



# Impacts and incentives of differentiated rail infrastructure charges in Europe - focus on freight

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## Abstract

One of the key objectives of rail infrastructure charges has been stated as being to promote the efficient use of the infrastructure. Much effort has been put into the derivation of charging regimes by infrastructure managers and regulators throughout Europe, and a mix of differing regimes have been put in place. However, relatively little work has been undertaken to examine the impacts and incentivisation effects that these charging regimes produce. This paper gives consideration to relevant theory in this area, what one might expect - from first principles - and then reports on a number of interviews and case studies undertaken to explore these impacts and incentives. Finally, it discusses a number of methodological issues surrounding this area of research, and proposes further lines of enquiry that might reasonably be pursued.

*Keywords:* Railways; Infrastructure charging; European Policy; Competitiveness; Impacts; Freight; Differentiated.

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## 1. Introduction

Charging in the rail sector has, over recent years, made a number of moves towards greater efficiency and this has tended to lead to a greater degree of differentiation in the charges. A number of countries sought, as part of the reform of their national railway industries, to develop and implement systems of rail infrastructure charging that approximate to marginal cost pricing and, since adoption of Directive 2001/14 which requires rail infrastructure charges to be based on marginal cost, the majority of member states have now done the same. However, the ways in which Member States are basing

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their systems on marginal cost principles differ from one country to the next and a diversity of approaches has developed.

Previous research in this area has tended to focus on the design of infrastructure charging regimes which, in principle, promote efficient use of the infrastructure, efficient investment or which enable a particular degree of cost recovery. This has then led on to a substantial body of research into the measurement of costs, in particular of marginal cost (Wheat and Smith, 2008; Nash et al, 2008 etc)).

There has been relatively little research in the area of how train operators react to the charges they face. There is, for example, no previous research to estimate infrastructure charge elasticities and no research into how train operators perceive and interpret different charging structures; i.e. whether they can interpret highly differentiated, complex regimes or whether there may be a necessity to keep things simple. A further apparent gap in the research on rail infrastructure charges relates to the issue of how operators pass on their costs to end-users – that is, passengers and freight forwarders - and how different infrastructure charging regimes impact on charges to end users.

There is, nevertheless, some evidence that train operator reactions to infrastructure charges are important. A key factor motivating the revisions to rail infrastructure charges in Britain in 2001 was the view that the initial system of infrastructure charges gave the wrong incentives to train operators and led to greater congestion on the network. User reactions were also a key factor in Germany, where the infrastructure charging system has undergone reforms largely motivated out of concerns about competitive incentives and user reactions amongst train operators.

One can postulate that rail infrastructure charges might have two principal effects on train operators. Firstly, they might affect their behaviour, in terms of their use of the infrastructure and the way they operate their services. That is, a train operator's decision as to whether to offer a rail service and how to offer that service – when, where and with what rolling stock, staffing levels etc – is likely to be affected by the charges that they will incur in doing so. If there is a differentiated charging system featuring relatively high infrastructure charges in peak times (as was proposed in Britain) or on highly utilized lines (as is the case in Germany and Austria), that may serve as a disincentive to an operator considering the introduction of a new or additional peak service. Correspondingly, relatively low charges at night, for example, or on less utilized lines are likely to serve as a stimulus to new or additional services. Secondly, rail infrastructure charges could be expected to affect the charges that train operators make to their customers, be they passengers or freight forwarders. In fact, there may be a feedback mechanism, whereby the charges that train operators are able to make to their customers has an impact on the rail infrastructure charges as well. For example, if a train operator is faced with a high infrastructure charge for operating a particular service but thinks that passengers place a high value on that service, they might decide to operate the service on the basis of being able to cover the cost of the infrastructure charges through charging high passenger fares. Indeed, the reason behind the high infrastructure charge for that service may actually be a factor of the value that train operators believe that their customers place on the relevant rail services.

There are likely to be differences between reactions and impacts within the passenger as compared with the freight market. Freight is, in European rail systems, often a marginal activity, which is fitted around the passenger services. Freight may be more flexible, at least for some flows, in that the time windows it operates in are less constrained than for passengers. Furthermore, freight tends to be, and it would appear to

increasingly be, more international in its nature than passenger services. This then leads to the necessity for operators to interpret several, sometimes very different, systems of infrastructure charging as they pass through two or more countries.

The diversity of infrastructure charging regimes that exist throughout Europe is, in one sense, a good opportunity to undertake comparative research in this area. That is, Europe provides a real world laboratory, in which the attributes and impacts of one system can be compared and analysed in relation to one or more others. However, it is not only infrastructure charging regimes that differ across different countries; differences in respect of subsidy to the industry, regulation of the industry, market entry and competition serve to cloud the issue somewhat. Hence, there is a rich set of situations to draw on for research purposes, but with this comes a set of varying contexts that need to be controlled for somehow.

Our aim was to develop a better understanding of the ways, in principle and in actuality, in which users react to differentiated charges in the rail sector. At a relatively early stage in the work, it became clear that relatively little quantitative data would be available to us, and so our method naturally turned toward being based on a mix of reviews and case studies, drawn from those Member States that have been most active in the areas of rail charging. In this paper we begin by reviewing the few items of previous research on this topic, before then summarising the outcomes of a round of stakeholder interviews and the results of a set of four case studies. We then give consideration to methodological issues that might affect further research in this area, and close with our conclusions.

## **2. Literature Review**

There is relatively little literature relating to the impacts of charging in the rail sector in terms of rail infrastructure charges. We pick out here three notable studies relating, in one form or another, to rail infrastructure charges.

Firstly, the Leeds Freight Transport (LEFT) model is used for multimodal freight demand modelling in the UK (Johnson, Whiteing and Fowkes, 2007). The model tests a range of individual policies for the UK. In order to form the 'best case strategies' for road and rail, the policies are bundled into two groups to form a Pro-rail strategy and a Pro-road strategy, which are tested against a Do-nothing strategy. The results are explained in terms of the impacts for 2016.

The impacts of the policy of doubling rail track access charges (part of the pro-road strategy) for rail freight operators, on road and rail modes are illustrated in the table below.

Table 1 shows that with the doubling of rail track access charges, rail tonnes fall by 2.03% and even further by 4.71% in tonne kms in comparison to the Do-nothing scenario. The length of haul falls by 2.73% in comparison to the Do-nothing scenario. As expected, the impact on road is in the opposite direction with increases in tonnes and tonne-kms and the length of haul in comparison to the Do-nothing, but the increases are rather modest. Interestingly, introduction of marginal social cost pricing on roads, part of the pro-rail strategy, increases rail-tonne kms by 18% (reducing road by 11%).

Table 1: Impact of Doubling Rail Track Access Charges by Mode for 2016.

<i>Mode</i>		
<b>Rail</b>	Tonnes (millions)	196.9
	Change from do nothing (%)	-2.03
	Tonne kms (billions)	28
	Change from do nothing (%)	-4.71
	Length of Haul	141.9
	Change from do nothing (%)	-2.73
<b>Road</b>	Tonnes (millions)	1935.2
	Change from do nothing (%)	0.14
	Tonne kms (billions)	170.3
	Change from do nothing (%)	0.7
	Length of Haul	87.8
	Change from do nothing (%)	0.56
<b>Total</b>	Tonnes (millions)	2132.1
	Change from do nothing (%)	-0.07
	Tonne kms (billions)	198.3
	Change from do nothing (%)	-0.1
	Length of Haul	92.8
	Change from do nothing (%)	-0.03

Source: adapted from Johnson, Whiteing and Fowkes, 2007.

It must be noted that several other multimodal models do exist for testing transport policies and scenarios, such as the MODEV model in France. But these models usually do not include a specific representation of infrastructure charges. The impact of infrastructure charges can be taken into account only indirectly, generally through the impact it is supposed to have on final rail prices.

Secondly, Preston, Holvad and Raje (2002) contrast infrastructure costs and charges in Britain and Sweden during the late 1990s. Although rail infrastructure costs appear similar on a track km basis in both countries, they highlight that British charges per train km were almost eight times those of Sweden. Table 2 shows the similarities in cost figures (particularly in terms of cost per track mile) and Table 3 shows the differences in infrastructure charge values. The basis of the charging regimes in Britain and Sweden are different. With charges in Britain being set on the basis of full cost recovery and charges in Sweden being based on short-run marginal cost.

Table 2: Comparison of Railtrack and Banverket's Infrastructure Wear and Tear Costs – 1998.

	<i>Infrastructure Wear and Tear Cost £m</i>	<i>Cost per Route Mile (£)</i>	<i>Cost per Track Mile (£)</i>	<i>Cost per Train Mile (£)</i>	<i>Cost per Traffic Unit (£)</i>
<b>Railtrack</b>	2290	217000	108000	7.95	0.051
<b>Banverket</b>	874	129000	113000	6.71	0.033

Source: Preston, Holvad and Raje, 2002.

Table 3: Swedish and British Rail Infrastructure Charges Compared (1999/2000 prices £ per train km).

<i>Sweden</i>	<i>1990</i>	<i>0.882</i>	<i>Great Britain</i>	<i>1994/5</i>	<i>6.032</i>
	<i>2000</i>	<i>0.646</i>		<i>1999/2000</i>	<i>5.039</i>

Sources: Nash, 1997, Prognos, A.G., 2000.

Assumes increases in RPI 1990/91 to 1999/2000 are 27.8% (<http://www.netaccountants.com/rpi.html>).

Assumes that €1=£0.646 Oct 1999 (<http://www.ecb.int/pub/pdf/mb199912en.pdf>).

Preston et al (2002) noted that on track competition in the passenger rail market is currently limited, but postulated that were such competition to be permitted on a wider scale, the extent would be influenced by the level of track access charges. To explore this, they used a simulation model - PRAISE - to assess the impact of on-track competition in both Britain and Sweden.

They found that, for a main line intercity route in Britain, competition would be largely of a cream skimming nature, with the new entrant concentrating its services during the peak periods of the day. Evaluation of this competition found that, although it was profitable for the new entrant, it would not improve welfare overall. Furthermore, head on and fares competition did not appear to be profitable where infrastructure charges are based on full cost recovery, with the possible exceptions of some route and product competition. By contrast, for Route S1 in Sweden, it was found that on-track competition would lead to large service increases and significant fare reductions, and that this would represent a welfare improvement on the current situation; however, it would force a parallel route, currently commercial, into requiring subsidy. They went on to observe that, in Sweden, a greater proportion of the passenger rail network can be operated commercially because infrastructure charges are much lower than in Great Britain. Hence, there is greater scope for commercial on-track competition in Sweden than in Britain.

