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EVES-Rail

Economic effects of Vertical Separation in the railway sector

Summary report

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Executive summary

What are the net quantitative effects of historical rail sector reforms in Europe? Is any specific model systematically superior to the others based on the empirical record?

In this study, we look at the potential impact of different forms of vertical organisation of railway markets on costs and mode share. We distinguish between three general models: Vertical Integration, Holding Company and Vertical Separation.

- Several points come out of the literature review: the effects of vertical separation in terms of induced cost increases resulting from misalignment of incentives are likely to be larger than the increased transaction costs. The efficient setting of track access charges is very important, but cannot by itself lead to the correct alignment of incentives regarding both efficient use and efficient development of the rail network. Whilst past studies generally find that increased competition reduces costs, they show no consistent pattern on the impact of vertical separation on costs. The literature also gives us little evidence on the impact of reform on modal split. Finally: There seems to be no evidence that vertical separation is unconditionally superior or inferior to other structures.
- Our new econometric evidence suggests that at higher traffic densities, vertical separation increases costs; whilst at lower densities it appears to reduce them. At mean traffic densities, vertical separation does not significantly change costs, whereas a holding company model reduces them, compared with complete vertical integration.
- We find that a high dependence on freight traffic for revenue appears to increase the costs of vertical separation. For a given level of train density, it seems that freight traffic causes more coordination problems in a separated environment than passenger traffic.
- We find no evidence that vertical separation is superior to the holding company model in its impact on rail's modal share in freight or passenger transport.

Why do certain reforms yield or fail to yield certain effects?

- The literature points to the importance of the analysis of transaction costs in unbundled regimes and at the relatively larger importance of the misalignment costs that may result from an inadequate institutional setup. Existing studies draw different conclusions concerning the desirability of vertical separation, but seem to agree that there does not seem to be a 'one-size-fits-all' solution in term of unbundling.
- Determining elements for the debate include the discussions on fragmentation versus leadership, short-termism versus the need for long-term planning, sub-optimization and misalignment versus whole-system approaches and incentive re-alignment, and transaction costs versus induced system costs.
- Four main planning time horizons, and corresponding coordination circles, need to be distinguished in the discussion on misalignment of incentives: Firstly, long term planning, which is concerned with investments in assets that are characterised by lengthy amortisation periods, both for the moving assets, and even more so for the fixed assets. Secondly, medium term service planning, which is concerned with the development of concrete service concepts and staffing (incl. training). Thirdly, the

timetable cycle, usually one year, representing the shorter term, often complemented by even shorter term planning (freight). Finally, real-time adjustments at the realisation phase to cope for unforeseen events, disruptions, etc. Various issues of misalignment exist within each of these.

- Unbundling is a potential source of detrimental misalignments, which have important technical components and the pivotal point with all these issues is that situations may arise where one actor bears the costs whilst the other one gains all or at least a noteworthy share of the benefits.
- Track-access charging regimes and national performance regimes are regulated contractual market mechanisms that can play an important role but that do not appear to be adequate to solve all misalignment issues. Furthermore, most European IMs are publicly owned and are partly funded by the state. Multi-annual contracts with the government and further regulation are important but might not lead to an efficient identification of what RUs need compared to a direct commercial relationship.
- Additional re-alignment mechanisms are being developed in various countries, and it is noteworthy to mention that these tend to move towards hybrid, cooperative arrangements, rather than simple contractual market mechanisms.
- Whether the combination of vertical separation with additional realignment mechanisms will lead to a similar level of performance to what can in principle be achieved in bundled regimes is doubtful, even though bundled regimes, as an alternative to unbundling, are not in themselves a guarantee for optimal performances (the old pre-reform bundled regimes of the European railways can serve as an example). Additional performance incentives may be helpful here too and various options exist.
- Ultimately the choice of the most appropriate re-alignment mechanisms to put in place will have to depend upon the characteristics of the elements of the value chain at stake, the economic circumstances and the institutional environment. The various elements of the value chain and boundaries between actors may require different coordination mechanisms, depending upon the characteristics of the transactions at stake.
- Seen from the point of view of actual market entry by new entrants, it seems clear from empirical data that substantial entry can occur under any of the reviewed institutional structures, and that one structure does not seem more favourable on grounds of promoting entry. One important condition is the presence of a rail regulator, independent from the Ministry and with adequate resources to enforce its decisions.

What are the potential effects of reforms in view of the 4th Railway Package?

- The evidence does not suggest that vertical separation is necessarily best in cost-benefit terms. We find no evidence that vertical separation increases competition compared with a holding company model and likewise none that such increased competition would reduce costs. Nor do we find any evidence that vertical separation improves rail's modal share compared with a holding company model (although it does improve passenger market share when combined with market opening compared with vertical integration). For freight, there is no evidence that if it did increase competition this would improve market share.
- Regarding the overall impact of restructuring on costs, the position is more complicated. At typical traffic densities, it appears that the holding company model

reduces costs compared with vertical separation. While vertical separation does not have much effect on costs at average train density levels, at high levels of train density it increases costs. However, on less dense systems, vertical separation seems to have lower costs. We particularly warn against extrapolating relationships to organizations which are very different from those for which they were estimated. We do not believe our results to be applicable to small local railways.

- A decision to impose vertical separation throughout Europe would raise costs by at least €5.8 billion/year for no accompanying benefits. If rail traffic density rises, as would be a result of the European Commission's strategy to raise rail mode share, then the costs of imposing complete vertical separation everywhere will rise dramatically.
- Where vertical separation is put in place, additional measures to align incentives should be considered. Vertical separation with enhanced alignment of incentives is assumed to work best where a single railway undertaking is dominant in each region and this operator can form an alliance with the appropriate region of the infrastructure manager (as identified in the British context).
- For the holding company model to work well, the operators which are in the holding would retain a substantial market share over the whole system. Clearly the gains for this form of alignment will be much more limited if the operators in question have only a small share of the market.
- We have examples of institutional separation of essential functions and of enhanced compliance mechanisms that seem to be working well, but we have no clear evidence on their benefits and it is not clear to what extent these experiences are transferable.
- Our overall conclusion must therefore be that there is no evidence to support implementation of a single structure on all railways regardless of their circumstances.

Conclusions

- Misalignment issues are important and need to be paid much more attention
- The need for coordination differs according to the situation of the railway regarding issues such as density of traffic and the need for change.
- There is no clear evidence that additional measures are needed to prevent discrimination in the holding company model, various existing measures seem to be working well in particular circumstances.
- There is no evidence that vertical separation is necessary in order to obtain the benefits expected from competition.
- The most effective model in terms of its impact on costs differs with circumstances, and in particular with traffic density as at high levels of traffic density vertical separation increases costs.
- Overall, different structures work best in different circumstances, without prejudice to the development of competition.

Policy recommendations

- Countries should be free to choose the structural option that best suits their circumstances – thus allowing competition between different organisational models – subject to providing for non-discriminatory access for competitors. This should include both the possibility of switching from a holding model to vertical

separation, and the possibility of switching from vertical separation to a holding model.

- Where vertical separation is adopted careful thought must be given to measures to ensure correct alignment of incentives between infrastructure manager and railway undertakings. This includes, but must go beyond, efficient setting of track access charges and performance regime bonuses and penalties.
- Whatever the structure of the railway, the need for coordination mechanisms must be recognised. Feed-back loops and knowledge exchange between infrastructure manager and railway undertakings would benefit the sector.
- Dense networks need particularly close co-ordination. The importance of dense networks will increase if the goals of European transport policy in increasing the usage of rail are realised.
- The transferability of alternative approaches to vertical separation that allow for a non-discriminatory network access (such as the separation of essential functions and enhanced compliance and regulatory mechanisms within a holding model) should be studied in more depth to allow adapting them to local circumstances.

1 Introduction

1.1 Study goals

The goal of this study is to assess the potential impact of various forms of partial or total vertical separation in the rail sector in the European context. A main policy question is whether a limitation in the choice between structural railway regimes is recommendable or not. Existing economic studies draw mixed conclusions about the impacts of various reforms – hence the need for a thorough assessment of key impacts and mechanisms in order to guide policy-makers ahead of discussions pertaining to the Fourth Railway Package.

The general argument for vertical separation, as assumed in many economic studies and policy documents, is based on the assumption that competition is needed to improve the performances of the railways and that competition may work less well without (full) vertical separation. So this argumentation assumes that there would be gains from separation on the competition side, while any system effects resulting from separation are assumed to be either positive or, if negative, smaller than the gains from the (assumed) higher competition, thus leading to a net positive effect of vertical separation.

The general argument for vertical integration is related to the technical complexity of the railway sector and the need for a close coordination between track and train. In this argumentation, separation is assumed to reduce the possibilities for system-wide (track and train) optimisation of investments and operations, ultimately leading to overall cost increases and a less efficient and competitive railway. Vertical integration is seen as allowing the development of clear integral business-cases for each investment or service idea, enabling the evaluation of its total contribution to the sector and preventing the double sub-optimisation that vertical separation would engender.

On the system efficiency side, there is a growing concern that system fragmentation cuts off crucial links and leads to a misalignment of incentives that then need to be “reconstructed” using other mechanisms, and that those mechanisms, overall, may be less cost-efficient. On the other hand, there is also a view that positive system effects may emerge thanks to the greater clarity and transparency created by separation, and because it opens up possibilities of specialisation. Consequently, the net effect on system efficiency is an open question, both theoretically and empirically, and this question needs to be assessed.

On the competition side, it is not necessarily clear from the empirical record that full separation always yields superior competitive results. In a partially separated system, such as a holding company, there may be effective ways of securing non-discriminatory access and effective market entry. On the other hand, the greater clarity of separation could also help removing conflicts of interest and ensure non-discriminatory access. Therefore the gains on the competition side from further separation are uncertain ex ante and need to be assessed.

In order to assess the validity of these arguments, we need to investigate the relationships between different separation models on the one hand, and overall system costs and competition on the other. In doing so, we need to pay attention not only to the interfaces created and the pure transaction costs that may result from vertical separation, but also to the costs that are potentially created throughout the value chain and that

result from incentive misalignment between the actors involved due to the lack of system-wide coordination and optimisation that the interfaces between actors may engender.

In sum, the net effect of a compulsory reform towards further separation for systems that are currently only partially separated could potentially be either positive or negative, and in either case the gains or losses may turn out to be large, or on the contrary very small. Conversely, a possible reform in the direction of partial re-integration of currently fully separated systems may or may not lead to a net positive effect. Such scenarios of potential structural reform need to be evaluated on the basis of a solid research effort.

1.2 Approach

This study seeks to contribute significantly to this important discussion both by investigating quantitative effects of previous reforms, and by going further into investigating what structural and institutional mechanisms are involved in driving the quantitative performance of rail systems in Europe.

The study is based on several methodological pillars of high scientific standard. It is not based on interviews and opinions of stakeholders. The study includes a literature review, econometric analysis based on refined data sets and also a value chain analysis, stressing that more than one approach is needed to understand the complexities of the railway sector and the impact of various institutional policies. In developing this new multi-faceted research work, the study goes much deeper than pre-existing studies into the analysis of the railway sector and its value chain, while covering a wide range of institutional configurations of the railway sector.

The study then evaluates the potential impact of further reforms that could be undertaken in some Member States as a result of potential legislation currently under consideration in the context of the Fourth Railway Package. It does so on the basis of the findings presented in the study before presenting relevant lessons for policy-makers.

1.3 Structure of the study

Part 1: Quantitative research findings

What are the net quantitative effects of historical rail sector reforms in Europe? Is any specific model systematically superior to the others based on the empirical record?

- What does the academic literature tell us so far?
 - Chapter 1: Literature review
- What can be quantified about the impact of reforms so far?
 - Chapter 2: Impact on rail system costs
 - Chapter 3: Impact on rail's modal share
 - Chapter 4: Value for money from state budgets

Part 2: Quantitative research findings

Why do certain reforms yield or fail to yield certain effects?

- What does the consulting literature tell us about the impacts of unbundling?
 - Chapter 5: Literature review
- What is the structure of the railway value-chain and what are the consequences of unbundling?
 - Chapter 6: Rail sector model: understanding the value chain, where interfaces lie, and what institutional forms exist or may potentially exist

- Chapter 7: What happens at those interfaces? What are the interests (“target functions”) of rail sector actors and where and when do they work well (aligned) or lead to conflicts/losses (misaligned)?
- What are the options for competition and non-discriminatory access?
 - Chapter 8: How is non-discriminatory access supported in different rail sector models? Is competition substantially affected by the vertical separation regime in practice?

Part 3: What are the potential effects of reforms in view of the 4th Railway Package?

- What are the implications of the findings of this study?
 - Chapter 8: What can be said about the (potential) effects of switching from one regime to the other?
 - Chapter 9: Conclusions of the study: what did we learn? (focus: content/analytical)
 - Chapter 10: Policy recommendations (focus: political)

Annexes: including country analyses and country fiches describing the institutional configuration of the railway sector in a selected number of countries.

