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Published paper

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Abstract

European Union bodies are considering whether to make complete vertical separation of rail infrastructure from operations mandatory. Yet academic research on the impact of vertical separation on costs seems inconclusive as much depends on the circumstances of the country concerned and the way in which the system is managed (Nash and Matthews, 2009). Other reforms can also have a significant impact.

Vertical separation is often advocated in network industries because it is assumed to be necessary to eliminate discrimination in gaining access to infrastructure and therefore helpful to the development of competition. Competition is not, however, an objective in its own right but simply a means of achieving a more efficient railway. Any efficiency advantages arising from competition must be compared with possible reductions in efficiency because of transaction costs between the infrastructure manager and the incumbent operator, the reduced pressure on costs and the negative impact on decision making, particularly for investment.

This paper compares aggregate data by country in order to see what evidence there is on the impact of vertical separation on (a) the level of competition in rail markets as reflected in the number of licences and the market shares of different operators and (b) on growth in traffic. Growth was chosen as a surrogate for desirable ultimate objectives such as lower unit costs and prices, and improved service quality and customer satisfaction, on which it is difficult to obtain data but which, in any case, are likely to be reflected to some extent in traffic growth.

The analysis indicates that typically countries with vertically separated railways have issued fewer operating licences than those with vertical integration. Also vertical separation is associated with slower growth in rail freight traffic than vertical integration but faster growth in rail passenger traffic. Again the findings are therefore inconclusive and contradictory.

The choice between vertical separation and integration may not be the most important factor in determining the extent of intra-rail competition and traffic growth. Other factors include the effectiveness of regulation, the financial situation of the incumbent operator and the under-compensation for mandated public service provision. Support by government for investment in infrastructure can also be important, given how poor infrastructure affects service quality, reliability and, ultimately, the competitiveness of the whole rail sector.

These factors appear to be particularly significant in some countries in Central and Eastern Europe where incumbents are in decline and rail as a whole is losing market share.

Before considering whether to make vertical separation mandatory within the EU, a much better understanding is therefore required of the factors which determine competition, efficiency and growth in the railway industry. On existing evidence therefore there is no reason to conclude that vertical separation improves rail performance.

1. Introduction

Unlike other network industries such as power and telecommunications, there is no consensus on the optimum structural model for the railway industry. The key structural issue, vertical separation of infrastructure from railway operations, has divided policy makers, railway managers and academics since it was first mooted in the 1980s.

Vertical separation is often advocated in network industries because it is assumed to be necessary to eliminate discrimination in gaining access to infrastructure and therefore helpful to the development of competition. Competition is not, however, an objective in its own right but simply a means of achieving a more efficient railway. Yet vertical separation may actually reduce efficiency because of transaction costs between the infrastructure manager and the incumbent operator¹ (although there is evidence that transaction costs are not a large proportion of total costs) and because of reduced incentives for efficiency and for appropriate investment by the infrastructure manager. In this event, it needs to be asked whether sufficient competition can be achieved to improve performance in a well regulated vertically integrated railway.

This paper compares data for EU member states in terms of:

- (a) The level of competition in the rail freight market, separately for the EU 15 and EU 12 countries and for countries with the largest railways;
- (b) Growth in both the rail freight and passenger markets and for countries with the largest railways (growth may be considered a surrogate for desirable ultimate objectives, such as lower unit costs and prices, and improved service quality and customer satisfaction, on which it is difficult to obtain data but which, in any case, should be reflected to some extent in traffic growth);
- (c) Rail's share of the total market for both freight and passengers in selected countries.

2. Literature review

2.1 Research in the US

There is empirical evidence from the US that, beyond some 'minimum efficient size', there are constant returns to scale (Caves et al, 1987). This implies that, providing the railways are large enough to support more than one operator without losing economies of scale, competition with or without vertical separation may not lead to increased costs. Also Ivaldi and McCullough (2001) found no cost complementarities between operations and infrastructure, implying that there are no inherent disadvantages in vertical separation.

In contrast, Bitzan (2003) demonstrated that vertical separation of infrastructure from operations increases costs. He also showed that having more than one operator increases costs since railroads are "natural monopolies over their own networks" (because of economies of density). Ivaldi and McCullough (2004) found both vertical and horizontal economies of scope in railways: there was a 20-40% loss of technical efficiency from separating rail freight

¹ In each EU country, the incumbent remains the largest operator

operations from infrastructure and an additional 70% loss of operational efficiency if there were more than one rail transport operator. (Nash 2006) has pointed out that these studies extrapolate from samples of vertically integrated railways, where a lower level of infrastructure spending may indicate that the infrastructure is being neglected. More reliable evidence requires comparisons between a mix of vertically separated and vertically integrated railways, as is now found in Europe. .

