

## Executive Summary

### Key findings:

Despite an unfavourable economic climate across much of the EU between 2007 and 2012, rail passenger km have grown, although tonne km transported by rail have fallen significantly.

The overall cost of the rail industry in the EU is €110 billion, 60% of which is covered by passenger and freight revenue, 30% by public subsidy and the remainder by other sources of income.

Railways in different Member States vary considerably in terms of their national characteristics, and any analysis of their comparative efficiency levels must take account of the impact of geographical, demographic and other external factors.

Levels of efficiency in the rail sector are also influenced by scale effects – some Member States that appear to be performing less efficiently are actually performing relatively well once the limited size of their networks is taken into account.

Some Member States, notably Bulgaria, the Czech Republic, Hungary and Romania, nevertheless have substantial scope for improving the total capital productivity of their railways.

If all Member States were to achieve levels of efficiency equivalent to the highest performing peers in their cluster, the NPV of the resulting increase in direct Gross Value Added (GVA) between 2015 and 2030 could be €32 billion; when including indirect GVA generated by upstream sectors, the benefits would rise to €64 billion.

The increase in rail activity resulting from reinvesting the operating surpluses can generate 1,600 direct jobs and a broadly equivalent number of indirect jobs over the period 2015-2030.

Various deficiencies in the data limit the potential for analysis, and hence the information required to inform policy both at national and EU level.

### Purpose of the study

The rail sector makes a substantial contribution to the European Union (EU) economy, directly employing 577,000 people across passenger and freight operations, and the provision of track and station infrastructure<sup>1</sup>. Some estimates suggest that, once the entire supply chain for rail services is taken into account (e.g. including train manufacturing, catering services etc.), the economic footprint of the rail sector in Europe extends to 2.3 million employees and €143 billion of Gross Value Added (some 1.1% of the total)<sup>2</sup>. It is also critical to the EU strategy for improving economic and social cohesion and connectivity within and between Member States.

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<sup>1</sup> EU Transport in Figures: Statistical Pocketbook 2015 (European Commission).

<sup>2</sup> The Economic Footprint of Railway Transport in Europe (CER, 2014).

Accordingly, the 2011 White Paper *Roadmap to a Single European Transport Area* envisages much greater use of rail transport in the future.

However, while the sector has achieved significant volume growth in recent years, rail's modal share remains below expectations, accounting for only 7% of passenger km and 11% of tonne-km within the EU28 in 2012<sup>3</sup>. These average shares reflect a wide range of experience in different Member States, but are generally considered symptomatic of a lack of competitiveness driven by insufficient investment, inadequate customer-focus, limited innovation and poor levels of cost efficiency in many Member States. At the same time the sector absorbs about €36 billion of public funds annually, some €80 for every European citizen<sup>4</sup>. Against this background, the primary objectives of this study are to:

- provide a 'broad brush' analysis of the trends in overall performance of different national rail systems; and
- conduct a scenario analysis assessing the potential societal benefits of a better performing rail sector.

### Overview of methodology

The methodology developed to meet the study objectives includes the following analytical steps:

- First, in order to better understand the nature and performance of railways across the EU, we undertook an extensive data collection and harmonisation exercise covering the 26 Member States that have a rail network (i.e. excluding Malta and Cyprus). This included demographic and economic data, indicators of rail sector resources and the value added by rail. The approach to data collection is described in Chapter 2.
- This data was then used to generate primary and secondary Key Performance Indicators (KPIs), which measure the performance of Member State railways and allow comparability over time as well as against other Member States. The results of the KPI analysis are described in Chapter 3.
- We then analysed relationships between KPIs and a range of exogenous variables, such as population density and port connections, in order to inform a clustering exercise. The purpose of clustering analysis is to categorise national rail systems into groups of Member States that are similar in terms of the impact of exogenous variables on rail industry performance. The methodology for establishing clusters is explained in more detail in Chapter 4.
- A technique called data envelopment analysis (DEA) was then used to measure the efficiency gap between rail systems. Given a set of inputs (e.g. rail sector employees, track kilometres) and outputs (e.g. passenger kilometres and train kilometres), DEA fits an efficiency frontier which envelops the data. The DEA approach is explained further in Chapter 5.
- Finally, both the outputs of the clustering exercise and the DEA were used to define the scope of achievable efficiency improvements over a certain timescale. Impacts of such potential efficiency improvements over time were then quantified using a range of

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<sup>3</sup> EU Transport in Figures: Statistical Pocketbook 2015 (European Commission) – includes non-surface modes.