1.4 Definitions

Several concepts are used throughout this study. We provide here a short definition list:

- **Reforms:** All modifications to the institutional configuration of the former state railways. This can cover a wide range of changes, such as: institutional reforms (separation), privatisations, introducing management independence from the state, internal reorganisations to improve efficiency, etc.
- **Separation (institutional, organisational, accounting):** Separation between IM and RU at three different levels of intensity. Accounting separation: IM and RU make up one company but their accounts are distinct. Organisational separation: IM and RU make up distinct organisations (companies) within one company (holding), and their accounts are – thus – separated. Institutional separation: IM and RU constitute totally distinct organisations (companies).
- **Vertical integration** (in short VI): Absence of institutional separation between IM and RU. Both are managed by one management. No unbundling measures are implemented.
- **Vertical separation** (in short VS): Institutional separation between infrastructure manager (IM) and railway undertaking (RU). Both are separate bodies or companies.
- **Holding company model** (in short HC): Intermediate form between VS and VI where IM and RU are distinct companies, but both part of a same holding, or somehow controlled by the same ‘mother’ company. ‘Holding models’ cover a wide variety of arrangements in terms of ownership, management, etc. We use this term here to cover all intermediate arrangements between vertical integration and vertical separation.
- **Essential functions** (EF): Path allocation and determination of track access charges (TAC).
- **Horizontal separation** (in short HS): Institutional separation between passenger operations and freight operations. Also, institutional separation between (vertically integrated) passenger operators, as implemented in Japan.

- **Liberalisation:** Opening the access of the railway to new entrants (besides the incumbent operators). The actual entry to the market can take place in various ways: open access, competitive tendering, direct award or by privatising an existing publicly-owned company.
- **Open access:** Open access to the rail network to licensed train operating companies, allowing for competition ‘on the tracks’ between operators.
- **Competitive tendering** (also franchising): Competitive mechanism to allocate a temporary right of operation of certain train services to an operator. This right can be exclusive or not.
- **Transaction costs:** Costs incurred in making an economic exchange, such as the search costs needed to determine whether the service or good required is available on the market and at what price, the costs of reaching an agreement with the selling party (contracting costs) and the costs related to enforcing the realisation of the transaction, making sure the seller sticks to the contract terms and – if needed – the costs of legal action to enforce the contract.
- **Costs of misalignment:** Costs resulting from the misalignment of incentives between actors created by structural reforms. VS, as structural reform, results in the existence of several actors (RU and IM), each of which submitted to a set of incentives given by the market and/or by the regulatory context. Each of these actors optimises its (economic) position under these constraints. A misalignment of incentives appears when this results in a situation that is not equal to what would be optimal at system-level and best value to society. The resulting ‘costs of misalignment’ are constituted by the difference between the economic balance under VS, compared to what the balance could have been under a system-wide optimisation (example: additional capacity investment needs, additional operational costs or lost revenue opportunity resulting from a lack of coordination between IM and RU).
- **System-level** (also system-wide): Approach considering the total economic balance of the railway sector, irrespective of a distinction between IM and RU.

2 Quantitative research findings

Part 1 of the study reviews the quantitative effects of rail sector reforms in Europe. It does so using complementary approaches in an attempt to shed the maximum amount of light on the measureable effects of reforms hitherto. This includes:

- What does the academic literature tell us so far?
 - Chapter 1: Literature review (academic literature)
- What can be quantified about the impact of reforms so far?
 - Chapter 2: Impact on rail system costs (econometric analysis)
 - Chapter 3: Impact on rail's modal share (econometric analysis)
 - Chapter 4: Value for money from state budgets

2.1 Literature review

Before developing its own econometric analysis, this study starts with a review of existing academic publications.

The literature finds that there are various reasons to suppose that reforms may affect all aspects of costs, but transaction costs are seen as an item that may be particularly influenced by vertical separation. It appears that few papers have tried to quantify directly the additional transaction costs arising from vertical separation and the findings until now seem to indicate that the increased transaction costs in the narrow sense (i.e. excluding effects of incentive misalignment¹) resulting from vertical separation exist but tend to be rather limited, representing less than 1% of total cost compared to the holding company model. However, the important McNulty study provides additional insights on the costs of incentive misalignment. This study, set up to examine why rail costs in Britain have increased since reform and which concluded that the costs of the British rail system could be reduced by 30% by 2018/9, found that of this some 2% might be achieved by reduced transaction costs but 2 to 20% cost reductions could be achieved by better-aligned incentives. Behind this, the observed near-impossibility to design a track access charging system that simultaneously provides for non-discrimination, appropriate incentives for efficient development of the network and appropriate incentives for its use remains a major point of attention.

¹ Transaction costs are costs incurred in making an economic exchange, such as the search costs needed to determine whether the service or good required is available on the market and at what price, the costs of reaching an agreement with the selling party (contracting costs) and the costs related to enforcing the realisation of the transaction, making sure the seller sticks to the contract terms and – if needed – the costs of legal action to enforce the contract. Costs of misalignment are additional costs throughout the value chain, resulting from the misalignment of incentives between actors created by structural reforms. These are not only transaction costs per se, but mainly additional capacity investment needs, additional operational costs or lost revenue opportunity resulting from a lack of coordination between IM and RU (see also definition section).

Impact of reforms on costs

Many studies have been undertaken to try to determine the impact on costs or on productivity of vertical separation. Our review illustrates that differing methodologies and inadequacy of the data could explain why no consistent pattern seems to emerge from these studies with results varying from no impact from vertical separation to significant diseconomies or – on the contrary – efficiency improvements. However, a recent study (Mizutani and Uranishi, 2012) attempted to solve these issues and found train density to be an important explanatory variable for the sign of the impact of vertical separation, with vertical separation leading to higher costs under higher density operations.

The literature review also showed that where competitive tendering has been introduced, similar savings seem to be reachable both under a holding company structure or with complete separation.

Table 1 gives a brief overview of some of the studies reviewed.

TABLE 1 IMPACT OF RAIL REFORM ON COSTS

Authors (year)	Countries covered	Effect of vertical separation	Effect of competition	Combined effect
Jensen and Stelling (2007)	Sweden	Negative	Positive	Positive
Friebel et al. (2010)	Europe	Positive if appropriately phased	Positive if appropriately phased	Positive if appropriately phased
Cantos et al. (2010)	Europe	Positive	Positive	Positive
Cantos (2011)	Europe	Not significant	Positive	Positive
Wetzel (2008)	Europe	Not significant	-	-
Growitsch and Wetzel (2009)	Europe	Negative for most countries	-	-
Mizutani and Uranishi (2012)	Europe and Japan	Depends on train density	-	-

Impact of reforms on demand and modal split

Compared with the mass of studies on costs, few studies have addressed the impact of railway reforms on traffic volume and modal shares. From those that have, it appears that whilst there might be some benefit, the major influences on rail's modal share growth are external factors.

In the freight market, a review of modal share statistics showed that there was more competition in the freight market in vertically separated railways but on average vertically integrated railways have seen substantial growth, and vertically separated countries none. Vertically separated railways, most of which are in countries that have not introduced competition, seem to perform better on average in terms of passenger growth, but most of these have seen no competition so the explanation must lie elsewhere. Growth was concentrated mainly in countries that had invested in high-speed rail.

Conclusion

In summary, we observe many inconsistencies in the results of studies on the impact of European rail policy, and these may partly be explained by the difficulty of getting appropriate and consistent data. On balance, most studies suggest benefits from

competition, and in particular from competitive tendering, but the impact of structural reform is ambiguous. One study suggests that this may be because the impact of vertical separation varies with the density of traffic on the system concerned.

2.2 Econometric assessment of costs

The review of the academic literature was then used to develop improvements to the most recent estimation methods. For this, the study gathered new data and improved the quality of existing data. The econometric modelling work carried out aimed at drawing conclusions on the impact of vertical and horizontal separation (as well as intermediate forms), and on the introduction of competition (in both passenger and freight) on rail costs.

The approach

The analysis is an update of a previous paper by Mizutani and Uranishi (2012). As set out in the literature review, the previous literature is dominated by studies that utilise physical measures that may not adequately capture the inputs used by railways (in particular, the use of track or route length to measure the capital input). Moreover, it is subject to distortion, particularly in terms of staff numbers, from the very different degrees of subcontracting found in different railway companies. A cost based study, such as that conducted here thus has a number of advantages.

For this study we updated and enhanced this Mizutani and Uranishi (2012) study in a number of important ways, by: adding the British data to that sample (the exclusion of Britain from previous studies has been a major disadvantage of earlier work); updating the analysis beyond 2007, up to 2010 where possible (most previous papers have not extended beyond 2005) and covering 26 countries; asking CER members to check and correct, where necessary, the data that had previously been collected and which was predominantly based on UIC data (as is the case for other studies in the literature); using improved information on the timing of vertical and horizontal separation and on the dates for and extent of opening up of passenger and freight competition; enhancing the modelling of industry structure on costs (previous literature only considered vertical separation or vertical integration, we also consider intermediate forms, the holding company model, and one in which essential functions are separated); enhancing the modelling of market opening (using actual entry, and using a competition index for passenger transport); and enhancing the modelling of the relationship between industry structure and train density.

As noted above, the purpose of the analysis is to explore the impact of industry organisational structure and competition on rail industry costs. We seek to capture in the model a set of variables that reflect genuine differences between railways, for example, passenger-km, freight tonne-km, route-km and other variables such as input prices (e.g. labour wage rates). These variables allow, inter alia, the model to take account of any economies of scale and/or density. The model seeks to include a set of variables that capture differences between railways and thus to model the relationship between costs and these variables (control variables). Having taken account of the control variables the model then seeks to test the impact of vertical separation and the holding company model (the test variables). In simple terms the model can therefore be written in equation form as:

$$\text{Total Rail Industry Cost} = \text{Function}(\text{Control Variables}; \text{Test Variables})$$

The control and test variables, as listed in Table 2, are in line with the literature.

TABLE 2: CONTROL AND TEST VARIABLES

Control variables (variable name in brackets)	Test variables (variable name in brackets)
<ul style="list-style-type: none"> • Passenger output (passenger-km; Q_P) • Freight output (freight tonne-km; Q_F) • Route length (route-km; N) • Technology index (percentage of electrified lines) • Wage rate (labour cost per employee; W_L) • Energy price (energy price per 1000 TOE; W_E) • Materials price (Material costs per rolling stock; W_M) • Capital price (capital costs per route length; W_K) 	<ul style="list-style-type: none"> • Vertical separation dummy variable (D_{VS}) • Vertical separation dummy variable times train density ($D_{VS.V}$) • Vertical separation dummy variable times freight revenue as a proportion of total revenue ($D_{VS.R}$) • Holding company dummy variable (D_{HC}) • Holding company dummy variable times train density ($D_{HC.V}$) • Holding company dummy variable times freight revenue as a proportion of total revenue ($D_{HC.R}$) • Horizontal separation dummy variable (D_{HS}) • Passenger competition measure (CMP) • Freight competition dummy variable (D_{CF})

Findings and policy interpretation

We first of all note that careful interpretation of the results is needed.

The first conclusion is that whilst vertical separation does not have much effect on costs at average train density levels, at high levels of train density it increases costs and at low levels it reduces them. This finding is intuitive in that the coordination problems associated with vertical separation might be expected to be more severe when there are high levels of traffic relative to the size of the network, leading to poorer decisions and increased costs of misalignment. It may be less clear why vertical separation reduces costs on more lightly used networks, where competition may also be limited, though this might be simply associated with increased transparency in terms of cost and public payment; or simply cost reductions associated with change/reform of the system. Again, restructuring is often associated with a careful examination of staffing and costs.

Two important remarks should be made here. Firstly, all railways, and particularly larger ones, have a variety of densities of traffic on the network. Clearly the aggregate relationship identified cannot be used to make specific recommendations as to the best form of organisation for individual countries or parts of them. Examining the cost implications of vertical separation in individual countries would require more detailed, bottom-up modelling work. Secondly, we particularly warn against extrapolating relationships to organisations which are very different from those for which they were estimated. Our sample comprises main line railway companies with a mean output of 147 million train-km p.a. and a range from 2 million to 954 million. We do not believe our results to be applicable to small local railways.

The second conclusion is that the higher the proportion of freight running on the network (measured in our model by the proportion of revenue made up by freight) the smaller any cost reduction effect from vertical separation (or the larger any cost increase). Thus, for a given level of train density, it seems that freight traffic causes more coordination problems in a separated environment than passenger traffic. This finding appears to be

intuitive, and could result from the fact that typically passenger services on a route are provided by a single operator, whereas freight may involve multiple operators. Further, freight services are not set by a rigid timetable but vary from day to day. It could also reflect the increased problems of handling mixed traffic.

The third conclusion is that the Holding Company model seems to produce a small (ca. 5%) cost reduction as compared to the Vertical Integration model (which is also only weakly significant from a statistical perspective). This effect does not appear to change either with traffic density or with the proportion of freight volumes. The reduction could result from increased transparency resulting from the internal separation, whilst any loss of coordination benefits is avoided (though here we should also recognise that in practice the degree of coordination within the holding model varies considerably from country to country).