2.2 Research in the EU

In the EU, research on the advantages and disadvantages of vertical separation is also not convincing either way. This is partly because few countries had until recently carried out vertical separation. Also there are difficulties with obtaining comparable data, with measuring the extent of reform and with isolating the impact of vertical separation from that of other factors.

Rivera-Trujillo (2004) analysed European data and found that competition increases efficiency but that vertical separation reduces it. However, if vertical separation is necessary for introducing competition, he concluded that its overall effect may be to increase efficiency.

Lijesen et al (2005) found little evidence of economies of scope between track and train in the Dutch rail industry.

Merkert et al (2009) carried out an examination of efficiency scores across countries which showed that whether a firm is vertically separated or not may not be the dominant factor determining relative efficiency. They found that vertical separation did not have significant effect on technical efficiency although it had a negative effect on allocative efficiency.

Research by Wetzel (2008) found that separation has no significant impact on technical efficiency. Growitsch and Wetzel (2009) found significant diseconomies from separation of infrastructure and operations in Europe, but their study presents a static cross section comparison and does not allow for the impact of differences in geography or rail policy, and consequently in the volume and nature of the traffic on costs.

By contrast, the most recent study (Cantos et al, 2010) does fully allow for differences in the nature of the traffic by introducing traffic density and mean train loads into a second stage regression of the efficiency scores, and finds productivity growth to be faster when vertical separation is combined with increased competition

An article comparing the cost of railways in Germany, the UK and Sweden (Nash et al 2011), concludes that, contrary to expectations, the vertically integrated German system seems to operate at the lowest subsidies and fare levels, which raises questions about the benefits of pushing the breakup of the industry too far.

Research by Merkert et al (2011, unpublished) finds that, although transaction costs are not as significant as expected, vertical separation has other disadvantages such as the reduced pressure on costs and the negative impact on decision making, particularly for investment.

Research by Wardman (2006) focussed on growth rather than efficiency. He found that, whilst most growth in British passenger km is explained by factors other than vertical separation, franchising did raise the rate of growth above what would otherwise have occurred. But it is not possible to conclude whether there would not have been less growth if firms bidding for franchises had been competing with an incumbent who was also part of the same group that controlled the infrastructure. So again it is not possible to draw any conclusions on the benefits of separation.

Rivera-Trujillo (2004) concluded that, if vertical separation is necessary for introducing competition, it may increase efficiency indirectly.

In reviewing the results of research on the merits of vertical separation so far, Nash et al (2009) concluded that overall the results are inconclusive and that much depends on the circumstances of the country concerned and the way in which the system is managed. However, it seems from the above examples that researchers have generally found either a negative effect from separation, or no significant effect on costs. However, researchers have not considered the key issue of whether vertical separation increases competition and if so, whether this leads to faster growth in rail traffic and market share.²

3. Analysis

3.1 Definitions

All comparisons in this paper are made between countries where infrastructure is fully vertically separated and others. France, where many functions are contracted back to SNCF, is initially counted as fully separated. However, because third party access was not permitted for freight in France until 2007 and for domestic passenger services from 2010, and vertical separation could therefore have no impact on competition, the analysis is repeated excluding it. Countries with an independent body for capacity allocation but no vertical separation of infrastructure management in other respects (e.g. Hungary) are treated as vertically integrated.

3.2 Comparison by level of competition in rail freight

Table 1 compares, for vertically separated and vertically integrated railways in the EU15 (plus Norway) and the EU12, the various measures of competition used by RMMS (European Commission, 2010). Table 2 (at the end of the paper) shows the same measures for each country. Because of the large number of operators in Germany, the figures for vertically integrated railways are shown with and without DB.

Table 1 shows that countries with vertically integrated railways have more licences than those with vertical separation – however, licenses do not necessarily mean operations and so this is a poor measure of competition. Market share of non-incumbent railway operators and

² Wardman (2010) considered only the impact on passenger growth in a franchised railway.

the rail market opening score³ are better measures of the level of competition and both indicate slightly more competition in countries with vertically separated railways than in those where railways are integrated.

It is also significant that competition is greater in the EU12 than in the EU15. This may be because incumbent operators in the EU12 are so weak that market share can easily be taken by new entrants. Table 2 shows that new entrants carry 41% of rail freight in Romania, where the incumbent is in a particularly weak position, and 49% in Estonia.