<sup>4</sup> Fourth Report on Monitoring Development of the Rail Market (European Commission, 2014).

economic and social indicators. The core scenario of the study focuses on the effects of total capital productivity improvements (i.e. track and train utilisation in combination). In addition, further analysis of a supplementary scenario in which the EU rail sector faces increased demand following an increase in road transport costs was conducted. The methodology and results are set out in Chapter 6.

### Rail industry characteristics and trends

The data collection exercise has enabled us to examine trends in the rail industry at a Member State and EU level. Key trends in inputs and outputs at the EU level are illustrated below.

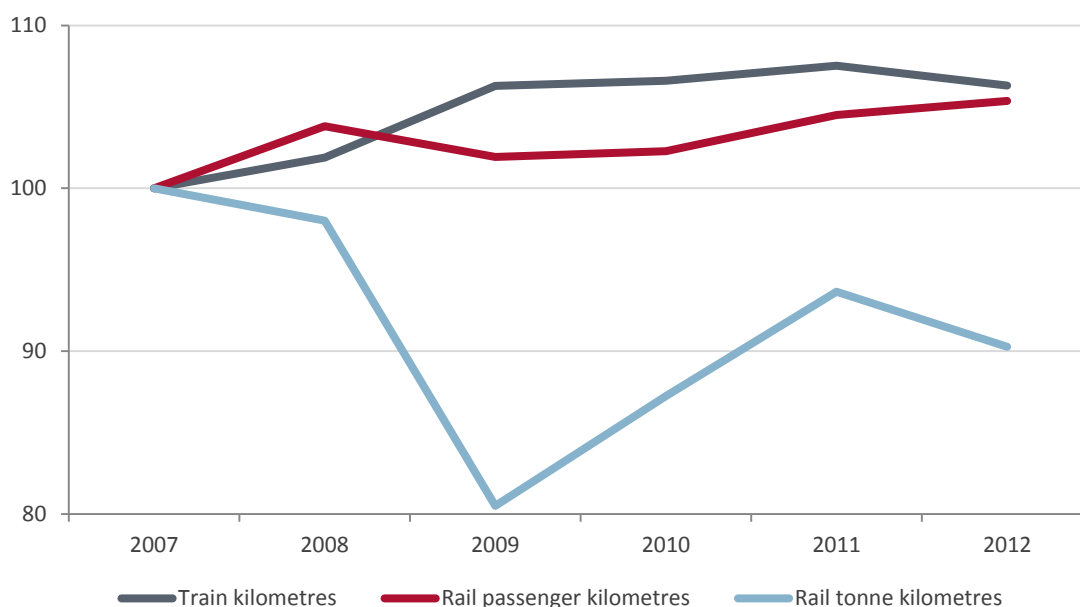
Rolling stock fleet sizes (vehicles) for both passenger and freight appear to have been in decline since 2009. This may be due to changes to the characteristics of rolling stock such as increasing seat densities and larger freight wagons, or economic effects such as asset disposal or stabling during the economic crisis. There has also been a marked decrease in employment in the rail sector. However, this trend could be attributed to structural changes in the industry (particularly outsourcing).