Taking the above three conclusions together, and computing the cost of imposing vertical separation on those EU countries which have not yet separated (and thus are either currently vertically integrated or have adopted the holding company model), and bearing in mind the Commission's aims for future traffic growth as stated in the 2011 Transport White Paper, we also show the cost of imposing vertical separation assuming that traffic density levels increase by 10%, 20% and 50% respectively. At existing densities, imposing vertical separation on all European railways would add costs of €5.8 billion. Since the model shows the cost of separation increasing with density levels, the cost of vertical separation at these higher density levels is correspondingly higher, at nearly €8 billion, €10 billion and €15 billion per year respectively.

Thus it does not seem appropriate to adopt a policy of requiring all railways to be vertically separated as this will increase costs, based on the results of the modelling exercise undertaken as part of this project. Of course the numbers quoted are based on an extrapolation from an econometric model and should be viewed as indicative rather than a precise finding. More precise modelling of the cost implications of vertical separation in individual countries would require more detailed, bottom-up modelling work which would be a much larger exercise than could have been attempted as part of this study.

Finally, the results show that horizontal separation appears to have led to a very substantial reduction in costs (of around a quarter). Horizontal separation has usually come into being as a result of the selling off of freight operations (or in the case of Japan of integrated passenger companies). This process may have entailed a careful examination of the staffing and costs of the freight operator and shedding of unprofitable traffic. Certainly this was the case in Britain. The cost reduction may also be driven by the increased cost and subsidy transparency resulting from the separation of the passenger and freight businesses.

However, it does not appear that actual competition in passenger and freight has much effect on costs over and above the effects of industry structure (holding company or vertical separation) or horizontal separation. This finding is surprising, though it might reflect the aforementioned problem of specifying appropriate competition measures and it may be that the impacts of competition are in part being picked up by other variables because of this problem.

Important caveats

The econometric analysis essentially shows whether or not a statistical relationship exists. If such a relationship does exist, it does not of itself explain why. If a relationship

does not exist, this does not prove that the two variables are not related, but only that with the data at our disposal we cannot detect it.

In contrast to most previous studies in the literature, which rely on published data, as part of this study we have had the opportunity to have our data verified by members and then extended. In addition, we have added Britain to the analysis for the first time. Nevertheless, some data issues remain (e.g. concerning the definition of rolling stock numbers in international data sets; comparability of depreciation costs across countries; definition of train density; proportion of freight). Also, in the time available we were not able to compute total costs for countries where cost data for small operators was not available, although we were able to make the adjustment for three highly liberalised systems (overall, we consider any bias caused to be small).

We have to stress, though, that despite these problems this data set (based on UIC-data), as checked and verified by CER members, is the best that can be achieved at the present time. This makes this study a major step forward in this area of research, where data quality has been a major issue.

2.3 Econometric assessment of modal shares

The main aim of this second econometric chapter is to assess the effect of several forms of separation on the modal share of rail. This is done by developing an econometric analysis of rail modal shares in passenger and freight transport. The analysis covers 26 OECD countries over the period 1994-2010.

Our modelling work looked into international freight transport, national freight transport and passenger transport. To provide a reliable image of this effect, we correct for other factors affecting the modal share of rail. We also discuss the possible impact of separation and competition. We have also used a trend variable to capture developments that take place over time. Since it would be impossible to measure all differences between countries correctly, we use fixed effect regressions to account for country-specific variables that are unobserved or hard to measure numerically.

Data

Data on modal shares in freight are collected from transport statistics from the International Transport Forum (ITF), and are defined as the share of rail in transport (measured in tonne-km) by train and truck. Transport by air, inland waterways, pipelines and short sea shipping are excluded from the analysis.

The figures below graph the modal share of rail for each country in 2008, grouping the countries by structural option: vertical integration (VI), holding company (HC) and vertical separation (VS).

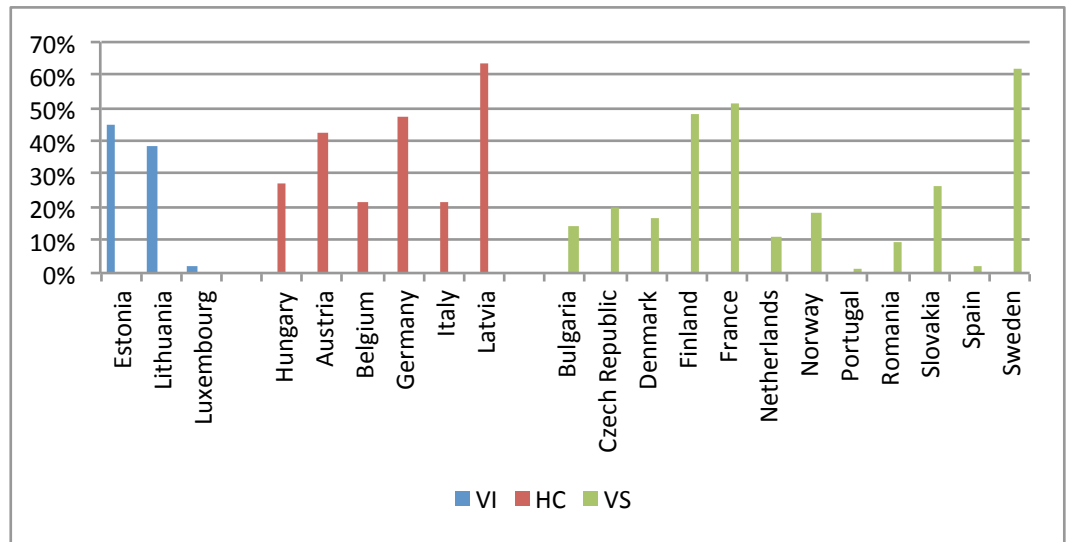


FIGURE 1 MODAL SHARE (2008) BY COUNTRY FOR INTERNATIONAL FREIGHT

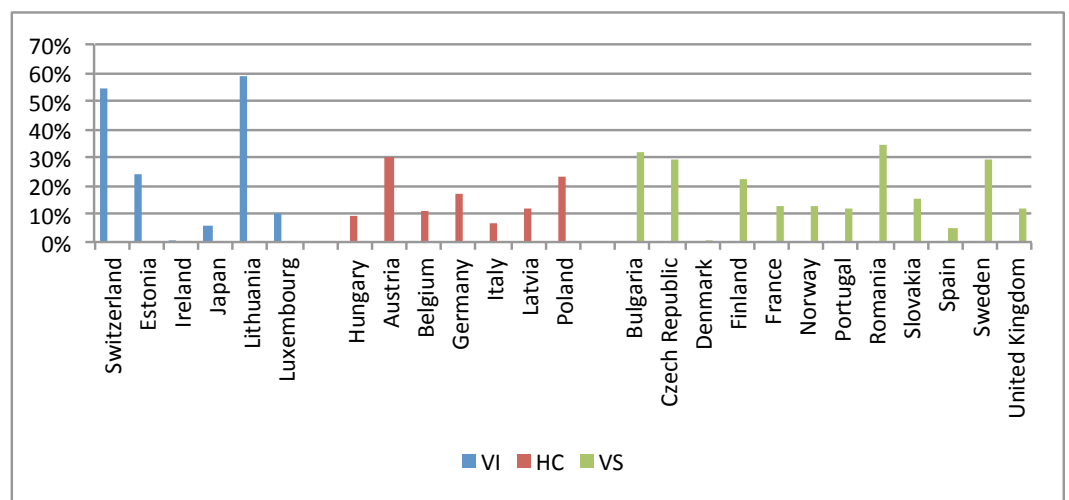


FIGURE 2 MODAL SHARE (2008) BY COUNTRY FOR NATIONAL FREIGHT

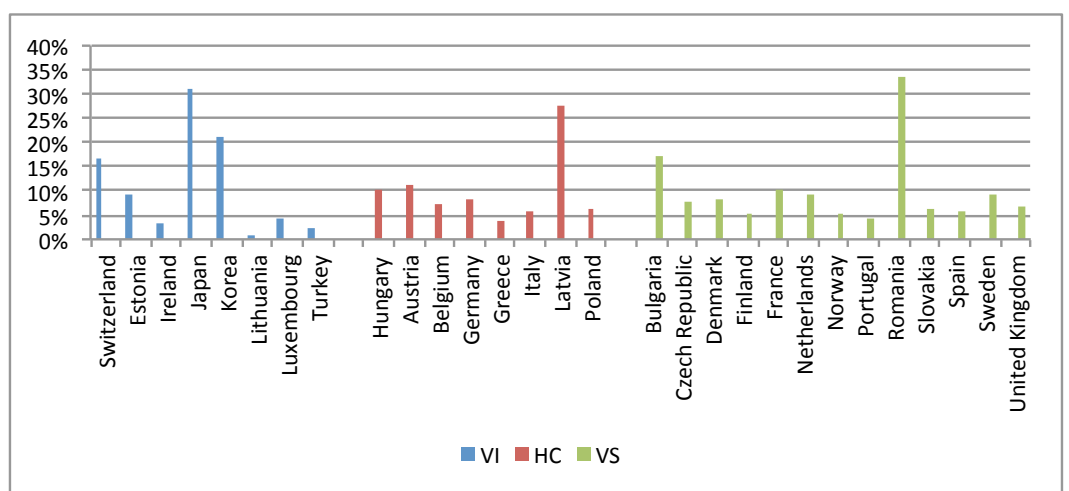


FIGURE 3 MODAL SHARE (2008) BY COUNTRY FOR PASSENGERS

It is clear from the figures that the differences between countries within regime groups are larger than the differences between regime groups. This suggests that other factors

play a role in determining modal share as well. In our research, we have tried to isolate the other factors influencing modal shares.

Empirical results

For national freight traffic, no statistically significant effect of any of the structural or competition indicators was found. Moreover, the difference between the parameters for the holding company and vertical separation is also statistically insignificant.

For passenger traffic, the key result is that there is no statistically significant difference between the vertical separation model and the holding company model when the passenger market is open to competition. However, the combination of vertical separation with market opening appears to be superior to vertical integration.

In short, then, we find no evidence that vertical separation is superior to the holding company model in its impact on rail's modal share in freight or passenger transport.

2.4 Value for money for state budgets

This last quantitative chapter takes a different, non-econometric approach and concentrates on one question: "How many Euros of taxpayers' money can yield a certain output?" This study develops a simple comparison of government spending and outputs achieved for a set of selected countries (Great-Britain, Germany, France, Switzerland and the Netherlands).

Traffic volumes

Graphing the evolution of traffic volumes for passengers (in absolute terms and per inhabitant) and for freight, the chapter shows that passenger traffic volumes in Germany (holding company model) and the Netherlands (vertical separation) have grown by around 10% over the past 10 years, while Britain (vertical separation) and Switzerland (vertical integration) had an overall growth of 33% and 42%. On average, Swiss inhabitants use passenger transport by rail most intensively, compared to the other countries in the sample. The UK has grown substantially too, but remains at about half the level of Switzerland. The evolution in freight transport is more diverse. Germany (holding company model) has realized a sizeable growth, while other countries have remained stable or saw a substantial decline, such as France (vertical separation). However, the central position of Germany in the European freight streams could be part of the explanation for this difference.

State funding

In term of state funding, no clear overall trend is visible from the analysis and definition problems linked to historical railway debts render the comparisons difficult. The funding in France (vertical separation) seems to remain on a fairly constant level, the UK (vertical separation) had a significant rise until 2006 and dropped again, in the Netherlands (vertical separation) funding oscillates between 8 and 12 ct/transport unit and Germany's (holding company model) numbers show a fairly constant downward trend.

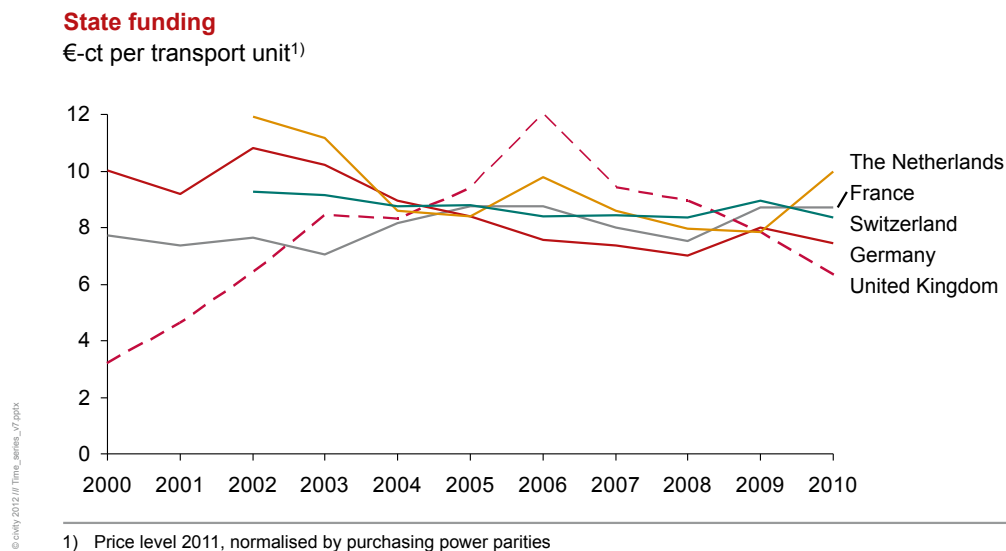


FIGURE 4 DEVELOPMENT OF STATE FUNDING (TRANSPORT UNITS)

The interpretation of state funding is caveated in the chapter for several reasons. Summing up passenger-km and tonne-km (though customary in the railway sector) does not completely enable a fair comparison of funding needs when the relative shares of freight and passenger transport vary between the countries compared. Furthermore, the data covers a shorter period than the lifetime of infrastructure assets and the countries compared operate under different conditions and provide a different blend of services (density, speed or mixity of services, isolated versus transit country, etc.). Finally, in the countries covered, the farebox revenues per passenger-km vary by a factor of two (see Figure 5), mainly due to different political decisions and pricing policies, fare levels, the type and quality of transport services offered etc. The largest difference between annual state funding and passenger revenues is visible for the UK, which is more user-financed than other systems.