Table 1 Freight market competition

| Structure/region | Average no of freight licenses/ country | Market share non incumbent freight operators (%) | Rail market opening score (HHI) |
|------------------|---|--|---------------------------------|
| VS | 12 | 15 | 0.72 |
| VI | 43 | 12 | 0.80 |
| VI ex DB | 15 | 11 | 0.82 |
| EU15 VS | 10 | 14 | 0.77 |
| EU15 VI | 85 | 8 | 0.87 |
| EU15 VI ex DB | 5 | 5 | 0.92 |
| EU12 VS | 16 | 16 | 0.55 |
| EU12 V1 | 22 | 16 | 0.74 |

Indicates most competition

3.3 Comparison by rail freight growth

However competition is not an objective in its own right and it may or may not contribute to meeting the underlying objective of a more efficient railway. Even if vertical separation enhances competition, it does not follow that this will necessarily improve efficiency.

³ Rail market opening score calculated on the basis of the Herfindahl-Hirschman Index which estimates the concentration ratio in an industry and serves as an indicator of the amount of competition in the respective market. Herfindahl-Hirschman Index is defined as the sum of squares of the market shares of each individual firm. As such, it can range from 0 to 1 moving from a very large amount of very small firms to a single monopolistic producer.

It is very difficult to compare efficiency between railways. However, one surrogate measure for comparing changes in efficiency is growth in rail traffic since traffic will be attracted to rail if its prices and services improve. Growth data is also readily available.

Figures 1 and 2 compare rail freight growth (expressed in tonne km) for all vertically separated and vertically integrated railways in the EU15 and EU 12 regions separately.⁴ The period of analysis was 1998-2008 for the EU15 and 2002-2008 for the EU12, the start dates reflecting the last year in which countries in each region separated infrastructure.

For each region, the accumulated growth in every year has been more for vertically integrated railways than for vertically separated ones. The gap is particularly wide for the EU15 where traffic on vertically separated railways hardly grew whilst traffic on vertically integrated railways grew by about 40% (largely because of the rapid growth and dominant size of German railways). The low growth for countries with vertically separated railways was largely because of the major decline in France where, despite vertical separation, there was until recently no competition allowed – but Figure 1 shows that, even excluding France from the analysis, integrated railways in the EU15 grew faster than vertically separated ones.

Indices of tonne km by region

Figure 1: EU15 1998-2008 (Index 1998=100)

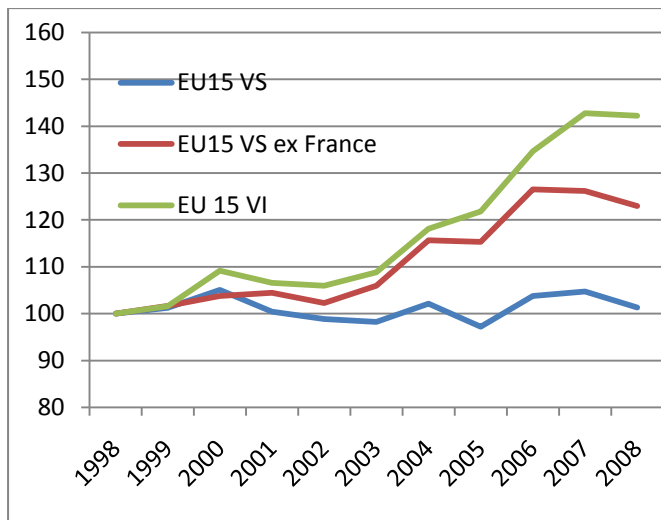
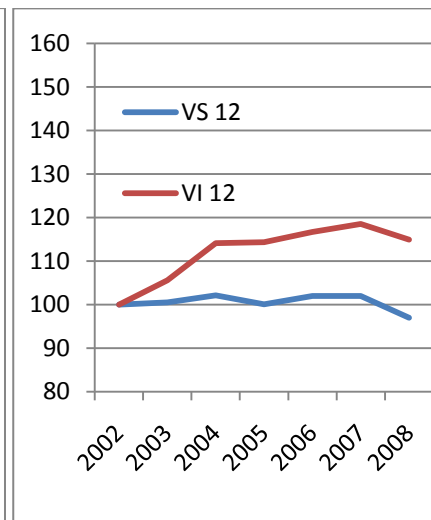


Figure 2: EU12 2002-2008 (Index 2002=100)



⁴ Source of data: European Commission (2010a)

Figures 3 and 4 compare rail freight growth (expressed as indices of tonne km) for countries with sizeable freight railways. In the EU15 the fastest growing freight railways are those in Germany, Austria (both vertically integrated) and UK (vertically separated) – where growth exceeded 40% - whereas in France (vertically separated) freight traffic declined by 25%.