Table 4: Estimated Impact of an Increase in Track Access Charges on Rail Freight Traffic (tonnage in 2014).

<b>Commodity</b>	<b>Growth by 2014 (%)</b>	<b>Impact of a track access charge increase (%)</b>	
		<b>+20%</b>	<b>+50%</b>
<b>Maritime Containers</b>	50	-6.4	-15.2
<b>ESI coal</b>	-9	-0.4	-1.1
<b>Other coal</b>	0	-0.7	-1.6
<b>Metals</b>	12	-1.9	-6.3
<b>Iron Ore</b>	-5	0	0
<b>Construction</b>	46	-10.5	-17.7
<b>Automotive</b>	100	-3.2	-8.5
<b>Petroleum and chemicals</b>	4	-1.8	-5.9
<b>Waste</b>	15	-0.1	-0.2
<b>Domestic intermodal</b>	215	-5.4	-13.5
<b>Spent nuclear fuel</b>	0	0	0
<b>Mail/premium logistics</b>	n/a	-2.3	-5.8
<b>Channel Tunnel</b>	261	-2.1	-5
<b>Total</b>	20	-3.9	-7.9

Source: ORR 2006, page 6 (i.e. table above)

Finally, the British Office of Rail Regulation (ORR) commissioned MDS Transmodal to assess the impact of an increase in track access charges on freight traffic (ORR, 2006). This work formed part of their work to review British charges, and was designed to investigate the impacts of including a mark-up on infrastructure charges for freight so as to recover the costs of freight-only lines. MDS used the GB Freight model along with models for intermodal and coal traffic, and their results are summarised in Table 4.

### **3. Stakeholder Interviews**

A next step in our methodology involved a round of 25 interviews with industry stakeholders, undertaken in early 2007. Rail infrastructure managers, regulators and train operators (both passenger and freight) from six countries – Austria, Britain, France, Germany, Italy and Sweden – were interviewed using a common semi-structured interview framework. Full details of the interviews are reported in Matthews et al (2007); here we provide a summary of the key findings to emerge.

One early finding was that, whilst infrastructure charges are a potential influence on train operator behaviour, other cost elements for train operators (staffing costs, train operating costs etc) and demand elements (demand reactivity to price levels, to quality of service, willingness to pay, etc) would also be expected to be important influences on the market. Furthermore, the rail market is also likely to be affected by a host of contextual factors, including the competitive and regulatory framework (monopoly or oligopoly, type of regulation) and levels of car ownership and economic growth.

Secondly, whilst we were able to gather information about infrastructure charge categories and levels for the selected case study countries, we very often encountered a lack of even the basic information about precise infrastructure charge quantities (i.e. train-paths, or train-km) bought for each category. Many of the other elements are viewed by train operators as being commercially sensitive; even the price levels are often not precisely observable, due to yield management techniques introduced in preparation for competition in the rail market.

Hence, it was concluded that a systematic analysis of the impact of infrastructure charge differentiation seems an extremely difficult prospect at this point. Disentangling the impact of charges from the impacts of all of the other significant influences on the rail market, amidst a diversity of charging regimes and contexts, with a limited supply of detailed data, would appear to be highly problematic.

The rail market is comprised of many different sub-markets, and there are potentially different scales of impacts in different sub-markets. In actuality, it appears to be the case that, in many situations, operators have relatively limited scope to adapt their supply policy and their tariffs in response to infrastructure charges. For instance, where services are franchised, e.g. as is the case with regional passenger services in Germany or France, and with nearly all passenger services in Britain, services are quite closely defined by the terms of those franchises. Hence, there is limited scope for operator response to infrastructure charges during the life of the franchise. However, charges may serve to influence the terms of franchises, either through franchising authorities examining the implications of the charges for the services they wish to specify or through the terms of the franchise bids submitted by competing operators. This

mechanism for response, being contained within the planning process, is very difficult indeed to tap into.

In some situations, there may be no reaction at all on the part of train operators, due to mechanisms of compensation being in place. For instance, again where services are franchised it is common (and reasonable) for the terms of that franchise to require operators to be compensated by the franchising authority for any changes in infrastructure charges during the course of the franchise. Again, it may be possible to tap into the impacts as they relate to the franchising authority, but this would again be expected to be problematic.

Nevertheless, whilst reactions may be difficult to analyse and, in certain situations, relatively limited in scale, our interviews did uncover which sorts of parameters have been affected. Main reactions observed were in relation to:

- Design and choice of rolling stock;
- Suppression of unnecessary path reservations when reservation charges were introduced in France.

There was some interesting discussion of the share of train operating costs comprised of infrastructure charge-payments, and we have come to the view that the scale and form of reaction to infrastructure charges is likely to depend crucially on these cost shares. The cost shares for the use of infrastructure vary markedly across the interviewees in different countries. In general, the share of infrastructure charge costs as a proportion of train operating costs was reported to range between 10% and 30%. However, in Sweden the cost share was estimated at approximately 5%, whilst in Germany some operators estimated it to be as high as 60%.

Almost all participants indicated elasticities greater than one. There are reasons to doubt whether elasticity in all cases is greater than one, since the interviewed persons represent at the same time the interests of their industry, and therefore it is natural that interviewed persons in such cases tend to exaggerate.

Interestingly, on a number of occasions, operators reported that current degrees of differentiation were actually insufficient to elicit a reaction. For example, participants in Austria and Germany expressed the view that charge differentiation for highly utilized lines seems, due to the higher operating costs of the lower charged tracks, to miss its goals. Apparently there would be more recognizable effects if there was a higher degree of differentiation. Furthermore, many operators reported that they would be ready to accept higher charges in exchange for better quality of service.

In all of our sets of interviews, freight operators indicated a greater degree of sensitivity to infrastructure charges than did passenger operators. In general rail freight tends to be privately operated, is confronted with severe competition from the road, has experienced more open access competition and receives less government financial support, than do passenger services, and together these factors may explain this apparent greater degree of sensitivity. In Britain, for example, there has been significant growth in the rail freight market since infrastructure charges for freight operators were revised – incorporating a marked reduction in their level – in 2001. The extent to which this growth is as a result of this revision is, however, not clear as other changes in the market have occurred simultaneously; nevertheless, it potentially offers an interesting line of further enquiry.

An initial hypothesis was that one of the impacts of differentiated infrastructure charges would be on prices charged to end-users – passengers and freight forwarders. In some cases, e.g. where services are franchised and infrastructure charges change during the course of the franchise, it seems clear that any such impact on prices to end-users is minimal or non-existent. Beyond this, it would seem that there would be some impact, but that this impact would be heavily influenced by the degree of external competition – be that from other rail operators or from other transport modes - in the end-user market. In general, the greater the degree of external competition the smaller the likely impact of infrastructure charges on prices to end-users. Indeed, the level of external competition often appears to be more important in determining end-user prices than infrastructure charges.

Finally, it became clear that the data situation with respect to user reactions to differentiation of track access charges in rail is very problematic. Certainly, the charges themselves are public (although in freight some are the subject of private contracts) but the necessary data to analyse the reactions of the train operators with respect to output quantity (e.g. train kilometres), prices, costs and adjustment of production processes (choice of path or of type of rolling stock etc.) are extremely unsatisfactory or none existent.

#### **4. Case studies**

Having found that freight operators indicated a greater degree of sensitivity to infrastructure charges than did passenger operators, we concentrated much of our subsequent attention on the freight market. As referred to above, rail freight tends to be privately operated, is confronted with severe competition from the road, has experienced more open access competition and receives less government financial support, than do passenger services, and together these factors may explain this apparent greater degree of sensitivity.

We undertook four case studies focused on rail freight. Three case studies analysed changes in the rail freight market in order to make informed observations regarding potential linkages between changes in the infrastructure charging regimes and changes in rail freight traffic; one focused on Britain, one on France and the third on Eurotunnel. The fourth case study undertook aggregate modelling, applying the LEFT model to the British rail freight market, to test a number of charging scenarios for their impacts. Additional case studies, focused on passenger services, were also undertaken, details of which are reported in Matthews et al (2008).

##### *4.1. Observations of Reactions in the British Freight Market*

Up to the point of British rail privatisation which commenced in 1993, the demand for rail freight had been on a 40-year downward trend. However, having reached a low-point in 1995, demand has grown over the subsequent 10 years for which we have data. There has been an increase in rail freight over the last ten years from 15 billion tkm moved in 1996 to 22 billion tkm in 2006. In terms of the total growth in freight across all four modes illustrated, there has been an increase of 189% from 1953 to 2005.

Privatisation established a series of privately-owned open access rail freight operators, required to pay Track Access Charges to the infrastructure manager for the use of the network. During this period there have been 2 sets of infrastructure charges in place for freight operators. The first framework of charges for freight train operators was put in place in 1995. This framework remained in place until 2001, when the first Periodic Review of Track Access Charges recommended substantial changes be made.

The first charging framework, introduced in 1995, was a negotiated two-part tariff, based on the value to each user of using the infrastructure, subject to the constraints of covering avoidable costs and avoiding discrimination between operators competing in the same sector. A charge ‘floor’ and a charge ‘ceiling’ were established. The floor was based on the avoidable costs, whilst the ceiling was based on standalone costs, I.E. those costs that ‘... would be incurred by a notionally efficient competitor providing a dedicated network for the service(s) in question.’ (ORR, 1997, cited in Stittle, 2004). In fact, the two-part tariff comprised a large fixed component and a relatively small variable component. The average track access charge under that framework payable by freight operators was estimated as being approximately £6.23 per thousand gross tonne miles (kgtm), whilst Railtrack's freight-specific costs were of £5.53 (CFIT, 2001).