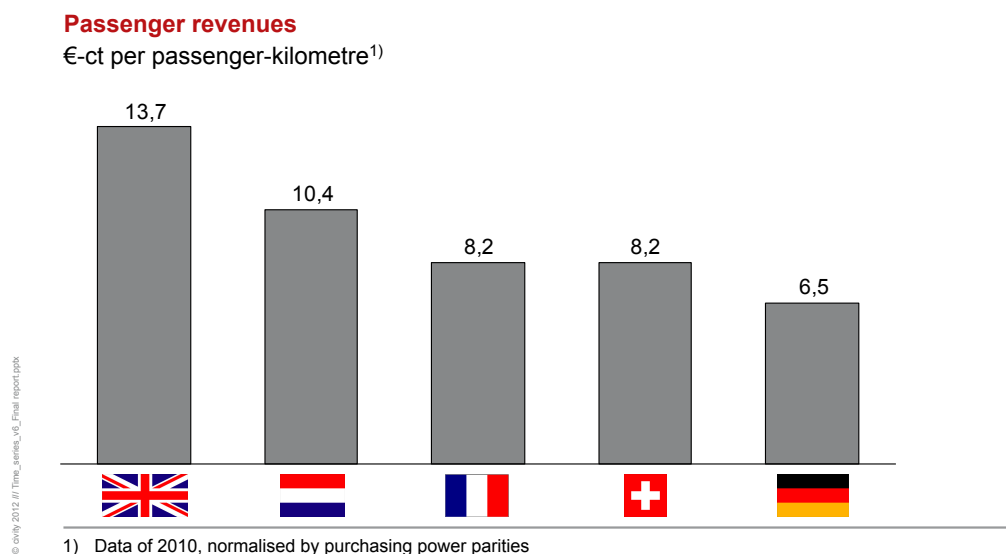


FIGURE 5 PASSENGER REVENUES PER PASSENGER-KM

2.5 Conclusion

The study carried out detailed econometric work in order to examine whether vertical separation is inherently better or worse than alternative organizational forms such as the holding company model or vertical integration in its impact on costs and modal share.

The econometric work conducted did not lead us to the conclusion that complete vertical separation is systematically superior to the holding company model or vertical integration in its impact on costs, although in some cases it might be for less dense railways. However, we find evidence that cost disadvantages of vertical separation arise and grow with increasing density of rail transport on a network and with the importance of freight traffic. In terms of modal split, vertical separation appears to have advantages over complete vertical integration for passenger traffic, when combined with market opening, but we cannot say on the basis of the current evidence whether or not it is superior to the holding company model.

Our additional analysis of state funding, also concluded that no clear pattern of worse value for money for state budget from more vertically integrated countries emerged from this approach.

To shed more light on these quantitative findings, we developed in the next part of this report a second – more qualitative – approach that looks in more detail into the railway value-chain to understand the specificities of the railway sector and the reasons why some reforms yield or fail to yield certain effects.

3 Qualitative research findings

Part 1 of the study reviewed the quantitative effects of rail sector reforms in Europe. There we have seen evidence in the econometric analysis that the structure of the industry may have an effect on costs and that the effect may vary with the density of traffic on the rail network. However, econometric analysis alone cannot show why these differences occur. We have also seen in the earlier chapters that transaction costs and costs resulting from incentive misalignments appear to be the main additional costs caused by vertical separation. To address these issues, the study complements the approach developed in Part 1 by a second one that looks in more detail into the railway value-chain to understand the specificities of the railway sector.

The research conducted in the next chapters develops a generic rail industry model and looks in more detail at the main potential problems of unbundled regimes in terms of potential misalignment of incentives in the case of vertical separation and potential for discrimination in alternative structural options. Various options for overcoming those problems are also presented.

The research includes addressing the following questions:

- What does the consulting literature tell us about the impacts of unbundling?
 - Chapter 5: Literature review
- What is the structure of the railway value-chain and what are the consequences of unbundling?
 - Chapter 6: Rail sector model: understanding the value chain, where interfaces lie, and what institutional forms exist or may potentially exist
 - Chapter 7: What happens at those interfaces? What are the interests (“target functions”) of rail sector actors and where and when do they work well (aligned) or lead to conflicts/losses (misaligned)?
- What are the options for competition and non-discriminatory access?
 - Chapter 8: How is non-discriminatory access supported in different rail sector models? Is competition substantially affected by the vertical separation regime in practice?

3.1 Review of the literature

This part of the research starts by reviewing non-academic literature on the impacts of alternative railway structures, to complement the academic review conducted in Part 1 of the study. This literature is very diverse, consisting mainly of government reports realised by teams of consultants. The studies that we briefly review here all focus on the functioning of the railway sector in one country, though most do also attempt to benchmark the performances of a national railway system with those of peers. Although most studies attempt to list the positive and negative consequences of various unbundling options, few existing studies do – to our regret – attempt to quantify precisely the consequences of unbundling, perhaps also underscoring the difficulty linked to the gathering of facts and the construction of useful counterfactual scenarios in this sector.

The most interesting recent study on the consequences of unbundling is undoubtedly the official British McNulty (2011) study. The study views the current market organisation with its high level of fragmentation as an important reason for inefficiencies, characterising the system as ineffective and misaligned and the industry's legal and

contractual framework as complex, leading to adverse effects and additional costs. It states that there are few effective incentives across the wheel/rail interface, despite the complex track access charging system and performance regime in place. The study recommends changes to structures and interfaces, and a closer alignment of incentives between IM and RU at the route level, by cost and revenue sharing (and joint targets), by joint ventures or by alliances. In some circumstances it even recommends full vertical integration through a combined concession for infrastructure management and train operations. The study recommends a stronger focus on co-operation, partnership, whole-system and whole-life approaches, and more consideration for trade-offs between infrastructure, rolling stock and operations. It concludes that "one size will not fit all" in different regions of Great Britain, with different solutions being seen as optimal in areas where a single franchisee dominates train operations compared to where this is not the case. Studies realised in the context of the McNulty study seemed to confirm that the reduction of transaction costs would be modest, instead the principal benefits of vertical integration were seen to come from better alignment of incentives that could lead to savings from 2 to 20% of infrastructure costs.

An earlier German study, which was considerably less comprehensive than the McNulty study, attempted to assess different institutional configurations for the German railway sector ('Synetra' report, Brenck et al., 2004) using a transaction cost based approach to assess the synergies between IM and RU. Contrary to the McNulty findings, the Synetra study concluded that for most interfaces and to fully benefit from synergies an integration of network and transportation is not needed. There is no general recommendation or one-size-fits-all solution either as the study concludes that for investments, especially in dedicated lines such as high-speed, a stronger need for coordination has been found, which could be resolved by using hybrid solutions. Other core interfaces such as timetable coordination, slot allocation and operations management should, according to the study, be coordinated through market mechanisms.

Only one study is directly aimed at calculating the financial consequences of separating infrastructure from transport (PRIMON-report, 2006). This study predicts budgetary disadvantages of full separation to range between € 6.4 to 9.4 billion and sustainable annual cost of complete separation of € 0.488 billion for Germany.

A recent Dutch parliament enquiry on maintenance and innovation in the rail sector also provides interesting insights (Tweede Kamer, 2011). Here a benchmark study realised an international benchmark comparing six countries (Hansen et al., 2011). One conclusion is that vertically integrated companies like SBB and JR East, combined with other regionally, vertically integrated railway undertakings and networks for passenger services achieve the highest performances without prejudice to freight operators who get open access to these networks. On that basis, the study recommends an inquiry regarding synergy and welfare effects of (re)integration of operations and infrastructure management, considering that integration of the main RU and the IM would, for the Dutch situation, create opportunities for a more effective governance, system wide innovation and higher efficiency by optimizing investments and management, while avoiding the disadvantages of vertical separation that the study observes, such as suboptimal decisions driven by individual financial (operational) interests of the IM and the RUs. The examples mentioned by the study include the current separated (and double) information streams to passengers during disruptions, the underutilisation of existing capacities during major disruptions, the consequences of track possessions for maintenance on passenger and

freight traffic, badly coordinated investment decisions on infrastructure extensions and new rolling stock and substantial transaction costs.

Finally, a national debate conducted by the French government (the so-called ‘Assises du ferroviaire’ involving all stakeholders in 2011) evaluated the current French railway model. The report on governance observes that the current regime (RFF and SNCF) has much trouble to respond to the expectations of the various actors, that the current model is hampered by its fragmentation and lack of clarity, that it is a source of inefficiency, that a further grouping of all infrastructure management competencies under one management is desirable, and that the current regime has led to a misallocation of public resources, away from priority investments needs. The report suggests two options for the future. One is based upon a stricter separation between IM and RU, the other based upon a stronger coordination of the RU and IM tasks within a common group company, but with a clear separation of essential functions. The report mentions that the first option could lead to sub-optimisation as identified by the McNulty study in Great Britain, and also to a loss expertise and professionalism due to an exaggerated separation. The second model is seen by the report as favouring system-wide optimisation but at the expense of a potential lack of neutrality versus potential entrants and of a monopolisation of railway expertise by the incumbent operator. Nevertheless, the report considers that the potential risks of a holding model (groupe-pivot) can be controlled and that the benefits of this model in terms of efficiency, staff mobilisation and industry development outweigh the risks. Therefore, in conclusion, the report recommends to the government to explore the option of a holding model.

In sum, the reports reviewed here question the optimality of full vertical separation but do not all come to identical conclusions, except perhaps for the finding that there does not seem to be a ‘one-size-fits-all’ solution in term of unbundling. Only one study is directly aimed at calculating the financial consequences of separating infrastructure from transport. It finds a net negative effect from separation for the German case. Determining elements for the debate include the discussions on fragmentation versus leadership, short-termism versus the need for long-term planning, sub-optimization and misalignment versus whole-systems approach and incentive re-alignment, and transaction costs versus induced system costs.

3.2 A generic model of the rail sector

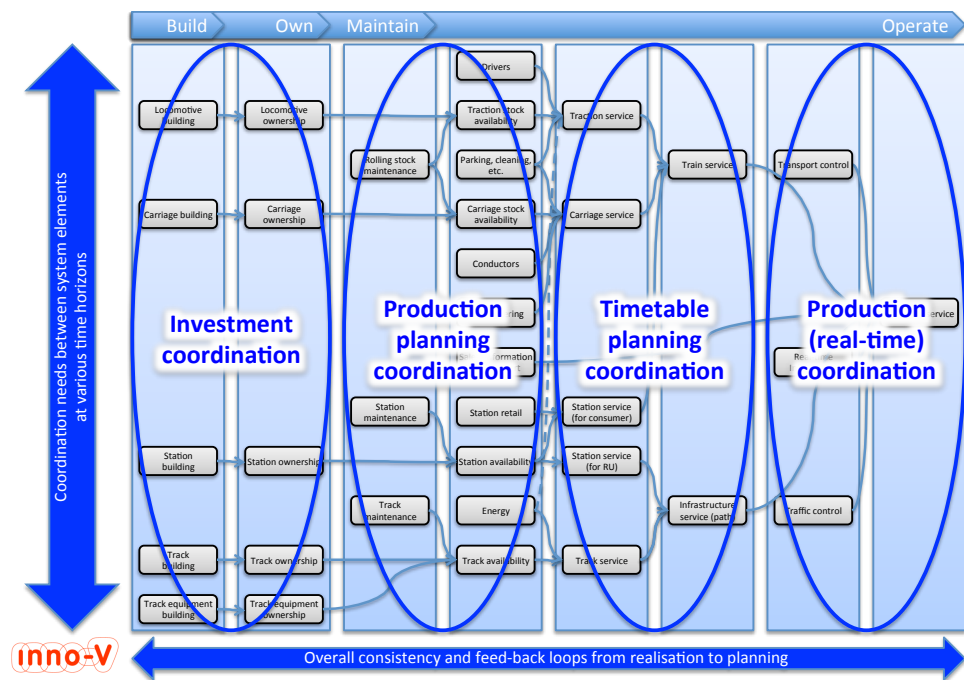
The literature review and the quantitative analysis point to the importance of the analysis of transaction costs in unbundled regimes, but also at the relatively larger importance of the misalignment costs that may result from an inadequate institutional setup.