In the EU12, the fastest growing freight railway is that in Lithuania (vertically integrated), largely because of changes in the Russian market, whilst traffic did not grow at all in either the Czech Republic or Romania (both vertically separated).

Indices of tonne km in selected countries

Figure 3: EU15 1998-2008 (Index 1998=100)

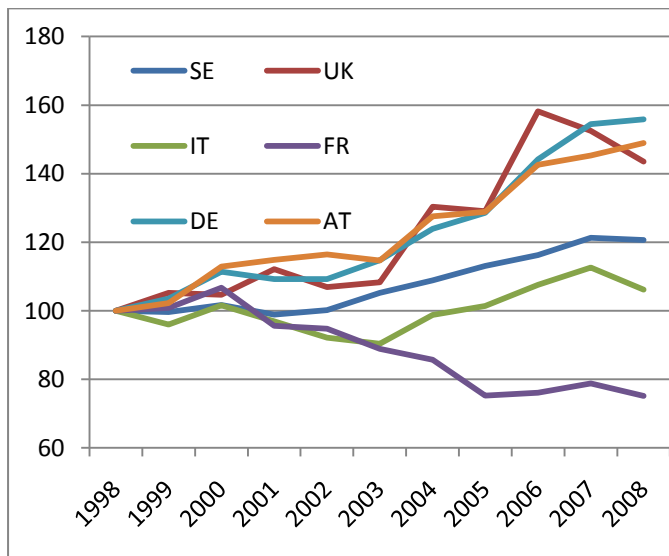
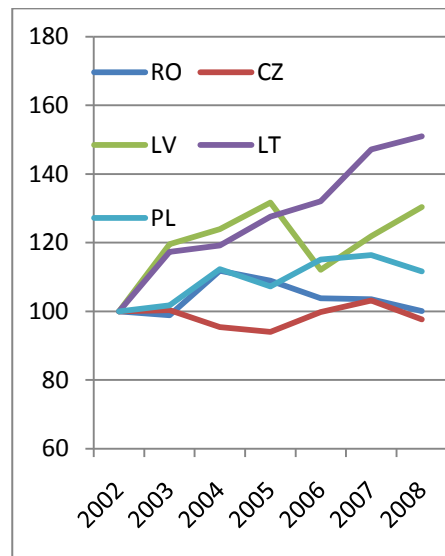


Figure 4: EU12 2002-2008 (Index 2002=100)



It is however unclear whether vertical separation was a factor in these different growth rates. There are many other explanations as to why rail freight traffic grows in some countries and declines in others. German growth may partly result from high levels of investment in rail infrastructure. Effective regulation may also have assisted the development of competition, especially in both Germany and the UK, as discussed below. There are also external factors: for example, in the UK the switch to imported coal (moved over longer distances) and in Lithuania the growth in Russian transit traffic.

A more reliable measure of the effectiveness or otherwise of reforms is rail's share of traffic relative of inland transport. This strips out the common effect of growth of total transport volume for reasons that have nothing to do changes to the rail industry (particularly real GDP growth, normally the main determinant of rail freight growth).

Figures 5 and 6 below show the trend in rail's share of road and rail freight for the EU15 and the EU 12:

Rail freight modal share⁵

Figure 5: EU15 1998-2008

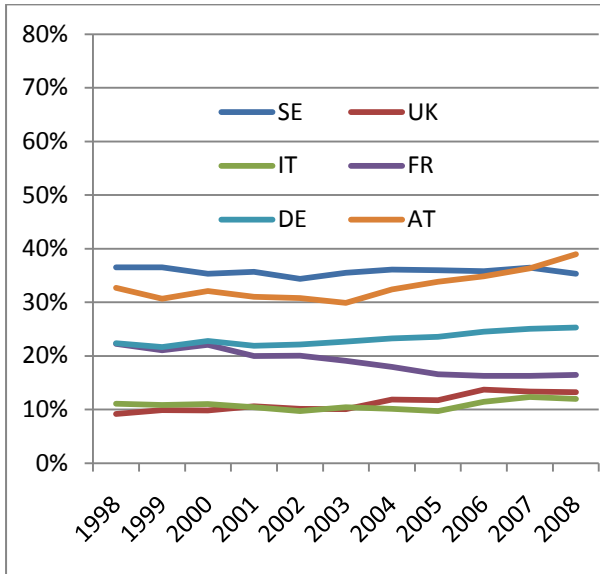
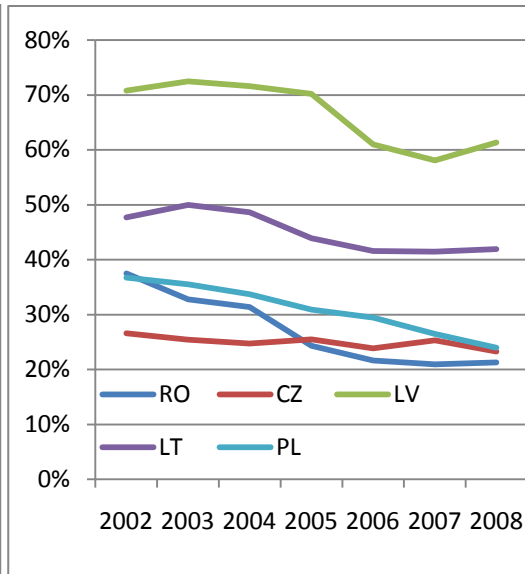