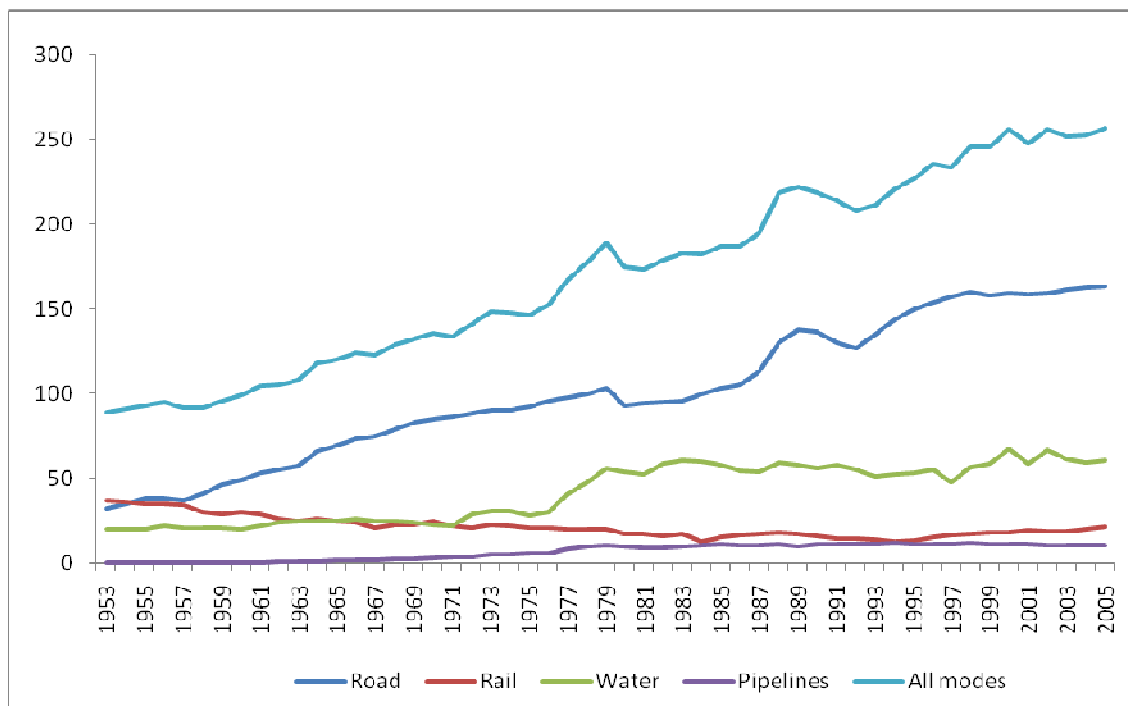


Figure 1: Domestic Freight Transport Moved (Billion Tkm) by Mode 1953-2005.

Source: Transport Statistics Great Britain 2007.

By 2001, gross tonne mileage had increased by more than 35% and additional growth was anticipated. Indeed, the government had set out an ambitious strategy for increasing demand for rail freight, with a target of achieving 80% growth over the period 1998/99-2010 and, with this in mind, a number of new operators were considering entering the market. Concurrently, rail freight was thought to be facing increased competitive pressures from road and other modes. For example, decisions to allow the operation of 44 tonne lorries and to stabilise vehicle/fuel duty were considered to be giving road haulage a significant competitive advantage. Furthermore, the periodic review of access

charges for franchised passenger train services had the effect of changing the balance of incentives between rail passenger and freight services on the network.

These changes in rail freight market conditions led the Regulator to conclude that it was appropriate to undertake a review of the freight charges. Crucially, a better understanding of cost causation had developed, meaning that there was a stronger body of evidence on which to base a new set of charges.

Prior to the outcome of the Periodic Review of Track Access Charges in 2001, an independent government advisory body, the Commission for Integrated Transport (CFIT) established a Rail Freight Working Group to consider track access charges. CFIT believed that rail infrastructure charges for freight services were “a significant factor for the further expansion of the domestic freight market”. In particular, their view was that the high costs of track access were serving to hold back rail freight operators from diversifying into non-bulk traffic. They commissioned research to analyse how rail freight operators could set about achieving the Government’s target of growing the rail freight market by 80% by 2010, with particular attention given to the influence of the amount paid for track access.

This work identified infrastructure charges as one of seven key issues associated with growing the rail freight market and estimated the level of track access charges which would need to apply, under various scenarios, to deliver the Government's 80% growth target. Under a central scenario, which assumed relatively small improvements in rail service efficiency, and continued decline in road haulage journey times (and efficiency), they estimated that an average track access charge of £3.50 per kgtm would deliver approximately 80% growth by 2010. This implied almost a halving of the then average track access charge. Under a "worst case" scenario, assuming no improvement in rail service efficiency or journey times over road haulage, they estimated that an average track access charge of £1.50 per kgtm would be required to deliver the same volume of growth by 2010.

The outcome of the 2001 Periodic Review represented a fundamental shift away from a negotiation-based approach to a published set of charges, the stated aim of which was to reflect the variable costs to the infrastructure manager of freight operations. The intention was that this would reduce transaction costs, improve operators’ ability to plan their businesses and create a more level playing field for new and potential freight operators.

A fundamental change involved the Regulator no longer requiring that freight operators be expected to pay either fixed freight costs or the infrastructure manager’s costs which are common between freight and passenger operations for use of the existing network. The charges comprised three components:

- Usage charges – designed to reflect infrastructure wear and tear costs directly attributable to particular services;
- Traction electricity charges – designed to relate directly to the amount of electricity consumed by any particular vehicle; and
- Capacity charges – designed to broadly reflect the congestion costs associated with increases in capacity utilization.

The effect of these changes was that, on average, the charges that freight operators paid to the infrastructure manager were halved. The resulting shortfall in revenue to the infrastructure manager from freight operations, which was estimated as being £500

million over a 5 year period, was to be funded by the government (via the Strategic Rail Authority). In addition, performance regime arrangements were put in place to provide both freight operators and the infrastructure manager with an incentive to reduce the delay which they impose on users of the network.

Interestingly, the outcome of the Periodic Review was very close to the charges associated with the 'central scenario' examined in the work for CFIT. It is, therefore, revealing to examine the growth in the demand for rail freight and how that compares with that projected in the CFIT work.

The trends in commodities moved by rail over 1998-99 to 2006-07 are illustrated in Table 5. It shows that, across all commodities, there has been a growth of 28%. Within this, it is notable that coal traffic has almost doubled and construction traffic has increased by a significant 29%.

Table 5: National Railways Freight - Freight Moved by Commodity 1998-99 to 2006-07 (Billion Tonne-Kilometres).

	<b>1998-99</b>	<b>1999-00</b>	<b>2000-01</b>	<b>2001-02</b>	<b>2002-03</b>	<b>2003-04</b>	<b>2004-05</b>	<b>2005-06</b>	<b>2006-07</b>
Coal	4.5	4.8	4.8	6.2	5.7	5.8	6.7	8.3	8.8
Metals	2.1	2.2	2.1	2.4	2.7	2.4	2.6	2.2	2.1
Construction	2.1	2.0	2.4	2.8	2.5	2.7	2.9	2.9	2.7
Oil and petroleum	1.6	1.5	1.4	1.2	1.2	1.2	1.2	1.2	1.5
Other traffic	7.1	7.6	7.4	6.7	6.6	6.8	7.0	7.1	7.0
All traffic	17.3	18.2	18.1	19.4	18.5	18.9	20.4	21.7	22.1

Source: Transport Statistics Great Britain 2007.

Table 6 illustrates the trends in rail freight lifted for coal, other traffic excluding coal, and of all traffic over the period 1998-99 to 2006-07. It shows a decline over the first part of the period, followed by an increase, resulting in an overall growth over the period of 6%. Linking this to the numbers presented in Table 5, this indicates that rail freight growth has been associated more with an increase in the distance freight is moved than the actual quantity of freight being moved. In terms of coal, despite the increase in tkm in 1998-99 to 2000-01, there has been a decline in tonnes lifted. Despite the 29% increase in coal tkm in 2001-02, tonnes lifted only rose by 12% in that same year. In the years that followed, changes in coal tkm were also characterised with changes in tonnes lifted in the same direction. However as coal tkm rose from 8.3 to 8.8 billion from 2005-06 to 2006-07, tonnes lifted decreased slightly from 48.9 to 48.8 million over that same period. In terms of all rail freight traffic lifted over the last decade, the lowest point was in 2002-03 where only 87 million tonnes were lifted.

Table 6: National Railways Freight - Freight Lifted by Commodity 1998-99 to 2006-07 (Million Tonnes).

	<b>1998-99</b>	<b>1999-00</b>	<b>2000-01</b>	<b>2001-02</b>	<b>2002-03</b>	<b>2003-04</b>	<b>2004-05</b>	<b>2005-06</b>	<b>2006-07</b>
Coal	45.3	35.9	35.3	39.5	34.0	35.2	44.0	48.9	48.8
Other traffic	56.8	60.6	60.3	54.5	53.0	53.7	57.1	58.7	59.6
All traffic	102.1	96.5	95.6	93.9	87.0	88.9	101.1	107.6	108.4

Source: Transport Statistics Great Britain 2007

Thus, whilst charges were essentially halved in 2001, growth in rail freight demand is not proceeding in line with the 80% government target (as the CFIT projections estimated that it would). Having grown by an impressive 4.8 billion tonne-kilometres between 1998-99 and 2006-07, it would have to grow by a further 9 billion tonne-kilometres over the next 3 years in order to achieve this target. This then begs the question of how the assumptions of the CFIT 'Central scenario' compare with what has actually occurred since 2001. Certainly a number of unforeseen events have taken place over the period, including the closure of a major steel works (reducing demand for both coal and steel traffic), the switching of postal services from rail to road and the essential break down of the Strategic Rail Authority's freight strategy. However, it is tempting to conclude that perhaps the CFIT work over-stated the importance of the role of infrastructure charges in stimulating rail freight demand.

Nevertheless, there has been considerable growth in rail freight over recent years and infrastructure charges are likely to be partly responsible for this. Indeed, commentators have tended to site six factors as explaining the growth since 1995, as follows:

- Increased road congestion;
- Increased costs for road freight arising out of the fuel duty escalator and, more recently, the Working Time directive;
- An increase in coal imports;
- Improved quality of service for rail freight;
- Investment in rail freight facilities;
- Infrastructure charge changes.