For this reason, the study developed a generic ‘rail sector model’, taking the shape of a generic chart, and laying down the conceptual framework needed for an analysis of potential misalignments that will be conducted within the study. This generic model describes the main production processes and transactions present in the railway sector, irrespective of the institutional configuration chosen. This approach then allows superimposing various institutional configurations to illustrate and better understand the localisation of and boundaries between the actors created by various unbundling options. This helps to understand where specific coordination mechanisms may be needed to ensure a proper functioning of the sector, distinguishing between the short, the medium and the longer term. It also helps to understand whether and why these needs might be different from what can be observed in other sectors. This decomposition also allows for a

better understanding of related transaction costs, coordination needs and regulatory needs.

As presented in Figure 6, the approach distinguishes between four main planning terms and coordination circles:

- Firstly, long term planning is concerned with investments in assets that are characterised by lengthy amortisation periods, both for the moving assets, and even more so for the fixed assets. Their configuration largely determines the general service concepts that will be feasible for the years to come (speed, comfort, connectivity, capacity).
- Secondly, medium term service planning is concerned with the development of concrete service concepts and staffing (incl. training).
- Thirdly, the rail sector is characterised by a timetable cycle, usually one year, representing the shorter term, often complemented by even shorter term planning (not represented here for the sake of clarity).
- Finally, real-time adjustments to the plans are often needed at the realisation phase to cope for unforeseen events, e.g. disruptions.



• Figure 6 Rail sector model: Coordination (Source: inno-V)

The model also discusses the place and role of regulatory interventions and wider coordination issues (such as technical standards).

The various existing or potential structural options for the rail sector represent different institutional configurations of this decomposed value chain, where different actors combine different elements of the value chain within one or several organisations. This chapter illustrated this by representing graphically how main incumbent operators have been reorganised into separate entities under different regimes.

3.3 Analysis of alignment of incentives between infrastructure managers and railway undertakings

On the basis of the four terms or circles described in the generic rail sector model, the study then inventories potential misalignments between infrastructure manager and railway undertakings. The approach is led by a consideration of the target functions that could lead the IM and RU in different institutional settings.

Target functions

In a vertically integrated regime, all decisions pertaining to both the infrastructure and the operations of trains can be taken within one company by one line of command and a business-case is developed for each ‘new idea’ and each is evaluated in terms of its total contribution. This approach is at the centre of the management decisions of the many privatised Japanese vertically integrated railway companies and it results in a tailor-made infrastructure that meets infrastructural needs while maximising passenger revenues. These for-profit companies are long-term profit-maximizers, subject to strong intermodal competition, sometimes network competition, and to various regulatory constraints such as yardstick competition with their peers to prevent excessive customer prices. Importantly, most of these railways have also extensively developed real estate, retail and public transport services around their lines to ensure a long-term passenger orientation towards the railways. This regime results in a powerful competitive and regulatory mix generating various strong competitive incentives on various time horizons.

In the European railway sector, which is submitted to an obligation of accounting separation between infrastructure management and train operations, one major re-alignment mechanism is required by law to replace internal trade-offs made by vertically integrated companies. This is the track access charging regime. Ideally, the track access charging regime should:

- Send the right signals to the infrastructure manager concerning the need for investments, renewals and enhancements to the infrastructure to provide a fit-for-purpose demand-oriented network;
- Influence the railway undertakings to make best use of the network, taking into account aspects such as route capacity and congestion, wear and tear caused by rolling stock and emissions from trains;
- Assure that both the infrastructure manager and the railway undertakings provide assets and services at a market-oriented level of performance (e.g. reliability, punctuality) and
- Induce both the infrastructure manager and the railway undertakings to constantly optimize their production to what is both technically and economically feasible.

Such a pricing regime would then – ideally – lead to system-wide optimisation, covering all activities in all coordination circles and leading to an optimal allocation of resources. However, it appears impossible to design a track access charging system that simultaneously provides for non-discrimination, appropriate incentives for efficient development of the network and appropriate incentives for its use.

Furthermore, most European IMs are publicly owned and are partly funded by the state. The incentives to invest will in this case to a large extent come from the financing coming from multi-annual contracts with the government as well as from further regulation. This might not lead to an efficient identification of what RUs need compared to a direct commercial relationship.

In addition, while asset specificity issues can be mitigated within an integrated or holding situation with credible long-term commitments from both 'sides' (IM and RU), this situation is more difficult to resolve under a separated regime. This can even result in a decline of infrastructure investments following separation in the rail sector (OECD, 2012, p. 110).

Interfaces, misalignment and coordination circles

The study then focuses on describing issues of misalignment that can exist within each of the four circles or planning terms:

- For investment coordination this includes misalignments that can appear when considering extensions of decommissioning parts of a network, or when upgrading or downgrading infrastructure.
- For production planning coordination, this includes misalignments that can appear in relation to the quality of the resources used and the resulting system reliability. It also includes the fundamental issue of 'small scale' investments that can prove to be determinant in their evolutionary impact on total system performance.
- For timetable coordination, this includes misalignments related to path allocation between maintenance and transport, but also issues related to timetable robustness.
- For real-time production coordination, this includes issues related to disruption handling and also the important feed-back loops from measured problems at the realisation phase back to timetabling, resource planning, system reconfigurations and major investments.

Unbundling and realignment

The potential consequences of misalignments appear to be varied and include: held-up investment opportunities in various technical assets, networks not developed in line with market requirements and sub-optimal combinations of assets (rolling stock, track and personnel). These lead to excessive costs of production, externalities in the sense of efficiency savings from one party's actions coming at the disadvantage of the other party's cost and performance and negative impacts on daily operations. The misalignment issues have important technical components and the pivotal point with all these issues is that costs and benefits of various actions can fall apart and that one actor bears the costs whilst the other one gains all or at least a noteworthy share of the benefits.

The quantitative evidence available to assess the concrete cost consequences of misalignment is unfortunately very limited, as few studies have attempted to review transaction costs and much less is available about the induced costs of unbundling, even though several studies (see the literature review) have pointed at the issue.

The review of the misalignment in the four circles have shown that additional re-alignment mechanisms have been developed in various contexts besides the basic re-alignment mechanism formed by the track access charging system, which itself proves to be insufficient to solve all misalignment issues created by unbundling. The re-alignment mechanisms put in place are hybrid solutions, combining market and hierarchy. Long term contracts, strategic partnerships and joint ventures are examples of this. They set out targets and partially apply bonus/penalties schemes to incentivise the actors over and across the train/infrastructure divide. Various types of co-operations or alliances spanning from non-contractual agreements between infrastructure manager and railway

undertakings, to voluntary contractual agreements and sharing of staff have been developed. The establishment of joint control centres represents a further example.

These solutions are scalable in scope, size and depth, and involve the development of partnerships over longer periods of time. This comes with transaction costs to design, negotiate, contract and manage them.

Re-aligned unbundled regimes versus incentivised bundled regimes

It remains difficult, however, to identify to what extent and under what conditions the combination of vertical separation with additional realignment mechanisms will be sufficiently powerful to deliver the same level of optimisation as what is potentially achievable under coordination through bundling. In other words, the existence and implementation of ‘a’ re-alignment mechanism that delivers performance improvements does not prove that the misalignment issue has completely been solved. Several issues prevent us from drawing clear conclusions: there is a lack of thorough benchmarking of relevant production processes, and European railways and governments have themselves not spent much time attempting to identify and quantify the potential misalignments resulting from unbundling or the exact beneficial consequences of the re-alignment mechanisms that have already been put in place. Additional research on incentive misalignment issues would be welcome.

The potential shortcomings of unbundling and re-alignment mechanisms do not necessarily mean that bundled railway systems are in themselves a guarantee for optimal performances. Rather, our analysis shows that a bundled regime can allow for integral decisions to be taken to the advantage of the system as a whole, leading to a higher performance at the system level than what would result from the juxtaposition of two optimal decisions at the sub-system level (RU and IM) that would be insufficiently re-aligned towards system-wide optimality. Whether a bundled regime will lead to optimal decisions at system-wide level and deliver better performances, depends upon more factors including sufficiently powerful external pressures for performance improvement. Clearly, many of the former European bundled regimes have in the 20th century been suffering from unclear, weak or contradictory sets of incentives, further blurred by various interventions (service obligations, investment policy, employment policy) that have heavily burdened railway costs and performances.

Additional performance incentives may be helpful here too and various options exist. Some see competitive pressure, such as open-access, as an indispensable additional source of discipline for better performances. But other options that retain vertical integration and choose for other competition regimes exist throughout the world and have proved to be very effective, for example the reform of the regulation of the Japanese railways in 1987 mixing privatisation, intermodal competition and competitive regulation with yardstick competition between classes of railways, or that of the deregulation and strengthened competition in the American (freight) railways in 1980, although probably less relevant for most European states, except perhaps for the Baltic states.

Conclusions

The considerations above lead us to conclude that there does not seem to be a single simple recipe for success:

- Unbundling is a potential source of detrimental misalignments, but re-alignment mechanisms can be devised.

- Complex track-access charging regimes and performance regimes are contractual market mechanisms that can play a role but that do not appear to be adequate to solve all misalignment issues.
- Additional re-alignment mechanisms are being developed in various countries (e.g. GB, NL), and it is noteworthy to mention that these tend to move towards hybrid, cooperative arrangements, rather than simple contractual market mechanisms.
- Whether the resulting set of mechanisms will lead to a similar level of performance to what in principle can be achieved in bundled regimes (see, e.g., Japan) is doubtful.
- But bundled regimes, as an alternative to unbundling, are not in themselves a guarantee for optimal performance. Additional performance incentives may be needed here too and various options exist.
- Ultimately the choice of the most appropriate re-alignment mechanisms to put in place will have to depend upon the characteristics of the elements of the value chain at stake, the economic circumstances (economic development, economic perspectives, market conditions, characteristics of the networks and demand, etc.) and the institutional environment of the country or region. It is therefore also important to realise that the various elements of the value chain and boundaries between actors may require the implementation of different coordination mechanisms throughout the chain, all depending upon the varying characteristics of the transactions at stake.

3.4 Competition and non-discrimination

Whereas the previous chapter reviewed the shortcomings of vertical separation, this chapter looks at the potential shortcomings of the holding company model and of vertical integration, especially in terms of non-discriminatory access to the infrastructure, to guarantee the proper functioning of regimes where several railway undertakings may get access to the same network.

Options for non-discrimination

This chapter describes options for non-discriminatory access to the infrastructure in relation to various institutional configurations and presents some evidence concerning the actual market share of new entrants under various institutional arrangements.

The study shows that a number of mechanisms may be used to ensure non-discrimination in dealing with entrants in the rail industry regardless of overall industry structure. One important condition is the presence of a rail regulator, independent from the Ministry and with adequate resources to enforce its decisions. The arrangements reviewed and concrete examples presented covered vertical separation, the separation of the so-called 'essential functions' into an institutionally separate organisation, the enforcement of enhanced compliance and regulatory mechanisms within the holding company model, and the option of additional independence requirements between RU and IM. We have no clear evidence on the cost and relative effectiveness of these different measures, although clearly the independent bodies undertaking the essential functions in Switzerland and Hungary are lean organisations which do not cost much to operate.

Evidence on shares of new entrants under various regimes

It can be interesting to review the facts in terms of the market shares of new entrants under various regimes in order to evaluate the relative merits of various institutional configurations.

Figure 7 shows the market share of entrants² in the freight transport sector, based on the most recent Rail Market Monitoring Survey (European Commission, 2012). The figure distinguishes between vertically separated regimes and vertically integrated or holding company regimes.

