. (becoming operational on 15 January 2014). This is very recent compared with other major European countries. However, the regulation of the railway sector was one of the Authority's primary commitments since its entry into operation. Beginning in 2014, a number of measures has been adopted to ensure fair and non-discriminatory access to infrastructures and service facilities, including the setting of access charges and the establishment of a regulatory period (ART Annual Report, 2016)..

In general, rail regulation remains an open question. It is indeed possible to identify two approaches to regulation.

- In the strict sense of the term, regulation is mainly intended to limit any discriminatory behaviour from the natural monopoly which is the infrastructure manager. The first task is to verify that all operators have the same network access: Allocation of track paths in the upstream phase (timetabling); equal treatment of trains in the operating phase; no price discrimination with the track access charges; access to essential facilities such as fuel delivery points, depots, sidings, etc. Just drawing up the list of these essential facilities can cause debate. For example, should marshalling yards or maintenance centres be included? To what extent should the historical operator be required to give up certain specific assets? The aim here is to reduce the barriers to entry, to allow new entrants onto the market.

- Regulation in the broad sense covers the mechanisms that will allow not only survival but also acceptable profitability for an adequate number of operators, to ensure the global efficiency of the sector. This raises technical questions such as the harmonisation of operating standards, which must eventually become similar across the

whole of Europe, but also economic and social questions about the management of companies in this sector. The question of state intervention is also crucial. Having been for a long time, and often still being, the main or sole shareholder in the historical operator, each country has a tendency to interfere in the competitive game, albeit in indirect or hidden ways. This is a delicate question that regulators cannot always address directly, but that we have a duty to examine.

- In light of market opening, regulators should also be equipped to assess the impacts of liberalisation, both ex-ante and ex-post. On the one hand, regulators that collect market data from infrastructure managers and operators will be in a favourable position to carry out ex-ante assessments, or at least to establish a baseline position for the analysis. Ex-post assessments, following the methodologies discussed in this paper and the related literature, should be encouraged. This practice will empower regulators to evaluate market opening impacts and to inform future decisions and ex-ante analysis.

The presence of the state in a sector is not a problem per se, but the state should facilitate and not hinder the necessary organisational reforms, and this is not the case everywhere. Thus in France, successive rail reforms, whether it was the reform of 1997 (creation of the independent infrastructure manager, the RFF), or the reform of 2014 have not directly addressed the question of productivity. This is due to the difficulty in adapting social relations and human resource management. The risk is therefore that the government cannot drive the process, but is totally restricted (M. Berstein) by various pressure groups. And thus, it has only very reduced rooms for manoeuvre for changing things. The “tyranny of the status quo" (Friedman 1988) imposes its law and managers have to work with these constraints which make any real improvements in their activity impossible. In the case of freight in France, even liberalisation was unable to produce a real organisational overhaul. The freight branch of the SNCF had only one solution, which was to reduce its activity by 60% in just a few years in order to preserve what was profitable, under the same organisation. Rail regulation can therefore strongly encourage stakeholders, but it cannot do everything (Crozet et al. 2014).

Conclusion

Rail companies have long been in a monopoly position which offers little incentive for seeking productivity gains. The objective of the rail reforms promoted by the European Union is to remedy this situation. It should not be forgotten that throughout almost the entire 20th Century, when faced with the growth of road transportation of people and goods, public authorities reacted almost everywhere by imposing restrictions on it. These included imposing strict rules on passenger transport by coach and severely regulating the transport of goods by trucks (maximum distances, prices charged, requirements to hold licences for the vehicles, etc.). These harsh restrictions did not stop the long decline in the railways. Rail reforms initiated in Europe in the last quarter century have turned their back on this restrictive approach. Instead of seeking to save rail transport by increasing constraints on road transport, they have succeeded in pushing rail transport to reform itself.