In terms of the types of commodities transported, there has been strong growth in some sectors. This has been most notable in relation to coal, which rail is inherently better-suited to carrying. The movement of coal and coke currently dominates rail freight, and 87% of coal and coke were carried by rail in 2006 (MDS GB Freight report 2006). However, it is thought that, for coal, transport accounts for only approximately 5% of the price of delivered coal, so the market is thought to be relatively insensitive to changes in the costs of transport. Hence, the actual growth in coal tonnes lifted was probably not related to the regime of infrastructure charges, but more concerned with changes in the detail of the power-generation market. The charge reductions may have enabled length of haul for coal and other traffic to increase at relatively little expense. Length of haul for coal traffic, for example, increased by 15% between 2001-02 and 2006-07. However, on inspection, this seems to simply be the continuation of a trend that commenced prior to 2001. The average length of haul was 120kms in 1980 and had risen to 206kms by 2004 (MDS GB Freight report 2006).

There has also been quite strong growth in construction traffic. In contrast to coal, the construction market is thought to be very price sensitive, with transport accounting for as much as 50% of the price of delivered materials. Hence, it is likely that charge reductions would stimulate growth in construction traffic. However, construction traffic since 2001 has fallen, then risen and, most recently, fallen again to a point slightly lower than that in 2001. It must be concluded that if charges are having an impact on this market, some other factor is clearly having an offsetting impact.

Rail freight growth actually started in 1995, and we do not observe a major change in the trend around the time of the reductions in infrastructure charges introduced in 2001. Prior to 2001, the structure of charges was such that there was a large fixed charge

which, once paid, provided an incentive to operate as much as possible. Post 2001 the structure no longer provided this incentive but it did allow for increased competitiveness, but the level was such that it enabled the rail freight market to remain buoyant. It is thought that, initially, charge-reductions were only passed on to clients in a limited way – so part of the reduction was enjoyed by the operators as windfall gains. Then, once contracts with clients were renegotiated, the reduction in charges were past on as reductions in charges to clients. Furthermore, differentiation by vehicle-type is thought to have focused the industry on track-friendly bogies.

As the rail freight industry has become more competitive and cost-conscious, it is rational that operators will pay more attention to what they are being charged for access to the infrastructure. It is suggested that this will have alerted operators to possible arguments for reduction of charges. Such arguments may have an effect on the overall charge level, as the rail freight industry has a strong incentive to make robust representations to the charge-setting authorities. They might also relate to incentives for operators to reduce impact of rail freight on the network, e.g. by operating less-damaging rolling stock, by requiring fewer slots to operate a particular service etc.

#### *4.2. Observations of Reactions in the French Freight Market*

Infrastructure charges in France were first implemented in 1997, at which time the French infrastructure manager, Réseau Ferré de France (RFF), had just been set up. The network was divided into track categories and the charging components were established as follows:

- DA - a fixed access right;
- DR - a path reservation fee;
- DC - a charge for train circulation; and
- Additional charges, such as for the use of electrical supply equipment and access to marshalling yards.

RFF was not then able to make a precise bill to SNCF, the only rail operator on the French network up to 2005, so the charging regime comprised a global package based on traffic, up to 2002. Hence, no freight or passenger trains had any marginal infrastructure charge to pay until 2002. Therefore, whereas the evolution of the total charges paid may be observed from 1997, the evolutions of unit price levels have to be made on the basis of 2002 or later years.

There have been several changes to charging structure and levels over the period. The level of charges was increased extensively in 1999, but this increase was chiefly focused on passenger traffic, with only a 2% increase in freight charges. Freight traffic decreased slightly (-1%) in 1999, then increased by 6% in 2000 before decreasing again in 2001 by some 9%.

From 2002 on, the structure of charges is stable and gives marginal charge levels' signals to the operator(s). Yearly arrêtés from the Ministry of Transport set the charging regime for one year and, generally, charge levels are known at least one year in advance. Given this level of pre-announcement, we assume that demand can adapt more or less to these evolutions with no important delay, allowing us to compare directly yearly traffic and tariffs. Additional charges such as those applying for the use of marshalling yards are not covered by these arrêtés.

The arrêté setting the 2002 charging regime defined the track categories, as set out in Table 7.

Table 7: RFF Track Categories.

<b>Track category</b>	<b>Subclasses</b>	<b>Length</b>	<b>Designation</b>
Urban and suburban lines	High level of traffic	287 km	A
	Medium level of traffic	985 km	B
Main interurban lines	High level of traffic	7,209 km	C
	High level of traffic and max. speed 220 km/h		C*
	Medium level of traffic	5,840 km	D
	Medium level of traffic and max. speed 220 km/h		D*
Other lines		12,738 km	E
High-speed lines	High level of traffic	718 km	N1
	Medium level of traffic	457 km	N2
	Mediterranean HSL, medium level of traffic		N2*
	Low level of traffic	321 km	N3
	Mediterranean HSL, low level of traffic		N3*
	East-European line	300	N4

Note: the length per track category actually changes slightly from year to year.

Key aspects of the charging regime introduced in 2002 are as follows:

- DA is zero for D and E track categories. It is 365.88 €/path-km used per month for A & B, and 3.05 € for C track category.
- DR is composed of a reservation fee (DRS) and a 0.6 coefficient (coefficient K) for freight trains (this means that freight trains get a 40% rebate on path reservation fee in return for lower quality paths – quality of passenger trains being consistently favoured). The levels of this charging component are set out in Table 8.

Table 8: DRS Tariffs for Conventional Track Categories in 2002 (€/Path-Km).

	<b>A</b>	<b>B</b>	<b>C</b>	<b>D &amp; E</b>
Off-peak hours	1.52	0.61	0	0
Normal hours	4.88	1.22	0.8	0
Peak hours	14.3	2.44	0.8	0

DC is set lower for freight trains than for passenger trains (0.23 €/train-km vs. 0.79), whilst a fee for power transport (RCTE) is created. Like the use of electrical supply equipment (RCE) and the use of marshalling yards, etc., it is an optional service. Rail freight traffic remained stable.

In 2003 DA was increased slightly for track categories A and B, but a coefficient M was created for differentiating this access fee, for A, B and N track categories, varying with the number of reserved paths and the duration of the agreement for those paths, as set out in Table 9. Total DA paid decreased (86 M euros i.e. 4.7% of total charges vs. 95 M euros and 5.2% in 2002).

Table 9: M Coefficient for Access Fee DA.

<b>Coefficient M</b>	<b>Number of booked paths in A, B, N</b>			
Per category	1-10	11-100	101-1000	>1000
Purchase agreement < 5 years	0.03	0.225	1.5	1.5
Purchase agreement > 5 years	0.02	0.15	1	1

Furthermore, coefficient K was divided into 2 categories: K=1 for train paths > 300 km with an average speed > 70 km/h (meaning no rebate for these “rapid” trains, that correspond roughly to “high value” freight such as containerised traffic), and K=0.6 for all other freight trains. In addition, all DRS and DC tariffs increase by 2 %.

Freight traffic decreased by 6.4%, but it is understood that this was mainly due to a long strike during the spring. SNCF freight branch’s losses reached 450 M€. A 3-year restructuring plan, the Plan Fret 2006, is implemented. It aims at focussing on heavy-haul, profitable services, and defines a new strategy based on customer approach and a better quality of service. SNCF forecast that they would obtain financial balance in 2006 and expected the traffic to decrease under 35 billion tkm.

Then in 2004, DA’s structure was modified by an arrêté, in readiness for the imminent arrival of new rail operators. For each path, DA became the product of the length of each network section used and a fee per path km. This new structure applied from 2006 on. Also, DRS of less expensive categories increased slightly. Zero terms were suppressed except for E off-peak hour category, but their level was still low (D= 0.01 to 0.05 €/path-km and E= 0,005 €/path-km). On the contrary, the increase was important for C category: + 60 % in normal hours (0.13 €/path-km), and multiplied by 15 in peak hours – still, the level remains quite low (1.25 €/path-km). A and B remain quite stable. In addition, DC freight increases by 3 %.

Freight traffic remained more or less stable (increased by 1 % in tonnes but decreased 1% in tkm). The Plan Fret seemed to achieve its 2004 target results, but traffic doesn’t fall under 40 billion tkm. The marshalling yards/ freight courtyards system was revised. Quality of service and productivity indicators showed a little improvement despite the increase of energy costs and important reorganisations in the industry. Some shippers report that SNCF’s freight tariffs doubled, or even were multiplied fourfold without prior consultation. All these evolutions of SNCF’s services and prices have in 2005 an overwhelming impact compared to the marginal impact of infrastructure charge evolution.

In 2005, conventional track categories (A to E) are not much affected by 2005 DRS rises, except for C which DRS gets almost quadrupled (x 3,7) for off-peak hours and tripled for normal hours (0.38 €/path-km for both tariffs). DC freight increases slightly but remains about 1/3 of DC passenger.

Freight traffic decreased by 12%, but it is understood that this was largely due to Plan Fret’s rationalisation. After a long controversy, the European Commission approved the 800 M€ State aid for SNCF freight branch reorganization.

The modifications of DA structure’s that were introduced in 2006 means that it is not possible to define its change in level from previous years. Although DA’s share in total charges is very small (around 4%), this modification was necessary in order to allow the development of new entrants’ traffic in a non-discriminative way –the package term would obviously have favoured SNCF. DA for conventional track categories was 0.015 €/ path-km, except for D and E, which were zero. In addition, DRS increased by 4 % in

B off-peak hours (0.65 €/path-km). C off-peak and normal hour tariffs were aligned on this tariff (+70 %). Furthermore, DC freight increased by 15 %.

Freight traffic remained stable. However, Plan Fret's objectives, even after downward revision, were not achieved, and the freight branch ended the year with 260 M€ losses. Shippers pointed out a downfall in quality –especially punctuality on the second half of the year. CNC, the main rail-road container operator owned by SNCF, was restructured and focused its activity on maritime containers, abandoning most other market segments.

In 2007 DRS' main increase was concentrated on A off-peak hours (19 %) and C peak hours (20 %). In addition, DC Freight increased by 33 % (0.4 €/train-km). The freight branch launched a second reorganization plan in the August, focussing on single wagon traffic. This traffic is to be handled through 3 main "hubs" –Villeneuve-saint-Georges (Paris), Sibelin (Lyons), Woippy (Metz)- and 31 regional yards, 262 courtyards (mainly located in Centre and Poitou-Charentes regions) being closed to single wagon traffic. Since this new organization was to be implemented within only 3-months following the announcement, shippers were forced to use emergency alternatives and local governments were alarmed. Strangely enough, the announcement was made while the Government organised the great debates of "Grenelle de l'Environnement", that planned for non-road transport modes a +25% market share increase. Besides this, the strikes following the special working regimes reform in France, that highly concerned SNCF's workers, brought on an estimated 80 M€ loss to freight branch. Recently, since high deficits continued and quality objectives were only partially met, SNCF issued another restructuring plan, including 1 billion Euros investment and a reorganization of its freight activities.