Figure 6: EU12 2002-2008



The above figures show that the largest increase in rail's modal share was in Austria (6%) followed by the UK (4% from a low base) and Germany (3%). France remains the worst performer in the EU15 on this measure with a decline of 6%. Large reductions in rail's share of freight have been experienced in the EU12: 16% in Romania and 13% in Poland. This analysis therefore shows that there are good and bad performers amongst both vertically integrated and vertically separated railways.

Overall the analysis of rail traffic and modal share shows that there appears to be no positive correlation between vertical separation and any of beneficial effects it is intended to bring about: the development of competition, the growth in rail freight traffic or rail's modal share.

3.4 Comparison by rail passenger growth

Figures 5 and 6 compare rail passenger growth (expressed in passenger km) for all vertically separated and vertically integrated railways in the EU15 and EU 12. In the EU15, vertically separated railways have grown faster than vertically integrated ones whereas, for the EU12, both groups have declined by around 10%.

⁵ Percentage of land transport. Source: European Commission (2010a) and author's calculations.

Indices of passenger km by region

Figure 7: EU15 1998-2002 (Index 1998=100)

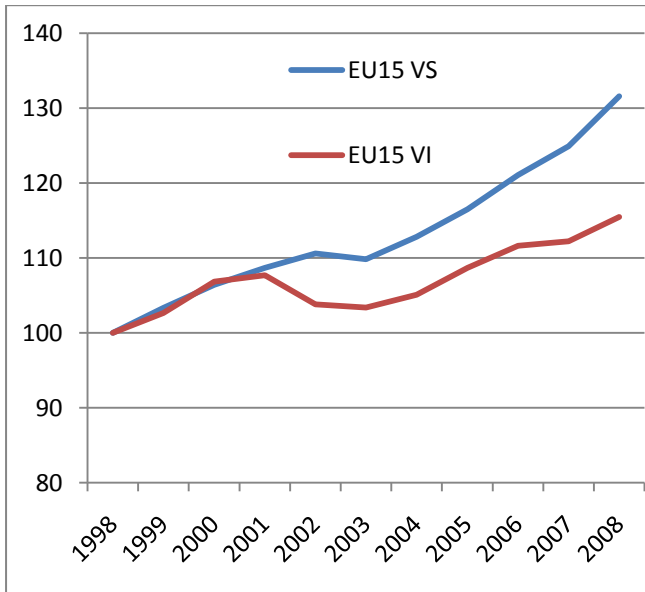
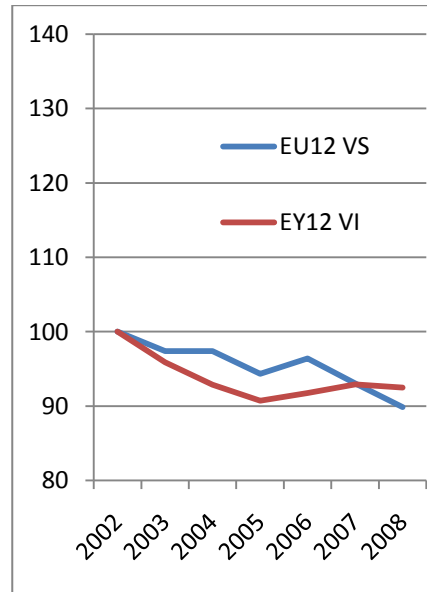


Figure 8: EU12 2002-2008 (Index 2002=100)



Figures 9 and 10 compare rail passenger growth (expressed as indices of passenger km) for countries with sizeable passenger railways. In the EU15, the fastest growing passenger railway is that in the UK (vertically separated) – where growth exceeded 40% - followed by France and Spain (both also vertically separated). Lower growth was experienced in Germany and Italy (both vertically integrated) and the Netherlands (vertically separated). In the EU12, the fastest growing passenger railway was in the Czech Republic (vertically separated) and the lowest in Romania (vertically separated) and Hungary (vertically integrated).