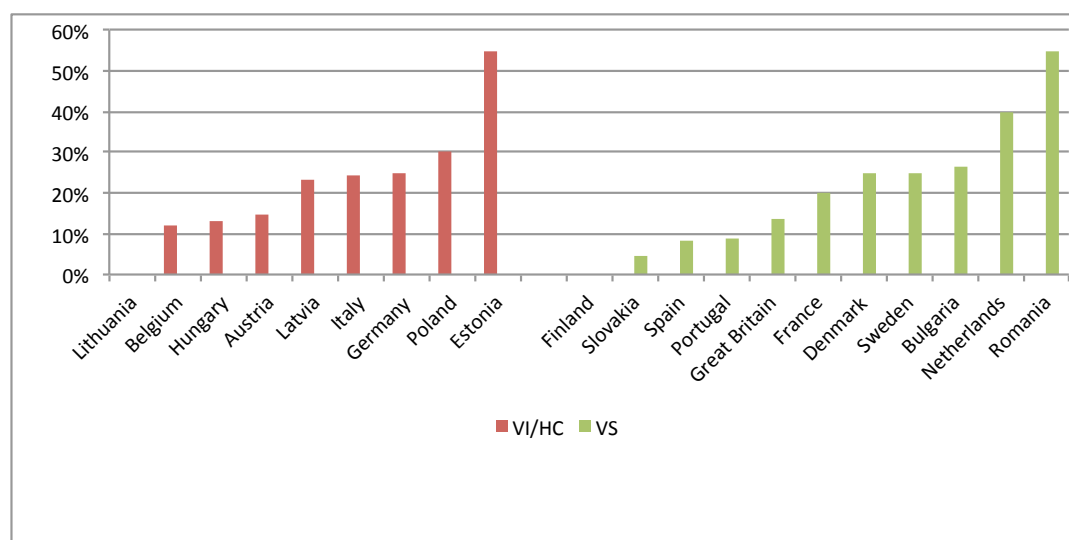


FIGURE 7 MARKET SHARE OF NEW ENTRANTS IN THE FREIGHT MARKET, SELECTED COUNTRIES, 2010 (SOURCE: RMMS, 2012)³

The figure shows that the average shares of new entrants for these two subsets of countries do not significantly differ, suggesting that market entry and intra-modal competition can exist under various institutional options. Nor is there any clear pattern that countries with separated essential functions or enhanced compliance mechanisms have a different level of competition than other VI/HC countries, although obviously the sample is very small for this to emerge. Atomistic market shares (numerous small operators without any single larger operator) do not either seem to be typical for these markets.

Growth of market shares of new entrants

A promising additional approach consists in looking at the *change* in market concentration over time by taking the market share of all but the largest operator. In this case Table 3 suggests that neither full separation nor full separation of capacity allocation lead to stronger growth in the market share of operators other than the largest operator. Having separation, in other words, does not seem to support rail freight market entry

² Entrants are defined here as operators that have won market shares besides the main incumbent operator. Main incumbents that were sold to a new owner, such as in the Netherlands and Denmark, are not considered to be 'entrants' in this figure.

³ The lack of full or comparable data did not allow us to include all Member States in this overview.

more than not having separation, as measured by the market shares of the smaller players and by the range (min. – max.) of market shares in the respective set of countries.

TABLE 3 AVERAGE CHANGE IN MARKET SHARE (2008-2010) OF ALL BUT THE LARGEST OPERATOR BY INSTITUTIONAL TYPE (PERCENTAGE POINTS)

	Countries with full separation	Countries without full separation	Countries with fully separated capacity allocation (including full separation cases)	Countries without fully separated capacity allocation
Average change in market share	6.7	5.4	5.8	7.0
(Min. – Max.)	(0.0 – 15.0)	(-4.0 – 13.7)	(-4.0 – 15.0)	(0.6 – 13.7)

Besides the average results there is also no clear pattern at the extremes of the distribution. The changes in market shares range from below one percentage point in four countries (Finland and Slovakia with full separation, Lithuania with full separation of capacity allocation, Austria with neither) to ten percentage points or more in another five countries (Romania and the Netherlands with full separation, France with full separation of capacity allocation, Poland and Latvia with neither).

Entry in the passenger market in the period of our data comprises almost entirely the outcome of competitive tendering. Competitive tendering is not used in many countries, but it occurs both under vertical separation and holding company models. Its outcome does not appear to depend on the degree of separation.

Open access in passenger transport is currently very limited, and took off essentially in the last one or two years. For this reason it could not be included in this study, although recent national experiences will be interesting to follow (e.g. Italy, Austria and Czech Republic).

Conclusions

A number of mechanisms may be used to ensure non-discrimination in dealing with entrants in the rail industry regardless of overall industry structure. One important condition is the presence of a rail regulator, independent from the Ministry and with adequate resources to enforce its decisions.

What is clear from the empirical data is that substantial entry can occur under any of the reviewed institutional structures, and that no single structure seems more favourable than the others in terms of promoting market entry.

4 Potential effects of reforms in view of the 4th Railway Package

This last part of the study brings together the findings of both the quantitative part and the qualitative part into a simplified cost-benefit analysis of shifting from one given structural option to other structural options. In doing so, it attempts to identify what the potential effects of reforms could be in view of the pending 4th Railway Package.

This part is organised as follows:

- What are the implications of the findings of this study?
 - Chapter 8: What can be said about the (potential) effects of switching from one regime to the other?
 - Chapter 9: Conclusions of the study: what did we learn? (focus: content/analytical)
 - Chapter 10: Policy recommendations (focus: political)

4.1 Cost-Benefit Analysis

Return to complete vertical integration is not seen as a realistic option within the European Union. Therefore, the following options were retained for the analysis to be conducted in this chapter:

- Vertical separation model:
 - No additional provisions
 - Measures to achieve realignment
- Holding company model:
 - No additional provisions
 - Enhanced compliance mechanisms
 - Annex 5 provisions
 - Separation of essential functions

We will first compare the two sets of options (vertical separation set and holding company set) as a whole, then compare the options within each of the two sets of options and – finally – draw general conclusions.

Comparing full institutional separation with the holding company model

In general, one would expect that the strongest argument for full institutional separation would be that it provides assurance to railway undertakings of non-discrimination, and therefore attracts the greatest degree of competition. This in turn might lead to an improvement in services (yielding benefits in the form of additional revenue, benefits to users) and reduction in costs. Other possible advantages of complete institutional separation are that it provides financial transparency and enables specialisation. Transparency may in itself be a way of increasing competition, but it may also have other advantages in terms of helping regulators and state authorities to make efficient decisions, for instance regarding investment. In a franchising system it may attract bids from more companies than those who would be willing to take responsibility for both the infrastructure and train operations in (regional) vertically integrated franchises.

On the other hand, as we have seen, complete institutional separation raises issues of transaction costs, duplication and misalignment of incentives. The literature review

provides evidence of all of these, and suggests that problems arising from misalignment of incentives may be the most significant. We have considered these possible misalignments in detail in chapter 7 of the study. Such misalignments may affect investment planning, production planning, timetabling and real time production coordination. For instance, infrastructure managers may have too little incentive to help train operating companies to increase revenue, by timely implementation of improvements in capacity and quality, and by failing to optimise timetables, slot allocation and day to day operations (for instance in terms of planning and undertaking track maintenance and renewals and recovery from delays).

TABLE 4 POSSIBLE COSTS AND BENEFITS OF FULL VERTICAL SEPARATION (COMPARED WITH A HOLDING COMPANY MODEL)

Possible costs	Possible benefits
<ul style="list-style-type: none"> • Increased transaction costs • Costs of duplication of staff • Misalignment of incentives leading to increased costs and poorer services in: <ul style="list-style-type: none"> • Investment coordination • Production planning efficiency • Timetabling optimality • Production coordination 	<ul style="list-style-type: none"> • Increased competition leading to lower costs and improved services • Increased specialisation also leading to lower costs and improved services • Increased transparency, improving efficiency of regulation and funding, leading to lower costs and improved services

Thus overall we find reasons to believe that depending on a number of circumstances vertical separation may raise or reduce costs, and may raise or reduce rail's modal share, compared with the holding company model. Any overall cost-benefit assessment must therefore depend on empirical quantification. Although our qualitative analysis provides many examples of such analysis, it does not permit overall quantification, so we must rely on the econometric analysis for that. However, we note already that we found no evidence that complete vertical separation typically leads to more competition than the holding company model, which already seems to undermine the strongest argument in favour of vertical separation.

We have found no evidence that structural reform in the freight market has benefitted rail's modal share. In the passenger market, it appears that the combination of permitting market entry and vertical separation is superior to vertical integration, but we are unable to conclude whether this is better than the combination of permitting market entry with a holding company.

Regarding costs, we have weak econometric evidence that the holding company model reduces costs compared with full integration, whilst the analysis strongly suggests that complete vertical separation reduces costs for lower density railways but raises it for high density railways. At typical density levels, the holding company model seems to have the lowest costs. At any density level, vertical separation is more costly where a high proportion of revenue comes from freight traffic.

We were prepared for the result in terms of higher density railways, as we believe that the transactions and misalignment costs that arise with vertical separation are to a considerable extent associated with timetabling and real time traffic control, which are more problematic where traffic is dense. We are less able to explain the result for lower density railways. Even if vertical separation increased competition, we find no evidence that increased competition reduces costs. Whilst we have noted that there are other

arguments as to why vertical separation might reduce costs, we do not find these very convincing.

In any event, for many of the largest European railways, at current traffic levels, complete vertical separation does not appear to reduce costs, and imposition of a rule requiring it would impose substantial costs on the European rail system as a whole. If traffic grows in accordance with European Commission goals (2011 transport white paper), there will be even fewer railways for which costs are projected to be reduced by complete vertical separation.

The only publicly available study of the impact of moving from the holding company model to complete vertical separation of which we are aware is the PRIMON (2006) study undertaken for the German government. The PRIMON study suggested that it would be likely that a completely separated model would be less favourable than a holding company model in its impact on the government budget. In a long term view (2006-2020) the negative budgetary effect is estimated to range between €6.4 to 9.4 billion. Yet, this estimate is based on several drivers, some of which should not be regarded as a cost in our cost benefit analysis, e.g. the assumption that separation would increase competition, and thus reduce the profitability of the assets the government would either sell, or retain and receive dividends on. In the narrow sense, the costs of complete separation identified were a loss of synergies of €1.1 billion for 2006-9 and transition costs of €1.5 billion over the same period. For the longer run, PRIMON estimated sustainable costs of complete separation of €0.488 billion per annum. As against these, the study assumed that competition would be higher and that this would lead to savings of €3.3 billion in present value terms in regional passenger services for 2006-2020, i.e. €0.22 billion per annum. Thus even if the latter estimate was accurate, these benefits would have been outweighed by the estimated costs.

Thus whilst it is possible that in some circumstances vertical separation might be a sensible structure to adopt, it certainly cannot be advocated for all circumstances.

Variations on the holding company model

The main objection of the Commission to the Holding Company model is that it gives the infrastructure manager an incentive to discriminate in favour of its own sister companies, and thus makes market entry more difficult for other undertakings. To date, the main defence against that has been the appointment of a regulator, to consider and rule on alleged cases of discrimination. Moreover, complete vertical separation will not remove the incentive for the infrastructure manager to favour major customers over minor ones. It should be reiterated that we have found no systematic pattern whereby new entry, where permitted, is less likely with a holding company than complete separation, so it is not clear that further measures are needed. Nevertheless, alternative further solutions to the problem of potential discrimination have been suggested and were discussed in the previous chapter. We will comment on each in turn:

- Firstly there is the possibility of institutional separation of essential functions, namely setting access charges and allocating capacity. We have found interesting examples of such arrangements in Switzerland (combined with complete vertical integration of infrastructure and operations), Hungary, Luxemburg, Slovenia and the Baltic countries, and for certain years in the Netherlands. However, the extent of the data was not sufficient for us to obtain robust econometric results. It does not appear that such a body needs to be expensive. We have seen the examples of

Switzerland and Hungary where a body with a very small staff fulfils this function (in Switzerland, infrastructure charges are the responsibility of the Ministry, and detailed timetabling is undertaken by SBB under the supervision of Trasse Schweiz, but in Hungary the body in question is completely responsible for capacity allocation, charging, and timetabling). Thus it is not in itself a costly reform, but it may introduce some of the misalignment problems that were discussed in chapter 7, where development of the most effective timetable is made more difficult by vertical separation of this function. In Switzerland, this risk is minimised by having the main operator prepare the actual timetable. Some would object that this solution could introduce some possibility for discrimination, but this seems to work well in Switzerland. In Hungary, the problem is reduced by the existence of spare capacity in the infrastructure.

- The second possibility is the complete or partial implementation of the Annexe 5 requirements that the Commission presented in its working document of 2005. These range from cooling-off periods for IM staff, passing by the obligation to separate IT systems to the obligation to have separate buildings for IM and RU staff. These are not generally completely implemented at present, and it is the subject of current legal proceedings to determine whether their requirement is implied by existing legislation. According to the recent opinions expressed by the Advocate-General to the European Court of Justice, this is not the case. Clearly we have no real evidence on the impact of these requirements at present. The costs they imply are not money costs but those of not always being able to appoint the best, most experienced person to a particular post, and of not being able to share knowledge from the infrastructure manager and train operators as effectively as when these conditions are not imposed.
- The third possibility is the implementation of enhanced compliance mechanisms. The closest experience we have found of this is the provisions within DB and FS to ensure transparency and non-discrimination as described in the previous chapter. Our impression is that this is a useful way of reinforcing the commitment of senior management to non-discrimination throughout the organisation, but again we have no quantitative evidence on its effects beyond noting that DB and FS are the holding company facing the greatest degree of competition in our sample.

Quite apart from these three variants, we have found that the role of the holding company varies enormously from case to case and may also change over time. Whilst we see the Holding Company model as always involving a body that is responsible for separate subsidiaries dealing with infrastructure and operations, the role of that body varies. In Poland, for instance, the holding company plays little role in trying to integrate the activities of the different subsidiaries, whilst in Germany it plays a much more active role particularly in terms of non-essential functions such as longer term planning and investment. Nevertheless, in the quantitative analysis we have had to take the holding company model as a single option for comparison with complete vertical separation and with a separated realigned system. The variety of roles a holding company may play and their effectiveness remain issues worthy of more detailed research.