Thus, there have been a number of modifications to infrastructure charges in France over the past decade, as well as some industrial upheaval arising out of reorganisation and new competition. Identifying clear and distinct impacts of these factors on the demand for rail freight would always be difficult, but the lack of data from the two main sources, SNCF and RFF, has been a major problem. Had it been possible to get the figures of quantities bought by rail operators for each type of tariff, we could have realistically sought to extract some kind of statistical link between tariffs and quantities bought. However, as it is, all that is possible is to draw some broad indications.

In drawing any conclusions, we should recall that low-value freight traffic cannot bear high prices and is not very sensitive to transit time; therefore it is more likely to use low quality paths and thus less expensive track categories, especially D and E. Still, two of the three main marshalling yards -Villeneuve-Saint-Georges (Paris) and Sibelin (Lyons) - are located on category A sections, so that a notable part of freight traffic cannot avoid running on the most expensive track category. Except for a few postal TGVs, freight trains cannot run on high-speed (N) lines, even though this issue is under study for future high speed lines. Freight trains are also more likely to use off-peak paths during the night.

As a whole, the increase of infrastructure charges for freight is important (see Table 10) but less apparent than for passenger traffic. RFF's global revenue for freight showed a 5 % increase from 1997 to 2004 with a 29% decrease in traffic (in tkm). The most important evolutions are those of track category C, coefficient K applied to reservation fee DRS, and circulation fee DC. The access fee DA decreased and remained stable at a low level since its new 2006 variable structure for all conventional (non-N) categories.

DRS increased mainly for track category C: A increased by 11% from 2002 to 2009, B increased by 28 % and C was multiplied by 15. D and E tracks began to pay a reservation fee in 2004. E tracks remained stable up to 2009 and D increased by 3%. DRS increased mainly in 2005, for C tracks only.

Peak hour tariff remained around 1.9 times the normal hours tariff from 2002 to 2009. But off-peak hour's coefficient increased from 0.27 to 0.42 during the same period, concerning more specifically freight trains. Indeed, the level of time differentiation has decreased during this period.

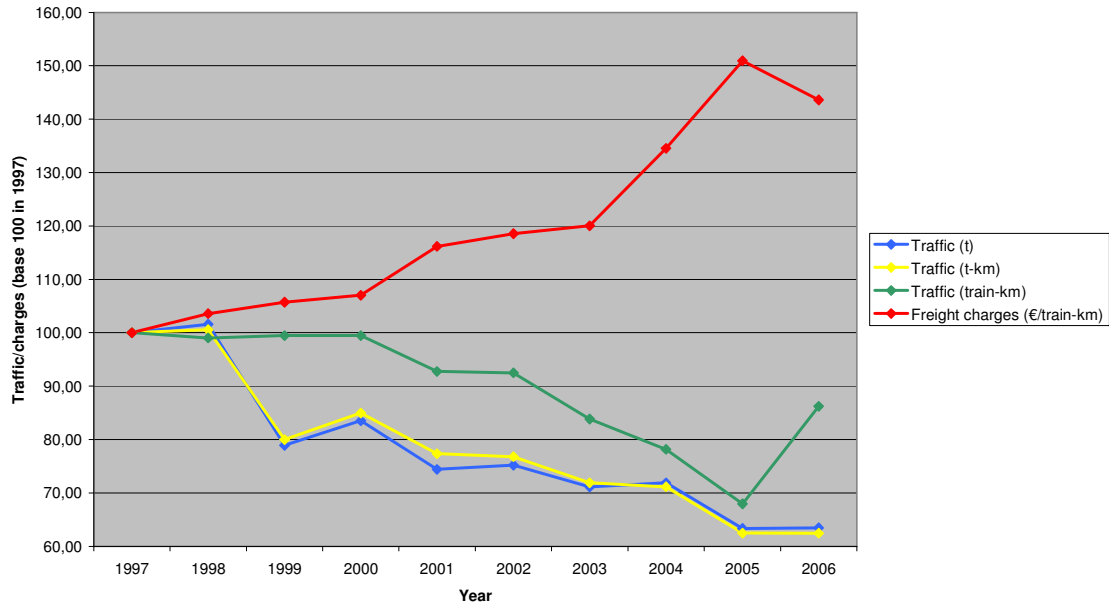


Figure 2: Freight Infrastructure Charges and Traffic Indicators from 1997 to 2006 (Base: 100).

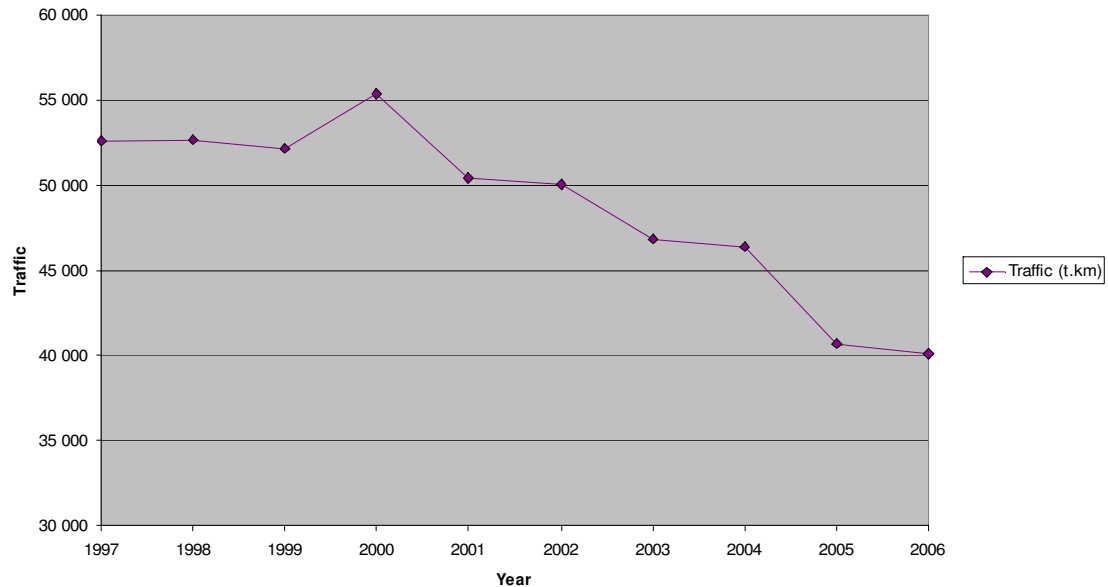


Figure 3: Freight Traffic (Mt-km) from 1997 to 2006.

Coefficient K has been modified in order to introduce a willingness to pay criterion, introducing a differentiation between “rapid” (high value) freight traffic and other

freight. DC for freight doubled between 2002 and 2009. While freight infrastructure charges went up as described, freight traffic went on a downward trend from the end of the 1990's (see Figure 2, Figure 3 and Table 10). These evolutions may seem, at first sight, to be closely related.

Table 10: Charges per Freight Train-Km from 1997 to 2005.

	<b>Total Freight Charges (M€)</b>	<b>Freight Traffic (M train-km)</b>	<b>Charges per train-km (€)</b>
1997	155	155,6	1,00
1998	159	154,1	1,03
1999	163	154,8	1,05
2000	165	154,7	1,07
2001	167	144,3	1,16
2002	170	143,9	1,18
2003	156	130,4	1,20
2004	163	121,6	1,34
2005	159	105,7	1,50

Nevertheless, the linkage between charges and traffic remains unclear and probably low; it would be certainly misleading to see tariff evolution as the main reason for freight traffic decreases; expert views and interviews of operators tend to think that the impact of tariffs is rather low. First, the main effect of tariff evolution, that occurred when reservation fees were effectively implemented, was the suppression of “facultative” paths that were unused, thus this effect does not appear in traffic figures. Second, even though it increased globally, the charge level still represents a low share in operators' costs, especially for SNCF (around 8%), whereas the evolution of traffic showed important shocks that seem to be much more related to the changes in SNCF's freight strategy. Indeed, reorganization plans, railway strikes, the liberalization of fret services and economic globalisation have extensively confused the price signal and impacted the traffic at a much higher degree than could do the relatively small signal of infrastructure charge.

However, set now at higher levels, and in a more stable environment, infrastructure charges may play a stronger role in the future. At least, the steady increases, observed also in 2009 tariffs, may have an impact on operator's purchase strategy –choice of day period, train speed, routes. Unfortunately, we couldn't have any access to wagon loading rates, or to the relative use of off-peak periods, or to the distribution of train speed.

RFF considers that freight operators have enough willingness to pay for long-haul, high-speed traffic, which is generally the most profitable. Nevertheless, French operators are doubtful about RFF's ability to improve the quality of its freight path offer. Discussions have been led on 2010-2015 infrastructure charges tariffs; this resulted in new increases, so as to obtain a better cost coverage ratio for RFF in exchange for improved infrastructure quality for freight trains. The problem is that a good deal of freight traffic could simply not pay for the tariff increase and would then disappear. Therefore, a public contribution will, for several years, compensate the operators for the tariff increase. This contribution will, however, decrease progressively and then disappear, since it is expected that operators' productivity gains, obtained both

by their own efforts and by the improvement of RFF's freight paths, will make it possible to progressively increase the tariff effectively paid by the operators.

As a conclusion, it has not been possible to show a precise impact of the increase and differentiation in RFF's freight tariffs. The lack of data from the two main sources, SNCF and RFF, was a major problem. Very important events on the operators' side and on the demand's side had a major effect, and data available was not precise enough to get effects sorted out. Nevertheless, it is highly plausible that RFF tariffs' evolution accompanied the other changes in the same direction, possibly accentuating the decreasing trends in traffic levels.

#### 4.3. Freight through Eurotunnel

Eurotunnel provides an interesting case, as rail freight through the tunnel has performed somewhat disappointingly over a number of years and the charges faced by freight operators have consistently been cited as a potential cause of this poor performance. After 14 years of service, the channel tunnel is far from operating at the level of capacity requested by the reports giving support to the tunnel alternative for a cross-channel fixed link. Having originally had a design capacity of approximately 10 million tonnes, freight traffic grew during the first 3 years of operation to three million tonnes in 1997. However, it then stagnated until 2000, before declining to just over one million tonnes in 2007.