Indices of passenger km in selected countries

Figure 9: EU15 1998-2008 (Index 1998=100)

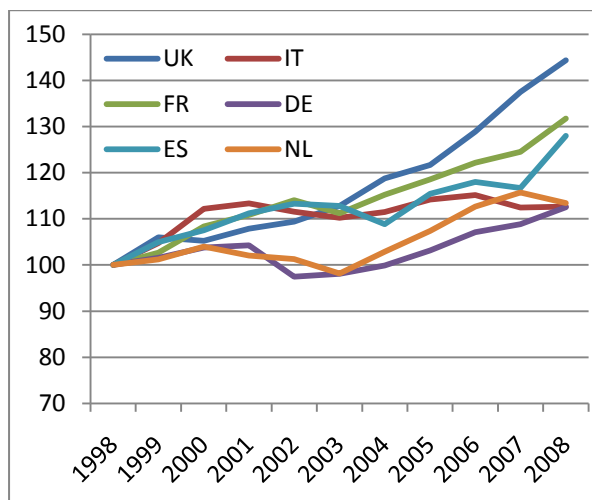
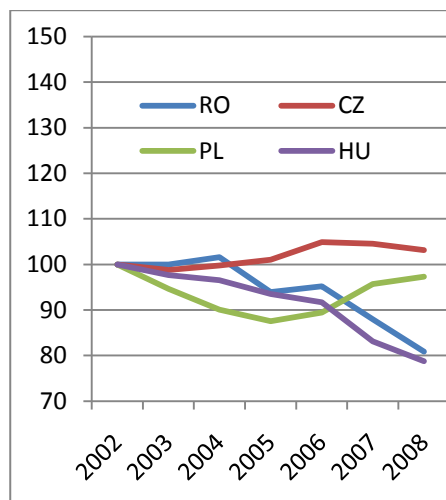


Figure 10: EU12 2002-2008 (Index 2002=100)



As with freight, a more reliable measure of the effectiveness or otherwise of reforms is rail's share of traffic relative of inland transport. Figures 11 and 12 show trends in rail's modal

share for the same selected countries. The UK and France (both vertically separated) experienced the largest increases of 2%, major achievements given the low base. Other EU15 countries experienced smaller increases. In contrast, modal share fell in all four EU12 countries, with the smallest reduction occurring in the Czech Republic (1%) and the biggest falls in Romania (5%) and Poland (4%).

Rail passenger modal share⁶

Figure 11: EU15 1998-2008

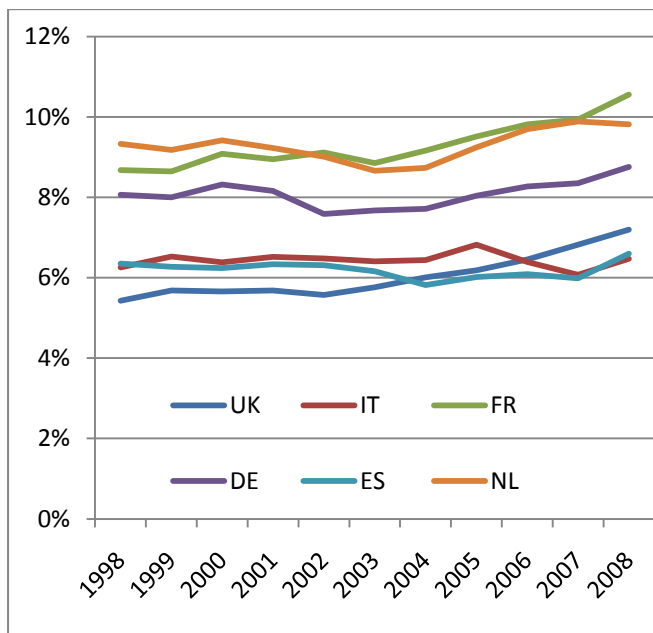
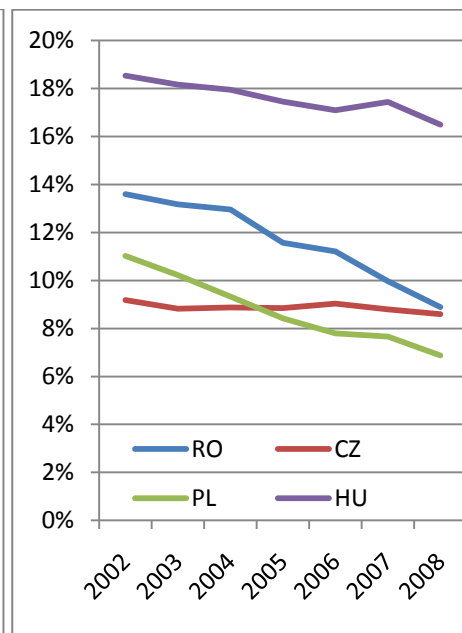