Comparing full institutional separation with a realigned separated system

Our main evidence on the comparison of a realigned separated system with complete vertical separation is that of Britain.

From the time of reform in 1994, Britain paid more attention to the alignment of incentives than did most countries. Thus a sophisticated system of track access charges differentiated to reflect the different wear and tear imposed by several hundred different types of vehicle was introduced. Later a congestion charge was added to reflect the greater potential for performance degradation (delays etc.) when lines are operated close to capacity. There are plans to increase the degree of differentiation of both charges as part of the current periodic review. There is a performance regime in which railway undertakings are compensated for delays attributed to the infrastructure manager or other operators, and in turn pay for the delays they cause. There is also a small payment to the infrastructure manager based on passenger-km to give them an incentive to undertake small-scale investments to enhance quality or capacity. Larger investment projects generally arise out of the process under which the government decides on the quality and capacity of infrastructure it is willing to pay for as part of the periodic review (the High Level Output Specification and the Statement of Funds Available). This process is informed by the application of cost-benefit analysis and overseen by the regulator. The regulator also undertakes periodic reviews of the infrastructure manager's finances, determining its revenue requirements on the basis of benchmarking studies of efficient costs, and has imposed a licence condition that it should 'meet the reasonable needs of its customers', and the regulator may impose penalties if it fails to do so. It can impose fines where quality falls below required standards. To the extent that it is unclear to what extent Network Rail will respond to such penalties, as it has no shareholders to bear the pain, these are supplemented by a system of performance related bonuses for Network Rail senior managers, also requiring the approval of the regulator.

Nevertheless, it was still considered by the McNulty (2011) review that there were major failings in the correct alignment of incentives. In particular, it concluded that railway undertakings had no incentive to assist the infrastructure manager in reducing total costs, since only franchisees pay more than marginal costs and they are protected from changes in track access charges under the terms of the franchise agreement, whilst the infrastructure manager had inadequate incentives to assist railway undertakings to improve performance and revenue. Various forms of alliances are advocated to overcome these problems. For some years, the infrastructure manager and railway undertakings have operated joint control centres responsible for real time control, with the dominant operator always present and smaller operators allowed to be present if they wish. Other alliances may cover specific issues such as track or station maintenance. The deepest alliance so far implemented is that with South West Trains, where a joint management team is now responsible for both infrastructure and train operations. Alliances necessarily involve a degree of sharing of revenues and or costs. But the most effective alliance in terms of alignment of incentives is the formation of a joint venture. Each partner then looks at its share of the profits rather than having an incentive only to look at the share of costs it will bear and the share of revenue it will receive. Essentially this result is also achieved in the case of South West Trains without a formal joint venture, since base line costs and revenues were agreed for the duration of the alliance, and all changes in costs and revenues from the baseline are shared equally between the two parties. There is evidence in the McNulty case studies that a joint venture might achieve substantial cost savings (up to 20% in one case study). However, railway undertakings that are not part of the joint venture will at best not receive the main benefits, and the problem of ensuring that they are not discriminated against may be tougher than with complete vertical separation. Thus these solutions work best where there is a single dominant train operator in the area covered by the alliance with common boundaries with

a region of the infrastructure manager; this is true of many areas of Britain because of the franchising system operated for passenger services and the low level of freight traffic.

Conclusions

In conclusion, then, the evidence does not suggest that vertical separation is necessarily best in cost-benefit terms. We find no evidence that vertical separation increases competition compared with a holding company model and likewise none that such increased competition would reduce costs. Nor do we find any evidence that vertical separation improves rail's modal share compared with a holding company model (although it does improve passenger market share when combined with market opening compared with vertical integration). For freight, there is no evidence that if it did increase competition this would improve market share.

Regarding the overall impact of restructuring on costs, the position is more complicated. At typical traffic densities, it appears that the holding company model reduces costs compared with vertical separation. While vertical separation does not have much effect on costs at average train density levels, at high levels of train density it increases costs. However, on less dense systems, vertical separation seems to have lower costs. We particularly warn against extrapolating relationships to organizations which are very different from those for which they were estimated. We do not believe our results to be applicable to small local railways.

A decision to impose vertical separation throughout Europe would raise costs by at least €5.8 billion/year for no accompanying benefits. If rail traffic density rises, as would be a result of the European Commission's strategy to raise rail's modal share, then the costs of imposing complete vertical separation everywhere will rise dramatically.

Where vertical separation is put in place, additional measures to align incentives should be considered. Vertical separation with enhanced alignment of incentives is assumed to work best where a single railway undertaking is dominant in each region and this operator can form an alliance with the appropriate region of the infrastructure manager (as identified in the British context).

For the holding company model to work well, the operators which are in the holding would retain a substantial market share over the whole system. Clearly the gains for this form of alignment will be much more limited if the operators in question have only a small share of the market.

We have examples of institutional separation of essential functions and of enhanced compliance mechanisms that seem to be working well, but we have no clear evidence on their benefits and it is not clear to what extent these experiences are transferable.

Our overall conclusion must therefore be that there is no evidence to support implementation of a single structure on all railways regardless of their circumstances.

4.2 Analytical conclusions

Some general conclusions arise from our analysis. Here, we begin with the implications of the qualitative work, and then return to the econometrics and overall conclusions.

Misalignment issues are important and need to be paid much more attention

There is evidence from the literature that vertical separation leads to additional transaction costs and costs from misalignment of incentives. Whilst the former appears only to add around 1% to total rail system costs, the latter appears to be more important, with estimates of up to 20% for particular case studies.

The high proportion of costs that are infrastructure costs and the complex interaction of infrastructure and operations as described in the rail industry model are very different to other utilities and transport modes, so solutions which work well there may not work for the rail industry.

Efficient setting of track access charges and a performance regime are important ways of contributing to the correct alignment of incentives in a vertically separated system, by giving train operators appropriate incentives regarding services to operate, equipment to use and reliability, and by giving infrastructure managers appropriate incentives regarding reliability and maintenance possessions.

Nevertheless, these misalignments of incentives cannot be fully removed by the combination of track access charges based on short run marginal social cost and a performance regime. Such access charges will not for instance give infrastructure managers appropriate investment incentives; nor will they incentivise train operators to assist infrastructure managers to minimise the costs of the required capacity and capability of the infrastructure. Investment plans and efficiency may therefore need to be overseen by the regulator to ensure that they meet the needs of railway undertakings in a cost-effective way. However, the regulator will not have the quality of information available to an integrated company, particularly as both parties will have incentives to distort the information the regulator receives to achieve their own interests.

Where a single operator carries a large part of the traffic over part or all of a system, a better alignment of incentives is likely to be achieved if this operator works closely with the infrastructure manager, either through a holding company or an alliance of some form. However, careful thought still needs to be given to how the holding company or alliance will work to overcome potential misalignment problems.

The need for coordination differs according to the situation of the railway

Railways in need for changes (upgrading, enhancements, extensions, scaling down) are likely to have different and more coordination needs than steady-state railways (railways that have a very low need for infrastructure adjustments). Railways in need for changes are more likely to find it more difficult to work under an unbundled regime than steady-state railways with sufficient capacity to accommodate all traffic.

While much of the academic literature on railway separation looked at the effect of various unbundling options on competition and efficiency, implicitly assuming a steady-state railway, the examples we reviewed show that incentive misalignment issues arise especially when railways are not in a steady state but have to evolve. While this can be true for large-scale investments such as new high-speed lines, it is probably even more crucial for smaller investments and more marginal improvement needs. It is important for future research to pay much more attention to the processes at the interface between infrastructure management and train operations. An inappropriate configuration of these interfaces can easily frustrate optimization processes that are inherently system-wide, resulting in a sub-optimal situation where both the track manager(s) and the train

operator(s) optimise on their own side of the fence, forgetting about the system-wide effects of their actions and generating a railway that is socially too expensive and remains short in terms of performance compared to what is technically feasible.

There is no clear evidence that additional measures are needed to prevent discrimination in the holding company model

Given that we find no evidence that the holding company model is currently inferior to complete vertical separation in terms of competition and market share, there is no clear evidence that existing arrangements to prevent discrimination are inadequate. These include a requirement for the regulator to deal with problems of discrimination in all countries, whilst examples of separation of essential functions and of enhanced compliance measures are found in particular countries.

There is no evidence that vertical separation is necessary in order to obtain the benefits expected from competition.

There is no evidence in practice that vertical separation leads to more intra-competition than the holding company model, nor that it leads to a higher rail modal share for either freight or passenger traffic. Recent trends show that changes in market concentration in the rail freight market vary substantially between countries but without any clear or significant relationship to the degree of separation. Whilst passenger market opening plus vertical separation seems to be better than vertical integration for passenger market share, we cannot conclude on whether it is better than passenger market opening plus a holding company.

The most effective model in terms of its impact on costs differs with circumstances

Our econometric evidence, based on data that has been subject to more checking and supplementation than previous studies, finds weak evidence that the holding company model reduces costs compared with complete vertical integration. It finds stronger evidence that it vertical separation raises costs for higher density systems and that it reduces costs for main line rail systems with on average lower density. We have seen plausible arguments as to why vertical separation might raise costs particularly for higher density systems, but the finding that it reduces costs for lower density systems is puzzling given that this does not appear to be due to greater competition. It has been argued that this is due to greater transparency and specialisation, but we do not find this fully convincing.

Our findings also implicitly indicate that there could be cases where switching models could be beneficial, either from a holding to vertical separation, or from vertical separation to a holding.

It should be noted that all countries have a mix of more or less dense routes with differing proportions of freight traffic. This might imply that it might be optimal to have a variety of structures within countries according to the characteristics of the region, but much more in depth work would be needed before such a conclusion could be drawn. Our relationships are estimated at the aggregate level only.

The econometric results show that horizontal separation appears to have led to a very substantial reduction in costs. Perhaps this is because such separation has usually been associated in Europe with selling off the freight operations, and has therefore imposed strong pressure to reduce costs (careful examination of the staffing and costs and

shedding of unprofitable traffic as was the case in Britain), thus the reduction, at least in that case, was not solely caused by separation itself. The cost reduction may also be driven by the increased cost and transparency resulting from the separation of the passenger and freight businesses; in central and eastern Europe, profits from freight traffic have often been used to cross-subsidise passenger traffic. It could also be the case that horizontal separation may have occurred disproportionately in countries where a positive result was expected; then such positive results should then not automatically be expected for all countries.

Vertical separation seems to have a less favourable impact on costs for railways with a high degree of freight traffic, suggesting that coordinating freight operations with infrastructure management is more demanding than for passenger. Possibly this is because freight runs to a less regular timetable than passenger and varies more from day to day.

We suspect that some of the beneficial impacts on costs of moving away from a completely vertically and horizontally integrated system, which do not seem to be associated with competition, arise simply because major structural reforms lead to a careful examination of costs and staffing levels. Other cleverly engineered reform could also have this effect.

Overall, different structures work best in different circumstances

We do consider our evidence to suggest that different structures work best in different circumstances, possibly even including different parts of the same country where traffic characteristics vary (different traffic density, different mixes of passenger and freight traffic, many small operators or one main operator)

For instance the holding company model seems to work best where traffic is relatively dense and includes a relatively high proportion of freight traffic. Vertical separation seems to work better when traffic is less dense, with a greater proportion of passenger traffic. Where vertical separation is in place, a combination of regional competitive tendering and alliancing (or even infrastructure leasing) to realign incentives between infrastructure manager and railway undertaking may constitute an efficient solution where traffic is dominated by a single operator as is often the case with a franchising regime. This solution depends on the ability to separate out the infrastructure used for regional services from the core main line network, which may not be possible in all countries.

Areas for further research

Most previous studies of the railway unbundling issue have suffered from inadequate and unreliable data, and perhaps that is one reason why results vary so much from study to study. We have made a good start in this project on dealing with this problem, but more needs to be done. We strongly recommend that the European Commission initiate further in depth research in this area in collaboration with the European rail industry.

The precise consequences of misalignment issues should be researched in greater detail along the line of the suggested rail sector model in order to enable the monetary quantification of their consequences, and to examine more closely mechanisms for their alleviation whether in vertically separated railways or holding companies.

A positive effect induced by a reform does not guarantee that reform to be the best possible one. A reform that generates performance improvements may prevent reaching

the higher level of performance improvement that a more suitable reform could have delivered. In the railway sector, the choice of an optimal reform path should therefore be based on a thorough understanding of the nature of the existing inefficiencies and, importantly, of the actual reasons creating those inefficiencies. Detailed benchmarking exercises, comparing the practices of railway sectors functioning under different structural regimes (from full vertical integration to full vertical separation) should therefore be strongly encouraged. This would generate essential new insights for the development of coherent structural options for the railway sector. It may well appear out of such analysis that major structural changes, such as vertical separation, are less potent than other, non-structural amendments to the existing regimes in reaching performance improvements.