Table 11 and Table 12 draw similar pictures for tunnel freight forecasts: a total traffic of about 30 million tonnes around 1993 and a total market share of about 35% for the tunnel, corresponding to about 10 Mt, with better market shares for rail wagons than for Le Shuttle.

Table 11: Historical Forecast for Freight: Total Cross-Channel vs. Channel Tunnel (Million Tonnes).

<i>Freight forecasts</i>		<i>1969</i>	<i>1971</i>	<i>1980</i>	<i>1985</i>	<i>1990</i>	<i>2000</i>
MoT (1963)	Via tunnel	2,6	2,9	4,0	4,5	-	-
C & L (1973)	Total demand	-	5,7	13,1	-	25,3	-
	Via tunnel	-	-	5,4	-	11,3	-
CTAG (1975)	Total demand	-	5,7	12,9	-	20,2	-
	Via tunnel	-	-	5,3	-	7,8	-
DoT (1982)	Total demand	-	-	15,9	-	27,3	37,2
	Via tunnel	-	-	-	-	8,6	11,1

Source: Chevroulet et al, 2007; Anguera, 2006.

Table 12: CTG-FM Unitised Freight Forecasts –Total Demand & Market Share (Million Tonnes).

	<i>Cross-Channel</i>	<i>Tunnel freight</i>	<i>Market share</i>	<i>Tunnel freight</i>
	<i>1993</i>	<i>1993</i>	<i>1993</i>	<i>2003</i>
Roll-on/roll-off freight	24,2	6,0	25	7,5
Containers and rail wagon	7,9	4,0	52	6,8
Total	32,1	10,0	31	14,3

Source: Chevroulet et al, 2007 ; Anguera, 2006.

However, actual traffic was much different, as shown in Table 13 and Table 14. The total freight tonnage was underestimated by most of the forecasts, and the traffic of

through rail services remains very low compared to forecast and to freight shuttle. Freight shuttle service, in absolute terms, increased quite steadily ahead of what was forecast through to 2007. Nevertheless, forecasts for freight Shuttle's market share appeared to be not far from what occurred.

Table 13: Actual Channel Tunnel Freight Tonnes (Million Tonnes).

	<b>1994</b>	<b>1995</b>	<b>1996</b>	<b>1997</b>	<b>1998</b>	<b>1999</b>	<b>2000</b>	<b>2001</b>	<b>2002</b>	<b>2003</b>
Le Shuttle Freight	0,8	5,1	6,7	3,3	9,2	10,9	14,7	15,6	15,6	16,7
Through rail services	-	1,3	2,4	2,9	3,1	2,9	2,9	2,4	1,5	1,7
Total tunnel freight	0,8	6,4	9,1	6,2	12,3	13,8	17,7	18,8	17,1	18,4

Source: Chevroulet et al., 2007; Anguera, 2006.

Table 14: Actual Channel Tunnel Freight Tonnage (Million Tonnes).

	<b>2004</b>	<b>2005</b>	<b>2006</b>	<b>2007</b>
Le Shuttle Freight	16,6	17	16,9	18,4
Through rail services	1,9	1,6	1,6	1,2
Total tunnel freight	18,5	18,6	18,5	19,6

Table 15: Cross-Channel Unitised Freight 1994-2003 (Million Tonnes).

	<b>1994</b>	<b>1995</b>	<b>1996</b>	<b>1997</b>	<b>1998</b>	<b>1999</b>	<b>2000</b>	<b>2001</b>	<b>2002</b>	<b>2003</b>
Channel tunnel	0,8	6,4	9,1	6,2	12,3	13,8	17,7	18,8	17,1	18,4
Port of Dover	15,1	14,0	13,9	20,8	19,8	21,7	21,0	23,0	24,1	23,2
Total cross-channel	15,9	20,4	23,0	27,1	32,1	35,5	38,7	41,1	41,2	41,6

Source: Chevroulet et al., 2007; Anguera, 2006.

Eurotunnel's only forecast that proved to be more or less correct is the freight Shuttle's market share. This traffic obeys mainly to road logics, for which existing methods, data and tools were more appropriate for doing forecasts. A hypothesis we can make is that by the time forecasts were made, the methods and tools used were built using these road logics, inducing no anticipation of strong competitive reaction (a shipping line is very mobile, unlike roads; prices are not often a competitive tool in the road sector) and modelling the competitive situation as a network composed of minor (high cost) "road links" for the ferries, compared to a new (low cost) motorway for the Tunnel. Another hypothesis is that Eurotunnel had more incentive and tools to reach its forecasts of roll-on roll-off than of through trains. This last point leads us to the issue of infrastructure charges.

The situation of infrastructure charges for using Eurotunnel is a complex one, having involved 3 major components. Prior to the opening of the tunnel, a fifty-year agreement was formed between Eurotunnel and the two then state railways, British Rail and SNCF, that each be allocated half of the tunnel's capacity in return for the payment of infrastructure charges. In addition, the two railways agreed to pay a Minimum Usage Charge each year for using the tunnel, irrespective of how many trains actually used it. Thirdly, the two railways agreed to pay a fixed annual contribution to Eurotunnel's operating costs, amounting to approximately £6.5 m each.

The infrastructure charges were initially levied on a per tonne basis, based on a guide price of £10 per tonne and an overall volume of 10m tonnes. To that was added fixed

charges for Eurotunnel and for essential facilities at either end of the tunnel, each of which should have added another £1 per tonne. In reality though, those fixed charges were divided by the number of trains, and, since there were not many trains, this ended up resulting in very high charges. The per tonne charges were differentiated between bulk and non-bulk traffic, though – apparently somewhat counter-intuitively – the charge for non-bulk was three times that for bulk traffic.

On rail privatisation in Britain, freight operations through the tunnel were sold to EWS, but it was agreed that government retain the responsibility for paying the infrastructure charges, the Minimum Usage Charge and the operating cost contribution through until November 2006. As of 2006, the agreement was that the Minimum Usage Charge would cease and the payment of infrastructure charges and the operating cost contribution would transfer to EWS. Subsequently, EWS have agreed with the government that the operating cost contribution continue to be paid by the government, leaving EWS to pay the remaining infrastructure charges. On the French side, SNCF has, throughout the past 14 years, been responsible for all 3 charging components.

Following the cessation of the Minimum Usage charge and continued decline in rail freight traffic through the tunnel, discussion between the key stakeholders led to another set of revised charges being announced in autumn 2007. This set of charges, set out below, was issued as part of Eurotunnel's strategy for 'relaunching' Open Access cross-Channel rail freight. The charges are focused around a central average charge of 4.5k Euro (£3k) per train, irrespective of train-load. This central charge represents a significant reduction compared to the 2007 average charge of 8k Euro (£5,3k). Furthermore, the charges are differentiated according to speed and time of day. The central charge is based on a train passing through the tunnel at a speed of 120kph during a period of medium traffic density; lower charges are applicable for higher speeds and/or periods of lower traffic density, and vice-versa. Most intermodal/non-bulk traffic tends to travel at 120kph, whilst bulk traffic has tended to travel at slower speeds. At the same time, additional measures have been introduced to provide operators guarantees of equitable and efficient open access to the essential facilities at either end of the tunnel.

These new charges, and the relaunch strategy, appear to be having clear impacts on rail freight traffic. Firstly, EWS report that they have increased the speed of their bulk traffic so as to take advantage of the lower charge for this. This has been somewhat fortuitous, as the change occurred at a time when they happened to have the rolling stock available to enable this. Secondly, EWS have announced the commencement of two regular Channel Tunnel services. Thirdly, though on a more negative note, Freight Europe UK have announced withdrawal of services apparently in response to the new charges. Freight Europe UK have been providing a less than train-load service between continental Europe and the UK which was, whilst charges were on a per-tonne basis, viable. However, with the switch to per-train charges, their payments have increased as they have begun having to pay for empty or part-empty trains. It may be that this is a temporary problem, as they rationalise their service and arrive at a new level of service, although it may also be the case that such a rationalised level of service may no longer be sufficiently attractive to customers and that they find their service having to be rationalised further.

Table 16: Eurotunnel Infrastructure Charges, 2007-08.

<b>Train @ 120 km/h</b>	<b>Reservation fee per train single (£)</b>	<b>Access fee per train single (£)</b>	<b>Equivalent price per train single (based on 52 train single/year) (£)</b>
Off-peak period	270	2430	2700
Intermediate period	300	2700	3000
Peak period	330	2970	3300

<b>Train @ 100 km/h</b>	<b>Reservation fee per train single (£)</b>	<b>Access fee per train single (£)</b>	<b>Equivalent price per train single (based on 52 train single/year) (£)</b>
Off-peak period	300	2700	3000

<b>Maintenance periods</b>	<b>Reservation fee per train single (£)</b>	<b>Access fee per train single (£)</b>	<b>Equivalent price per train single (based on 52 train single/year) (£)</b>
All trains @ 100 km/h	300	2700	3000

Source: Eurotunnel's Network Statement - 2008 Working Timetable.

The main problem of the forecasts, as compared with the actual traffic, seems to rely on the nature of the market Eurotunnel could try to grasp. The reaction of ferries proved to be quite effective at cutting Eurotunnel from a good part of its expected market, among other means by concentrating and reinforcing offers for origin-destination trips remote from the Channel. The decline in competitiveness relative to road transport, as a result of the impact of the fixed costs of frontier infrastructure (including security constraints) proved to be further constraints on channel Tunnel rail freight growth.

Hence, the original charges were devised with no reference to the market, and the monopoly and state aid aspects of the market rendered them irrelevant as signals to the market. Since the removal of state aid, opening up of the market and establishment of the new charging regime, traffic appears, on the whole, to be responding positively, though it is too soon to say whether this is a sustained turn-around.