Figure 12: EU12 2002 -2008



The rapid growth of passenger traffic and modal share in the UK, France and Spain cannot however be attributed to vertical separation. In the UK, there is very little open access operation and nearly all traffic is carried by franchise operators which rarely compete with each other. Vertical separation is therefore not an absolute requirement of the British system of franchising, although the degree of competition for franchises might have been difficult to achieve with a single vertically integrated infrastructure manager.

An ongoing review for the British government (McNulty, 2010) has concluded that a key cause of high costs in the UK rail industry is the absence of links between the revenue received by the operators and the cost incurred by Network Rail. McNulty identified the need to better align the infrastructure manager and operators and to reduce transaction costs – the review is now considering re-integration of infrastructure with passenger rail franchise operations for some parts of the network. This reflects recognition that different models are suitable for different circumstances.

The national operators in France and Spain are still the only passenger operators, despite vertical separation. It is therefore difficult to see how vertical separation can have contributed to growth in passenger traffic, unless it has led to a higher level of investment. In both cases, the growth is mainly caused by investment in high speed rail. So despite the higher passenger

⁶ Percentage of rail and car. Source: European Commission (2010a) and author's calculations.

growth in countries which have introduced vertical separation, this cannot be definitively attributed to vertical separation.

4. Other factors affecting growth

4.1 Government support for railways

The main difficulty with assessing the impact of vertical separation is that of separating its impact from other changes that are taking place at the same time, and in determining whether these changes are a consequence of separation or part of a package of complimentary changes. For example, governments may be more willing to invest in rail infrastructure when it is clear that this will not leak into operating subsidies. This was the case in Sweden, for example, but doubts have been expressed about the commercial viability of these investments, some of which were made on political grounds and, as a result of vertical separation, without giving sufficient weight to the needs of operators (Alexandersson and Hulten 2005). Also there is no reason, in principle, why full vertical separation is necessary to achieve transparency in how state support is used.

In Central and Eastern Europe, the issue of government support is particularly critical. Romania separated infrastructure from operations in 1997 and competition in rail freight began in 2002. Yet, in this shorter period, a far higher proportion of traffic has been diverted to new entrants than in the UK or Germany. This is largely because the incumbent in Romania has been weakened by years of onerous government requirements for passenger services for which it has not been fully compensated and for which freight profits were used to provide support by cross subsidy. This has made it difficult for the incumbent to compete with new entrants but the growth in traffic carried by new entrants has so far fallen short of replacing the traffic lost by the incumbent and it is not known if and when they will do so. These changes have therefore had the effect of reducing both rail traffic and market share.

Market opening and vertical separation on rapidly deteriorating infrastructure therefore appears to be reducing the competitiveness of all rail operators in some countries in Central and Eastern Europe. This suggests that solutions which suit Western Europe, where most railways have adequate finance for infrastructure, may need to be adapted for Central and Eastern Europe where state support is often not available.

4.2 Importance of regulation

Regulation can also affect competition and traffic growth. To address concerns about equality of treatment under vertical integration, the First Railway Package included requirements for the establishment of Regulatory Bodies. In circumstances where it is neither practical nor cost effective to separate infrastructure from operations, it is possible to increase competition through strong regulation.

Most regulators have some nominal independence from the ministry responsible for transport though this independence is rarely complete. There are however wide differences between countries in terms of the powers and capabilities of regulators. IBM/Kirchner (2007) found

that only the countries that have advanced well with liberalisation in general, the UK, Germany Sweden and the Netherlands, have regulatory arrangements which provide for non-discriminatory network access. In all four of these countries, non-incumbents had captured over 20% of the rail freight market by 2008 and rail freight has been growing. Rail traffic growth has been very rapid in the UK and Germany, the first countries to establish independent regulators (both in 1994) – this is significant as it can take time to strengthen regulatory arrangements and build up procedures for non-discriminatory access.⁷ In contrast, France was one of the last countries in the EU to establish a regulator and it is the only major EU15 country in which rail freight has declined – by more than 20% between 1998 and 2008. Other factors in France, such as not allowing competition until 2007 and the focus on high speed passenger services, may also have contributed to the decline of rail freight. However, the evidence suggests that sound regulation promotes competition, efficiency and growth.