4.3 Policy recommendations

Freedom to choose a structural option

Subject to providing for non-discriminatory access for competitors, EU Member States should be free to choose the structure for their railways that best suits their individual circumstances, thus allowing competition between different organisational models. This should include both the possibility of switching from a holding model to vertical separation, and the possibility of switching from vertical separation to a holding model.

Importance of alignment of incentives

Where vertical separation is adopted (and indeed where there is a holding company which is not active in coordinating decisions of its train operating and infrastructure subsidiaries) careful thought must be given to measures to ensure correct alignment of incentives between infrastructure manager and railway undertakings. This includes, but must go beyond, efficient setting of track access charges and performance regime bonuses and penalties.

Whatever the structure of the railway, the need for coordination mechanisms must be recognised

The infrastructure manager and railway undertakings must be encouraged to work together at a number of levels ranging from long term investment planning through to day-to-day traffic control. The implementation of feed-back loops across the whole sector from the measurement of operational performances to timetabling, resource planning and investment planning are essential. The circulation of personnel between infrastructure managers and operators from the one to the other is essential to guarantee a full understanding of the issues at stake in the sector. Separation can easily lead to a knowledge loss and to sub-optimisation.

Dense networks need particularly close co-ordination

Where traffic is dense, there is a particularly strong need to ensure close coordination. This may suggest complete vertical integration, a holding company structure, with an active holding company, or hybrid arrangements (such as joint ventures) between the infrastructure manager and the leading train operator.

The importance of dense networks will increase if the goals of European transport policy in increasing the usage of rail are realised.

Strengthening alternative regimes to guarantee freedom from discrimination in network access

Non-discriminatory network access has to be guaranteed whatever the regime chosen, in combination with mechanisms that allow for closer cooperation. To this effect, regulators need to get enough financial and personnel resources. The transferability of alternative approaches to vertical separation that allow for a non-discriminatory network access (such as the separation of essential functions and enhanced compliance and regulatory mechanisms within a holding model) should be studied in more depth to allow adapting them to local circumstances.

References

- Abate, M et al (2009), 'Estimating efficiency of reliable railroad companies', Department of Spatial Economics, VU University Amsterdam, The Netherlands.
- Alexandersson, G (2009) Rail Privatisation and Competitive Tendering in Europe. *Built Environment*. 36 (1) 37-52.
- Asmild, M, Holvad, T, Hougaard, J L and Kronborg, D (2008) Railway Reforms: Do They Influence Operating Efficiency? Discussion Paper 08/05, Department of Economics, University of Copenhagen
- Assises du ferroviaire (2011), "La gouvernance du système ferroviaire", Rapport final de la Commission No. 2, Paris.
- Berenschot (2011), "Operationeel Controle Centrum Rail - Audit naar de doeltreffendheid van het OCCR", Berenschot, Utrecht, 62 pp.
- Booz Allen Hamilton (2006), "Privatisierungsvarianten der Deutschen Bahn AG "mit und ohne Netz"", Berlin, 560 pp.
- Brenck, A., M. Holzhey, L. Hübner, B. Peter, T. Schulin and S.r. Schultz (2004), "Synergien zwischen Bahnnetz und -Transport, Praxis, Probleme, Potentiale", TU Berlin, Wirtschafts- und Infrastrukturpolitik, Berlin, 448 pp.
- Brenck, H. and Peter, M. (2007) Experience with Competitive Tendering in Germany In European Conference of Ministers of Transport (2007) Competitive tendering for rail services, ECMT, Paris.
- Cantos P, J M Pastor and L Serrano (2010) Vertical and horizontal separation in the European railway sector and its effects on productivity. *Journal of Transport Economics and Policy*. 44 (2) 139-160
- Cantos P, J M Pastor and L Serrano (2011) Evaluating European railway deregulation using different approaches. Paper given at the workshop on Competition and Regulation in Railways, FEDEA, Madrid, March 12.
- Caves, D.W., L.R. Christensen, M. Tretheway and R.J. Windle (1987) Network effects and the measurement of returns to scale and density for US railroads, in: A.F. Daugherty, ed., *Analytical studies in transport economics*. Cambridge: Cambridge University Press, 97–120.
- CER (2011), "Structural models for Europe's national rail sectors", CER Position Paper, Community of European Railway and Infrastructure Companies, Brussels.
- Coublucq, D, Ivaldi, M and McCullough, G. (2012) The Potential Impact of Open-Access on Prices and Investment: The Case of the U.S. Rail Freight Industry. .Paper given at the workshop on Competition and Regulation in Railways, FEDEA, Madrid, March 12.
- Drew, J. (2009). The benefits for rail freight customers of vertical separation and open access. *Transport Reviews*. , 29(2), 223–237.
- Drew, J. and C.A. Nash (2011), Vertical separation of railway infrastructure - does it always make sense? Institute for Transport Studies, University of Leeds, Working Paper 594.

Ehrmann, T., K.-H. Hartwig, T. Marner and H. Schmale (2009), "Specific Investments and Ownership Structures in Railways – An Experimental Analysis", Discussion Papers, No. 12, Institut für Verkehrswissenschaft, Westfälische Wilhelms-Universität Münster, Münster.

European Commission (2006), "Commission Staff Working Document - Annexes to the Communication on the implementation of the railway infrastructure package Directives ('First Railway Package')", SEC(2006) 530, Commission of the European Communities, Brussels.

European Commission (2012), "Commission staff working document accompanying the document 2012 Report from the Commission to the Council and the European Parliament on monitoring development of the rail market", SWD(2012) 246 final, European Commission, Brussels.

First class partnerships (2011), "Rail VfM Alternative railway structure study - Chiltern case study - executive summary", Department for Transport, London.

Fowkes A S and Nash C A (2002) Rail Privatisation in Britain – lessons for the rail freight industry. ECMT Round Table on Rail Privatisation, OECD, Paris

Friebel, G et al. (2010) Railway (De)Regulation: A European Efficiency Comparison *Economica* Volume 77, Issue 305, pages 77–91, January 2010

Griffiths T (2009) On Rail Competition: The Impact of Open Access Entry on the Great Britain Rail Market. Paper presented to the international conference on competition and ownership in land passenger transport, Delft, September 2009

Growitsch, C. and Wetzel, H. (2009) Testing for economies of scope in European Railways: an efficiency analysis. *Journal of Transport Economics and Policy*, 43 (1) pp1-24.

Hansen, I.A., P.B.L. Wiggeraad and J.W. Wolff (2011), "Inrichting, Gebruik en Onderhoud Nederlands Spoorsysteem Internationale Vergelijking", Parlementair onderzoek onderhoud en innovatie spoor, 32 707, Nr. 12, Tweede Kamer der Staten-Generaal, Den Haag.

Jensen, A. and P. Stelling (2007) Economic impacts of Swedish rail way deregulation: A longitudinal study. *Transportation Research E*, Vol 43, No. 5, pp. 516-534.

Ksoll, M. (2004). Integration of infrastructure and transport: An assessment from industrial economics and railway perspectives. Paper Presented at the 2nd Conference on Railroad Industry Structure Competition and Investment, October 8–9, 2004, Evanston, IL, USA.

Laabsch, C. and H. Sanner (2012), "The Impact of Vertical Separation on the Success of the Railways", *Intereconomics - Review of European Economic Policy*, 47, 120-128.

L.E.K. and Frontier Economics (2011), "Rail VfM Alternative Railway Structures - Final Report", L.E.K., London.

McNulty, Sir R (2011) Realising the potential of GB Rail: final independent report of the Rail Value for Money study. Department for Transport and Office of Rail Regulation, London.

Merkert, R. (2010), 'An empirical study on the transaction sector within rail firms', *Transportmetrica*, iFirst 1-16.

- Merkert, R., Smith, A. and Nash, C.A. (2012), 'The measurement of transaction costs – Evidence from European Railways', *Journal of Transport Economics and Policy*, 46(3), 349-365.
- Mizutani, F. and K. Nakamura (1997), "Privatization of the Japan National Railway: Overview of Performance Changes", *International Journal of Transport Economics*, 24, 75-99.
- Mizutani, F. and S. Uranishi (2012), "Does vertical separation reduce cost? An empirical analysis of the rail industry in European and East Asian OECD Countries", *Journal of Regulatory Economics*, DOI 10.1007/s11149-012-9193-4.
- Nash, C. (1997). The separation of operation from infrastructure in the provision of railway services: The British experience. In ECMT (Ed.) *The Separation of Operation from Infrastructure in the Provision of Railway Service* (pp. 53–89), OECD, Paris, France.
- Nash, C. (2005) Rail Infrastructure Charges in Europe, *Journal of Transport Economics and Policy* 39(3) 259-278
- Nash, C. (forthcoming) Railways. In: Finger, M. and T. Holvad (Eds) "Regulating Transport in Europe". Edward Elgar.
- National Audit Office (2008), "Reducing passenger rail delays by better management of incidents", National Audit Office, London.
- Network Rail (2006), "Survey of the impact of control co-location on London North Western, Anglia, Sussex and Kent Routes", Operations Development, Network Rail, London.
- OECD (2012), "Report on Experiences with Structural Separation 2011", Competition Committee, OECD, Paris, 125 pp.
- Pakula, B. and G. Götz (2011), "Biased Quality Investments and Organisational Structures in Network Industries – An Application to the Railway Industry", MAGKS Joint Discussion Paper Series, No. 09-2011, University of Marburg.
- Pfuhl, S., M. Schenk, H. Buttler, D. Martinoni, M. Schürch, S. Spiegel and B. Stehrenberger (2010), "Die nächste Optimierungsstufe im Schweizer Bahnsystem", *Eisenbahn-Revue*, 508-512.
- Preston, J. (2002). The transaction cost economics of railways. *Trasporti Europei*, 8(20/21), 6–15
- Preston, J.M., Wardman and G. Whelan (1999), An Analysis of the Potential for On-Track Competition in the British Passenger Rail Industry, *Journal of Transport Economics and Policy*, vol. 33, part 1, pp. 77-94.
- Preston, J.M., Holvad, T. and Rajé, F. (2002) Track Access Charges and Rail Competition: A Comparative Analysis of Britain and Sweden, Paper presented at the European Transport Conference, Cambridge.
- Preston, J. and Robins, D. (2011) Evaluating the Long Term Impacts of Transport Policy: The Case of Passenger Rail Privatisation. Paper presented at the 12th international conference on competition and ownership in Land Passenger Transport.
- Roland Berger (2012), "The optimal setup of a rail system – Lessons learned from outside Europe", Roland Berger Strategy Consultants, Munich.

Seguret, S. (2009) Is Competition On Track a Real Alternative To Competitive Tendering In The Railway Industry? Evidence from Germany, Paper presented to the international conference on competition and ownership in land passenger transport, Delft, September 2009

Sénat (France) (2012), Entretien du réseau ferroviaire national - Audition pour suite à donner à l'enquête de la Cour des comptes, <http://www.senat.fr/compte-rendu-commissions/20120924/fin.html#toc5>, 25-10.

Smith, A., Nash, C.A. and Wheat, P. (2009) Passenger rail franchising in Britain: has it been a success? *International Journal of Transport Economics* 36 (1) 33-62

Steenhuizen, B. (forthcoming), "Cutting dark matter: Professional capacity and organisational change", *Journal of Organisational Ethnography*.

Steenhuisen, B. and M. de Bruijne (2009), "The Brittleness of Unbundled Train Systems: Crumbling Operational Coping Strategies", Second International Symposium on Engineering Systems, Cambridge, Massachusetts, June 15-17, 2009, MIT.

Tweede Kamer (2011), "Parlementair onderzoek onderhoud en innovatie spoor", 32 707, Nr. 9, Tweede Kamer der Staten-Generaal, Den Haag.

van de Velde, D.M. (1999), "De bedrijfsketen in het collectief geregeld vervoer", In: *Optimale netwerken en Kernnet* (Eds.: van Reeve, P.A., D.M. van de Velde, J.J.T. de Vlieger and B.P.A. Bakker), 3-6 & 25, Erasmus Universiteit Rotterdam, Rotterdam.

van de Velde, D.M. (2009), "Economics of the transport markets", In: EPA1231 *Economics of Infrastructures*, Syllabus, Delft University of Technology, Delft.

Wardman, M. (2006) Demand for Rail Travel and the Effects of External Factors. *Transportation Research E*, 42 (3), pp.129-1.

Wetzel, H. (2008), *European Railway Deregulation*, Working Paper 86, Institute of Economics, Leuphana University of Lüneburg.
<http://ideas.repec.org/p/lue/wpaper/86.html>

Wheat, P.E. and Smith, A.S.J. (2010). *Econometric Evidence on Train Operating Company Size*. Report for ORR, Institute for Transport Studies, University of Leeds.

Williamson, O.E. (1975), *Markets and hierarchies, analysis and antitrust implications : a study in the economics of internal organization*, Free Press, New York.

Williamson, O.E. (2000), "The New Institutional Economics: Taking Stock, Looking Ahead", *Journal of Economic Literature*, 38, 595-613.