#### 4.4. Modelling Reactions in the British Rail Freight Market

The effect of changes in rail access charge regimes on rail and road traffic in Britain have been modelled using the Leeds Freight Transport Model (LEFT) (Johnson et al, 2007)). The LEFT model is essentially an aggregate mode split model for road and rail freight traffic in Britain, capable of forecasting changes in traffic for different commodities and modes following changes in transport costs. LEFT was initially constructed in 2002 and has been further developed over subsequent years, the current version being LEFT3. The model has no geography and uses Binary Logit models calibrated to existing data to perform mode split. Market size is determined using elasticities of tkm with respect to Generalised Cost and applying them with the mode

split element stripped out. Disaggregation within LEFT3 is by the following dimensions:

1. The base data is split over 7 commodity groups consistent with the categories provided in the Department for Transport's Continuing Survey of Road Goods Transport (CSRGT) data, reported in Transport Statistics Great Britain (TSGB) (DfT, annual):
  - a. Food, Drink and Agricultural Products;
  - b. Coal, Coke and related items;
  - c. Petroleum and Petroleum Products;
  - d. Metals and Ores;
  - e. Aggregates and Construction;
  - f. Chemicals and Fertilisers;
  - g. Other, including manufactures, miscellaneous, containerised, and international.
2. The base data by commodity is split over 9 distance bands, again consistent with those used by the CSRGT data. These are, 1-25 km, 25-50 km, 50-100 km, 100-150 km, 150-200 km, 200-300 km, 300-400 km, 400-500 km and Over 500 km. We have taken the midpoint of the 500+ distance band to be 550 km.
3. The base total market is split for each commodity and distance band according to whether traffic is favourable for rail operations, referred to as train-friendly (TF), or train-unfriendly (TU). For Bulks, TF traffic is that traffic we deem suitable for trainload movement from origin to destination. For Non-bulks (Food etc, and Miscellaneous), TF traffic is that to which we have assigned the need for collection and delivery (at most) at one end.

There are therefore  $2*7*9 = 126$  cells in LEFT3. Traffic can switch mode or distance band, disappear altogether or new traffic can be generated. Just two modes were modelled - road and rail. The data used was collected from a variety of sources. For road, the primary source has been the Continuing Survey of Road Goods Transport, as reported in TSGB. For rail we have used unpublished data from the Strategic Rail Authority (SRA) with gaps being filled by our own best estimates. Base data relates to the period 1998-2000. All monetary amounts are in 2000 prices. A base for 2010 was obtained by projecting current trends forward.

We were interested in looking at the responsiveness of rail traffic to different access regimes and pricing structures. Our aim was to see if, and to what extent, rail can replace some road traffic given the appropriate incentives. We determined the following six scenarios/policy tests to examine:

- Removing current track access charges- the idea here is to create the best possible scenario for rail freight and see how much growth there could be in these conditions, with the aim of mode shift from road to rail on environmental grounds.
- Halving current track access charges; again here the aim is to stimulate mode shift, whilst still recovering some track access revenues.

- Doubling current track access charges; here we see how rail traffic responds to a doubling of access charges across the board, with the aim of raising revenue from rail access charges.
- Quadrupling current track access charges; as above but a larger increase.
- Introduce a structure of fixed and variable track access charges; punishing short distance rail traffic. This is approximated using distance bands, with doubled access charges for the shortest distance band, tapering down to current charges at the longest distance. The justification for this scenario is to remove some short distance rail traffic, for which rail may be not as well suited and for which there are fewer environmental benefits of mode shift
- A fixed and variable access charge stimulating long distance traffic. This is approximated by using differential charges over distance bands, with double access charges for the shortest distance, tapering down to ½ current charges at the longest distance. The justification here would be to stimulate a switch to rail from road only from that traffic for which rail is most suitable, namely long distance traffic, which will have a good environmental benefit and which is approximately revenue neutral.

Table 17 and Table 18 report the results for the 6 different scenarios compared to the 2010 Do Nothing. It can be seen that, in *Scenario 1 (Zero Access Charges)* Rail tonnes increase by 8.17 million (5.69%) and tkm increase by 2.13 billion (9.24%). Nearly half of the overall increased rail traffic is accounted for by an increase of 0.99 billion tkm in Ores & Metals. There is also a significant increase of 0.57 billion tkm in Others. The largest increases in rail's share of tkm are found in Chemicals (by 31.75%), Ores & Metals (by 21.6%) and Others (12.08%). The smallest absolute increases are in rail's Food, Drink & Agriculture and Petroleum tkm traffic. The smallest increases are in rail's share of tkm of Food, Drink & Agriculture, Petroleum and Coal & Coke.

In *Scenario 2 (Halved Access Charges)* Rail tonnes increase by 3.95 million (2.75%) and tkm by 1.02 billion (4.43%). The magnitude of the effect of this scenario is approximately a half that of scenario 1, which is as expected. The increase of 0.48 billion tkm in Ores & Metals accounts for nearly half of the overall increased rail traffic. There is also a significant increase in Others and Construction traffic. The largest increases in rail's share of tkm are found in Chemicals (by 15.36%), Ores & Metals (by 10.60%) and Others (5.85%). The smallest absolute increases are in rails' Food, Drink & Agriculture, Petroleum, Coal & Coke and Chemicals tkm traffic. The smallest increases are in rail's tkm share of Food, Drink & Agriculture, Petroleum and Coal & Coke.

In *Scenario 3 (Doubled Access Charges)*, Rail tonnes decrease by 7.16 million (4.99%) and tkm by 1.75 billion (7.59%) overall. The drop of 0.83 billion tkm in Ores & Metals accounts for nearly half of the overall lost rail traffic. There is also a significant drop of 0.50 billion tkm in Others. The largest percentage reductions in rail shares of tkm are in Chemicals (by 27.54%), Ores & Metals (by 18.17%) and Others (by 10.59%). The smallest absolute falls are in rails' Food, Drink & Agriculture, Petroleum and Coal & Coke tkm. The smallest effects on rail's share of tkm are in Food, Drink & Agriculture, Petroleum and Coal & Coke.

In *Scenario 4 (Quadrupled Access Charges)*, Rail tonnes decrease by 17.97 million (12.51%) and tkm by 4.29 (18.62%) overall. The drop of 1.88 billion tkm in Ores & Metals accounts for over one third of the overall lost rail traffic. There is also a

significant drop of 1.33 billion tkm in Others and 0.38 billion tkm in Construction. The largest reductions in rail's share of tkm are in Chemicals (67.27%), Ores & Metals (41.12%) and Others (28.3%). The smallest absolute falls in rails' Food, Drink & Agriculture and Petroleum tkm traffic. The smallest effects on rail's share of tkm are in Food, Drink & Agriculture, Petroleum and Coal & Coke.

In *Scenario 5 (Higher Short Distance Access Charges)* rail tonnes decrease by 4.28 million (2.98%), and tkm by 0.82 billion (3.54%). Compared to scenario 3, tonnes fall by proportionally more than tkm highlighting that the reduction in rail traffic is more concentrated in the shorter distances than in scenario 3. In absolute terms, the drop of 0.43 billion tkm in Ores & Metals accounts for more than half of the overall lost rail traffic. There is also a significant drop of 0.18 billion tkm in Others. The largest decreases in rail shares of tkm are in Chemicals (by 12.85%), Ores & Metals (by 9.41%) and Others (by 3.88%). The smallest absolute decreases in Food, Drink & Agriculture, Petroleum, Coal & Coke and Chemicals tkm traffic. The smallest decreases in rail's share of tkm are in Food, Drink & Agriculture, Coal & coke and Petroleum.

In *Scenario 6 (Higher Short Distance and Lower Long Distance Access Charges)*, rail tonnes decrease by 2.65 million (1.85%) and tkm decrease by 0.27 billion (1.16%), highlighting that much of the reduction in traffic is over the short distances. Interestingly there is little increase in Food, Drink & Agriculture tkm (0.06%) but decreases in all other commodities – very little of rail's traffic in this commodity is in the shorter distances. The largest absolute falls are found in Ores & Metals and Construction. The largest decreases in rail share of tkm are in Chemicals (by 5.15%), Ores & Metals (by 4.02%) and Construction (by 1.04%). The smallest reductions in rail's market share of tkm are found in Coal & Coke, Others and Petroleum.

Overall, changes in rail freight traffic are driven primarily by the shifts in Ores & Metals traffic, (as this accounts for 19.8% of Rail's overall tkm traffic), and also Others (accounting for 20.4%). Although Coal & Coke accounts for 22.3% of rail's tkm traffic, there is little movement in tkm as its market share stays relatively static due to the level of captivity and the favourability of rail over longer distances. There are relatively significant changes in Construction, which accounts for 17.1% of rail's tkm traffic. Whilst there are large shifts in the market shares of Chemicals, these represent very small absolute changes in tkm.

In summary, by using LEFT, we were able to explore the potential impacts of variations in infrastructure charging in isolation from any other changes that might impact on the rail freight market. We found that by removing access charges, rail tonne kms increase by 9%, reducing road traffic by almost 2 billion tkm, just 1%. This highlights an underlying lack of competitiveness of rail in key freight markets such as Food Drink and Agriculture and Construction, because of high captivity to road transport, given the short distances involved and the lack of suitable rail infrastructure. We examined the sensitivity of the rail market to levels of access charges and found that rail is slightly less sensitive to access charge increases than it is to equivalent decreases. If we introduce different structures of access charging over distance bands, approximating a fixed and variable charging regime, we show how we can incentivise rail traffic over the longer distances where rail is more competitive and environmentally more beneficial.

Table 17: Tonnes Lifted by Commodity for Different Scenarios in 2010.