But as the traditional market for rail freight has been structurally reduced by intermodal competition, the results in terms of traffic and market share have not matched the ambitions of the 2011 White Paper. The weak dynamism of the rail markets also encourages major companies, the former historical operators, to develop strategies limiting the arrival of new competitors. It is true that the liberalisation processes is still recent and that consolidation mechanisms will be put in place. Companies appear and disappear; others merge or are bought by those with capital resources. It is therefore useful to ask what would be the optimal situation

in the rail sector. Can we imagine a market structure where there would be a multitude of operators, as in the road mode? This seems unlikely. Should we therefore see the most likely scenario being the presence of two or three dominant players, like in air transport? If we are heading towards an oligopolistic structure, and if this situation is considered to be more favourable for the efficiency of the sector, a particular format of regulation will have to be created, which closely monitors mergers and acquisitions, the market shares of the various operators, and ensures the survival of smaller operators, an essential source of innovations.

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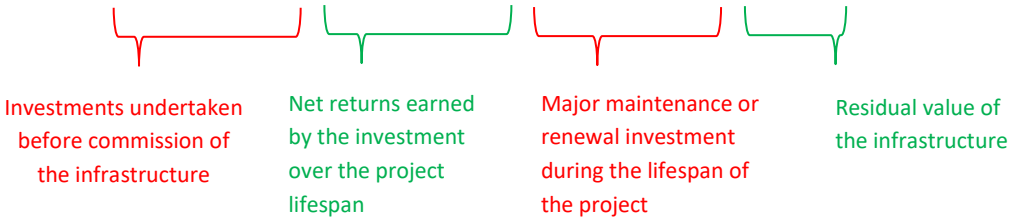
ANNEX 1

Net Present Value and taking risk into account

The NPV is the difference between the updated costs and benefits of all kinds created by the operation, calculated in comparison to a reference situation. The calculation is performed using constant money.

$$NPV = -(I - I_{avoided}) + \sum_{t=1}^{T} \frac{A_{(t0+t)}}{(1+a)^t} - \sum_{t=1}^{T} \frac{\Delta I_{(t0+t)}}{(1+a)^t} + \frac{R}{(1+a)^T}$$



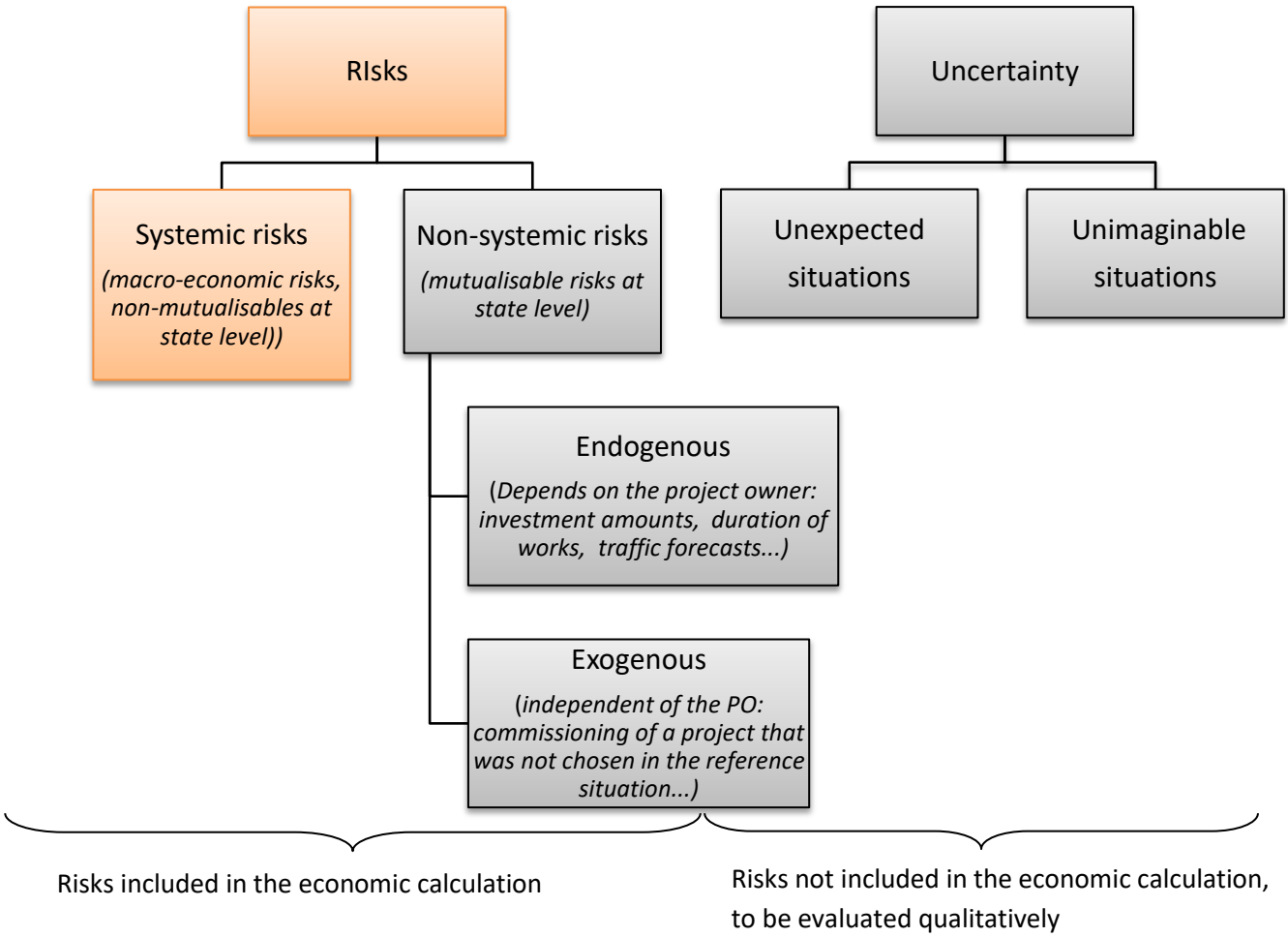
Where:

- t_0 is the year preceding the commissioning of the project (or its first phase)
- ω is the duration of the project construction
- T is the lifespan of the project from the year of commissioning
- $I = \sum_{t=-\omega}^{0} \frac{I_{(t0+t)}}{(1+a)^t}$ is the initial cost of the project (discounted, spread over many years, or over a number of commissioning phases)
- $I_{\text{éludés}}$ is the sum of avoided investment
- ΔI_t is the variation in large maintenance investments which are not included in operating costs and are made in year t
- A_t is the economic benefit for the project at year t :

$$A_t = A_{users}(t) + A_{third\ parties}(t) + A_{AOT}(t) + A_{RFF}(t) + A_{other\ IM}(t) + A_{public\ authority}(t) + A_{railway\ operators}(t) + A_{transporters\ using\ other\ modes}(t)$$

- The benefits for each of the players are expressed in constant money. As a large number of outcomes impacting on these benefits do not have an intrinsic value in euros (value of time, carbon, safety, etc.), they have to be given a monetary value in the form of reference values
- a is the discount rate or the 'rate of exchange' between the future and the present, in constant money. The higher the chosen discount rate, the more we favour the present or near future over the distant future. In real terms, a discount rate of 10% reflects the idea that there is an equivalence between receiving 100€ immediately or 110€ the next year. Its value can decrease over time. For example in France it could be 4% until 2034, then 3.5% in 2035 to 2054, then 3% beyond 2055.
- R is the residual value of the investment at the end of the period in question, which represents the economic value over the useful life of the project. R can be negative if there is a land restoration cost at the end of the project.
- We can also add an Opportunity Cost of Public Capital (COFP) to evaluate the NPV, for example by multiplying all public spending and income (other than tax variations) by a coefficient (0.3 in France or a multiplication by 1.3).
  - $NPV_{with\ COFP} = NPV_{without\ COFP} + [0.3 * (\Delta_{public\ income} + \Delta_{public\ spending})]$

– In terms of risk, we can identify two categories. Probabilisable risk, which can be described by more or less complex probability laws and can be quantified, and Non-probabilisable risks, which are unpredictable or even unimaginable. The first can be included in the economic calculation. The second are more difficult to circumscribe and cannot be taken into account through a calculation and must therefore be assessed qualitatively. This is illustrated as shown below:



– In France, taking into account systemic risks linked to weak economic growth halved the IRR of high-speed train projects, when their profitability was already low.