Several Central and Eastern European countries established regulators and allowed competition later than the UK and Germany. Although new entrants have very high market shares in rail freight (e.g. Estonia 49%, Romania 41%⁸), overall growth in rail freight traffic has been disappointing, particularly in Romania and the Czech Republic (see Figures 2 and 4) and Slovakia. This implies that other factors are important in determining rail freight growth in Central and Eastern Europe. One factor is government support as noted above.

5. Conclusions

Academic literature provides no evidence that vertical separation leads to efficiency gains although one study indicates that, if vertical separation is necessary for introducing competition, it may increase efficiency indirectly.

This paper takes a different approach to most previous research by examining the impact of vertical separation, not on costs, but on the market. The analysis shows no correlation between vertical separation and the growth in rail freight traffic or rail's share of total freight traffic (two surrogate measures of attractiveness of rail services to customers which should reflect efficiency and service quality). Indeed, if the key objective is to promote the efficiency and growth of rail freight, vertical separation may in some circumstances, particularly those in some Central and Eastern European countries where adequate government funding for infrastructure is not available, impede rail growth. Also, despite the higher passenger growth in some countries which have introduced vertical separation, this cannot be attributed to vertical separation.

The absence of definitive findings may be a result of the small number of countries and the many other changes, often part of the same package of reforms, which influence competition

⁷ For example, in Germany, the powers of the regulator were strengthened considerably in 2002 by giving it responsibility for monitoring third party access to ensure non-discrimination (Kirchner (2005).

⁸ Source: European Commission, (2010). Data from Romania reproduced in Stancu (2011) suggest the figure was only 35% in 2008 but increased to 51% in 2009.

and growth. Also, simply distinguishing between vertical separation and vertical integration does not take account of the fact there are many different forms of each.

More detailed research is clearly needed, through individual country studies to explain changes in competition, efficiency and growth in response to open access alone, and to open access together with vertical separation. A thorough review is needed of existing econometric studies to understand why findings differ, determine which are the most reliable and, if possible, draw out some conclusions. These should be supplemented by more detailed transnational econometric comparisons, considering factors other than structure: investment strategy, the effectiveness of regulation and market factors. These comparisons should identify the costs and benefits from vertical separation for railways with different characteristics, disentangling these impacts from those arising from factors which have nothing to do with vertical separation. This work should provide a guide to possible future legislation, at both EU and member state level. It is important that this research covers the EU12 thoroughly as vertical separation and open access appear to have different effects there due to the rather different circumstances.

Before considering whether to make vertical separation mandatory within the EU, a much better understanding is therefore required of the factors which determine competition, efficiency and growth in the railway industry. In the meantime, there is no evidence to support the view that all member states should be required to fully separate infrastructure from train operations.

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Table 2

| Country | Year separated | No of freight licenses | Market share non incumbent freight operators (%) | Rail market opening score (HHI) |
|--|-----------------------|-------------------------------|---|--|
| SE | 1989 | 17 | 36 | |
| UK | 1994 | 26 | 25 ⁹ | 0.31 |
| NL | 1995 | | 25 | |
| FI | 1995 | 1 | 0 | 1 |
| NO | 1996 | 8 | 21 | 0.62 |
| FR | 1997 | 7 | 10 | 0.81 |
| PT | 1997 | 2 | 0 | 1 |
| DK | 1997 | 11 | 5 | |
| ES | 1997 | 10 | 5 | 0.9 |
| RO | 1998 | 25 | 41 | 0.35 |
| BG | 2002 | 6 | 14 | 0.75 |
| CZ | 2002 | 33 | 5 | |
| SK | 2002 | 1 | 2 | |
| BE | | 5 | 6 | 0.88 |
| DE | | 315 | 22 | 0.61 |
| EE | | 13 | 49 | 0.39 |
| IE | | | 0 | 1 |
| EL | | 0 | 0 | 1 |
| IT | | | 11.5 | |
| LV | | 4 | 9.6 | 0.82 |
| LT | | 21 | 0 | 1 |
| LU | | 2 | 0 | 1 |
| HU | | 22 | 14 | 0.73 |
| AT | | 17 | 14 | 0.74 |
| PL | | 67 | 24 | 0.47 |
| SI | | 2 | 0 | 1 |
| Sources: EU (2010) RMMS (data for 2008); SIKa (where script red) and for UK, share not carried by privatised rail companies estimated by author. | | | | |

⁹ Source: RMMS (2009). This is the proportion of traffic not carried by DB Schenker and Freightliners (formed from privatised companies) but not Freightliners Heavy Haul, a separate business from Freightliners' original container business. This more accurately reflects this measure than the 100% given in RMMS. It may understate the amount of competition in the UK but HHI does not.