Scenario	Mode	Tonnes lifted [millions]							
		Food, Drink, Ag	Coal & Coke	Petroleum	Ores & Metals	Construction	Chemicals	Others	TOTALS
Do nothing	Road	525.86	23.30	85.49	75.89	676.09	69.18	708.69	2164.50
	Rail	11.32	42.12	10.84	33.82	27.72	1.64	16.17	143.63
Scenario 1 Zero access charges	Road	525.83	23.20	85.38	73.19	675.88	68.77	708.34	2160.60
	<i>% change from do nothing</i>	-0.01	-0.42	-0.12	-3.57	-0.03	-0.60	-0.05	-0.18
	Rail	11.48	42.22	10.95	38.31	28.76	2.12	17.96	151.80
	<i>% change from do nothing</i>	1.41	0.24	0.99	13.29	3.74	29.57	11.06	5.69
Scenario 2 Halved Access Charges	Road	525.84	23.25	85.44	74.56	675.98	68.99	708.52	2162.58
	<i>% change from do nothing</i>	0.00	-0.22	-0.06	-1.76	-0.02	-0.29	-0.02	-0.09
	Rail	11.39	42.17	10.89	36.04	28.17	1.87	17.05	147.58
	<i>% change from do nothing</i>	0.65	0.12	0.44	6.56	1.63	14.21	5.39	2.75
Scenario 3 Doubled Access Charges	Road	525.89	23.43	85.56	78.32	676.33	69.53	709.00	2168.05
	<i>% change from do nothing</i>	0.01	0.55	0.08	3.19	0.04	0.50	0.04	0.16
	Rail	11.18	41.99	10.77	29.70	27.02	1.23	14.57	136.46
	<i>% change from do nothing</i>	-1.19	-0.30	-0.61	-12.19	-2.52	-24.93	-9.94	-4.99
Scenario 4 Quadruple d Access Charges	Road	525.97	23.69	85.65	81.75	676.96	70.01	709.53	2173.57
	<i>% change from do nothing</i>	0.02	1.69	0.19	7.72	0.13	1.20	0.12	0.42
	Rail	10.89	41.73	10.70	23.88	25.99	0.66	11.82	125.66
	<i>% change from do nothing</i>	-3.82	-0.93	-1.32	-29.39	-6.22	-59.94	-26.91	-12.51
Scenario 5 Higher Short Distance Access Charges	Road	525.88	23.37	85.54	77.46	676.24	69.37	708.84	2166.70
	<i>% change from do nothing</i>	0.00	0.32	0.06	2.07	0.02	0.27	0.02	0.10
	Rail	11.23	42.05	10.79	31.16	27.26	1.42	15.44	139.35
	<i>% change from do nothing</i>	-0.79	-0.18	-0.41	-7.85	-1.66	-13.46	-4.54	-2.98
Scenario 6 Higher Short/ Lower Long Distance Charges	Road	525.88	23.35	85.52	76.98	676.20	69.29	708.75	2165.96
	<i>% change from do nothing</i>	0.00	0.20	0.04	1.43	0.02	0.15	0.01	0.07
	Rail	11.26	42.07	10.81	32.00	27.40	1.52	15.91	140.97
	<i>% change from do nothing</i>	-0.51	-0.11	-0.30	-5.38	-1.14	-7.41	-1.61	-1.85

Table 18: Tonne-Kilometres by Commodity for Different Scenarios in 2010.

Scenario	Mode	Tonne kms [Billions]							
		Food, Drink, Ag	Coal & Coke	Petroleum	Ores & Metals	Construction	Chemicals	Others	TOTALS
Do nothing	Road	63.33	2.31	8.29	8.53	35.91	8.84	73.09	200.30
	Rail	2.17	5.13	2.13	4.57	3.94	0.40	4.69	23.04
Scenario 1 Zero access charges	Road	63.29	2.30	8.26	7.59	35.68	8.71	72.55	198.39
	% change from do nothing	-0.06	-0.62	-0.27	-11.05	-0.62	-1.43	-0.74	-0.95
	Rail	2.21	5.24	2.17	5.56	4.19	0.53	5.26	25.17
	% change from do nothing	1.96	2.10	2.03	21.60	6.46	31.75	12.08	9.24
Scenario 2 Halved Access Charges	Road	63.32	2.31	8.28	8.07	35.81	8.78	72.83	199.38
	% change from do nothing	-0.03	-0.32	-0.12	-5.43	-0.26	-0.69	-0.36	-0.46
	Rail	2.19	5.18	2.15	5.06	4.05	0.46	4.97	24.06
	% change from do nothing	0.82	1.02	0.95	10.60	2.75	15.36	5.85	4.43
Scenario 3 Doubled Access Charges	Road	63.36	2.33	8.30	9.33	36.02	8.95	73.56	201.85
	% change from do nothing	0.04	0.61	0.18	9.42	0.32	1.24	0.65	0.78
	Rail	2.15	5.04	2.10	3.74	3.78	0.29	4.20	21.29
	% change from do nothing	-1.20	-1.85	-1.61	-18.17	-3.92	-27.54	-10.59	-7.59
Scenario 4 Quadrupled Access Charges	Road	63.40	2.36	8.32	10.34	36.19	9.11	74.35	204.07
	% change from do nothing	0.11	2.09	0.38	21.26	0.78	3.02	1.73	1.88
	Rail	2.10	4.87	2.04	2.69	3.55	0.13	3.36	18.75
	% change from do nothing	-3.41	-5.12	-4.13	-41.12	-9.76	-67.27	-28.30	-18.62
Scenario 5 Higher Short Distance Access Charges	Road	63.34	2.32	8.30	8.94	35.97	8.89	73.26	201.03
	% change from do nothing	0.02	0.40	0.11	4.84	0.19	0.58	0.23	0.36
	Rail	2.16	5.09	2.11	4.14	3.85	0.35	4.51	22.22
	% change from do nothing	-0.50	-0.72	-0.89	-9.41	-2.17	-12.85	-3.88	-3.54
Scenario 6 Higher Short/ Lower Long Distance Charges	Road	63.33	2.32	8.29	8.70	35.94	8.86	73.09	200.54
	% change from do nothing	0.00	0.29	0.07	2.01	0.09	0.23	0.00	0.12
	Rail	2.17	5.12	2.12	4.39	3.90	0.38	4.69	22.77
	% change from do nothing	0.06	-0.12	-0.50	-4.02	-1.04	-5.15	-0.15	-1.16

## **5. Conclusions**

Infrastructure charges were introduced in Britain in 1995 and, when reviewed in 2001, were effectively halved for freight operators. Over the period, growth in freight traffic has been quite remarkable, in the order of 50% over 12 years. Within this, growth has been particularly notable in coal traffic, which rail is inherently better-suited to carrying, and in construction traffic which appears particularly price-sensitive. However, rail freight growth actually started in 1995, and we do not observe a major change in the trend around the time of the reductions in infrastructure charges introduced in 2001. Nevertheless, the structure of charges appear to be incentivising operators to reduce impact of rail freight on the network, e.g. by operating less-damaging rolling stock and by requiring fewer slots to operate a particular service. Further changes are soon to be implemented, involving greater differentiation and increased charging levels for freight-only lines. It will be interesting to monitor any observable impacts of these forthcoming changes.

Infrastructure charges in France were first implemented in 1997 and there have been several changes to charging structure and levels over the period. A differentiation between “rapid” (high value) freight traffic and other freight was introduced. The circulation charge for freight doubled between 2002 and 2009. While freight infrastructure charges went up as described, freight traffic went on a downward trend from the end of the 1990’s. These evolutions may seem, at first sight, to be closely related but the linkage between charges and traffic remains unclear and probably low. First, a notable effect occurred when reservation fees were implemented and led to the suppression of “facultative” paths that were unused. Second, even though it increased globally, the charge level still represents a low share in operators’ costs, especially for SNCF (around 8%), whereas the evolution of traffic showed important shocks that seem to be much more related to the changes in SNCF’s freight strategy. Indeed, reorganization plans, railway strikes, the liberalization of freight services and economic globalisation have extensively confused the price signal and impacted the traffic at a much higher degree than the relatively small signal of infrastructure charge could. However, set now at higher levels, and in a more stable environment, infrastructure charges may play a stronger role in the future.

Eurotunnel provides an interesting case, as rail freight through the tunnel has performed somewhat disappointingly over a number of years and the charges faced by freight operators have consistently been cited as a potential cause of this poor performance. Having originally had a design capacity of c10 million tonnes, freight traffic grew during the first 3 years of operation to three million tonnes in 1997. However, it then stagnated until 2000, before declining to just over one million tonnes in 2007. The original charges were devised in the midst of rail re-structuring in both Britain and France, with no actual reference to the market. Furthermore, the monopoly and state aid aspects of the market rendered them irrelevant as signals to the market. Following the cessation of the Minimum Usage charge in 2006 and continued decline in rail freight traffic through the tunnel, discussion between the key stakeholders led to another set of revised charges being announced in autumn 2007.

Since the removal of state aid, opening up of the market and establishment of the new charging regime, traffic appears, on the whole, to be responding positively, though it is too soon to say whether this is a sustained turn-around.

The effect of changes in rail access charge regimes on rail and road traffic in Britain have been modelled using the LEeds Freight Transport Model (LEFT) (Johnson, Whiteing and Fowkes (2007)). Six scenarios/policy tests examined the effects of:

- Removing current track access charges;
- Halving current track access charges;
- Doubling current track access charges;
- Quadrupling current track access charges;
- Introduce a structure of fixed and variable track access charges; punishing short distance rail traffic;
- A fixed and variable access charge stimulating long distance traffic.

By using LEFT, we have been able to explore the potential impacts of variations in infrastructure charging in isolation from any other changes that might impact on the rail freight market. We have found that by removing access charges, rail tonne-kilometres increase by 9%, reducing road traffic by almost 2 billion tkm, just 1%. This highlights an underlying lack of competitiveness of rail in key freight markets such as Food Drink and Agriculture and Construction, because of high captivity to road transport, given the short distances involved and the lack of suitable rail infrastructure. We have examined the sensitivity of the rail market to levels of access charges and found that rail is slightly less sensitive to access charge increases than it is to equivalent decreases. If we introduce different structures of access charging over distance bands, approximating a fixed and variable charging regime, we have shown how we can incentivise rail traffic over the longer distances where rail is more competitive and environmentally more beneficial.

Data availability issues have placed constraints on the level of analytical detail that we have been able to achieve. For further systematic analysis in this area, one might, ordinarily, seek to employ some form of econometric or statistical modelling exercise. However, for this, one would require detailed cost and demand statistics at the train operator level, and this would appear not to be available to us. Nevertheless, the case study research has helped to identify key trends and issues, whilst we have also been able to pursue some interesting modelling ideas. It is clear that modelling can help in identifying the cases where the final impact of infrastructure charges is rather low, and therefore in giving indications about the degree of desirability of infrastructure charge differentiation, given some minimal data requirements on the market segments concerned.

Besides data requirements, the research field of imperfect competition in rail markets seems to be quite important if we want to explore these important issues further and have a better understanding of what the final indirect impacts of infrastructure charging are, once interactions between competitors and demand converge to an equilibrium. Simulation models, such as those developed by Meunier and Quinet (see “Effect of imperfect competition on infrastructure charges” in this issue) appear to provide a promising line of further research in this area.

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