#### Trends in input indicators (2007=100)

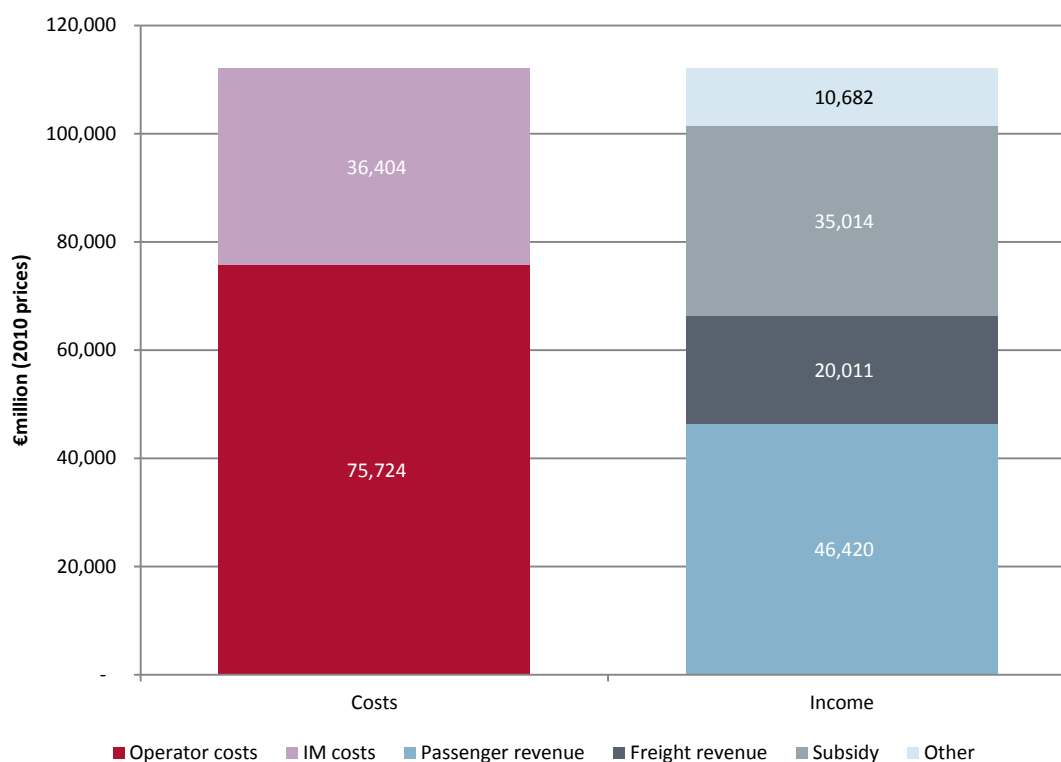


Despite an unfavourable economic climate across much of the EU over this period, rail passenger outputs have grown. The figure below shows that both passenger kilometres and train kilometres (the latter including both passenger and freight train movements) have increased by approximately 1% each year. This is in contrast to the change in rail freight outputs (tonne kilometres), which have declined by 10% overall in the five years to 2012 despite recovering substantially since the depth of the recession in 2009.

## Trends in output indicators (2007=100)



The overall cost of EU railways in 2012 was around €110 billion, as shown in the figure below. On average, the split between infrastructure and operator costs is approximately 30%:70%. This is largely a function of the dominance of passenger railways in a number of larger, higher income Member States. In those countries where freight traffic plays a more significant role, the proportion of total costs accounted for by the infrastructure manager is greater. On the income side of the equation, roughly 60% of costs are covered by fare-box and freight revenue (40% passenger and 20% freight) and a further 30% by subsidy. The remaining 10% (around €10.7bn) is a residual balancing item that is likely to include freight income not captured at the Member State level (data was not available for all Member States) and other sources of income such as property rents and retail revenue.

**Cost and contribution of the EU rail sector (2012)**

The figures above mask significant differences in input and output trends, and in costs, revenues and subsidies, between different Member States. Moreover, high level analysis of this kind cannot identify hidden costs, for example maintenance backlogs in some Member States.

**Key performance indicators**

Our selection of KPIs measuring the performance of different national rail systems was determined by the scenario analysis, literature review and discussion with the Commission with a view to support the scenario analysis. The KPIs are:

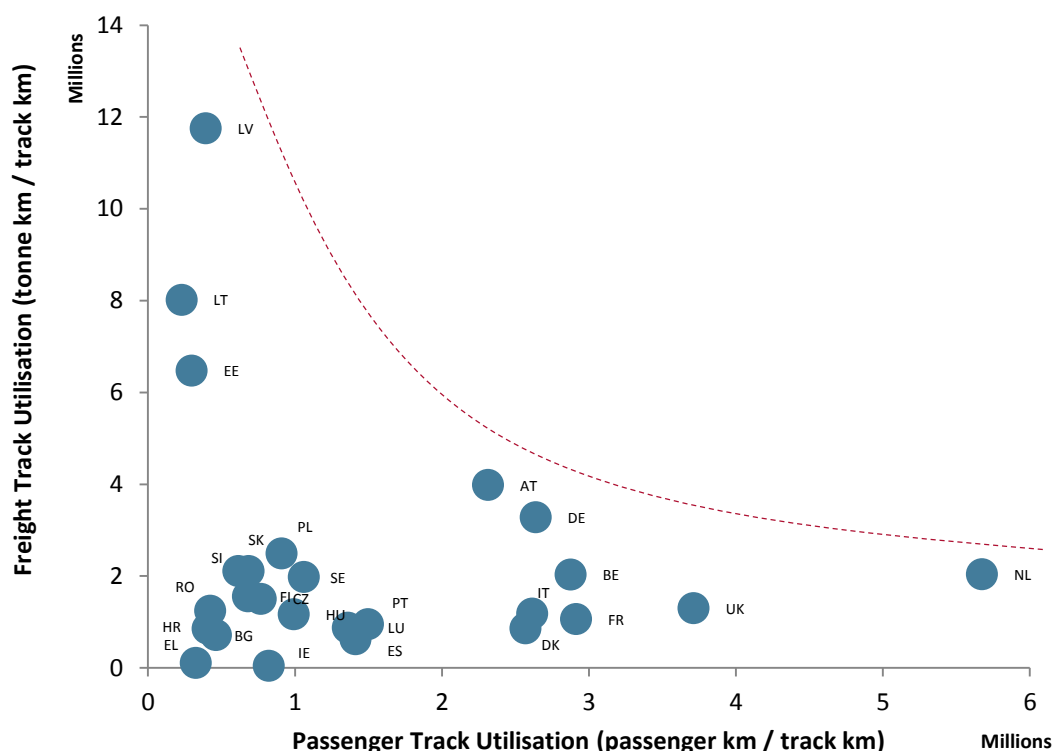
- Primary KPIs
  - Track utilisation (train kilometres/track kilometre)
  - Passenger train utilisation (passenger kilometres/passenger rolling stock)
  - Freight train utilisation (freight tonne kilometres/freight rolling stock)
- Secondary KPIs
  - Cost efficiency 1 (train kilometre/total operating costs)
  - Cost efficiency 2 (passenger kilometres/passenger operating costs)
  - Cost efficiency 3 (freight tonne kilometres/freight operating costs)
  - Staff efficiency (train kilometres/employees).

A data mining exercise helped to identify the relationships between primary KPIs, secondary KPIs and exogenous variables and to shortlist those that are likely to have greatest influence on the efficiency of the rail sector.

Few relationships could be identified by analysing two variables only, suggesting that the range of factors which affect the relative efficiency of rail networks in different Member States are many and/or complex. However, the figure below provides evidence of the generally

established trade-off between freight and passenger track utilisation and the existence of an efficiency frontier for rail networks across Europe.

**Passenger track utilisation and freight track utilisation (2012) – absolute figures**



Other key findings from this analysis included the following:

- Changes in track and train utilisation varied considerably between Member States. For example, the former grew by 30% in the Netherlands over the five years between 2007 and 2012, while in Greece it fell by 64%.
- In passenger rail, relatively few countries achieve high levels of both track and train utilisation. Denmark, Germany, the Netherlands and the UK appear to be leveraging their capital assets most efficiently overall, although Sweden achieves high levels of train utilisation.
- In freight markets, the Member States that border the North Sea and/or serve the Alpine region achieve higher capital utilisation. Countries on the periphery, notably Bulgaria and Greece, report much lower levels of both train and track utilisation.
- Financial measures of efficiency provided by the secondary KPIs do not necessarily align with physical measures of the kind discussed above. This may be due to increases in input prices offsetting the impact of improvements in the efficiency of resource use. To some degree, there may be an inverse relationship between each type of measure with, for example, an increase in operating costs per unit of output (driven by an increase in input prices) encouraging improvements in track or train utilisation.

**Clustering analysis**

The primary goal of the clustering exercise is to control for the impact of exogenous factors that are beyond the ability of managers and policy-makers to influence directly and can only be changed over the long term, if at all. In analytical terms, the aim is to minimise the similarity between the subsets while maximising the similarity between countries within each

subset. This will establish a basic categorisation of national rail systems to be used for efficiency analysis. The final clusters are shown in the table below.

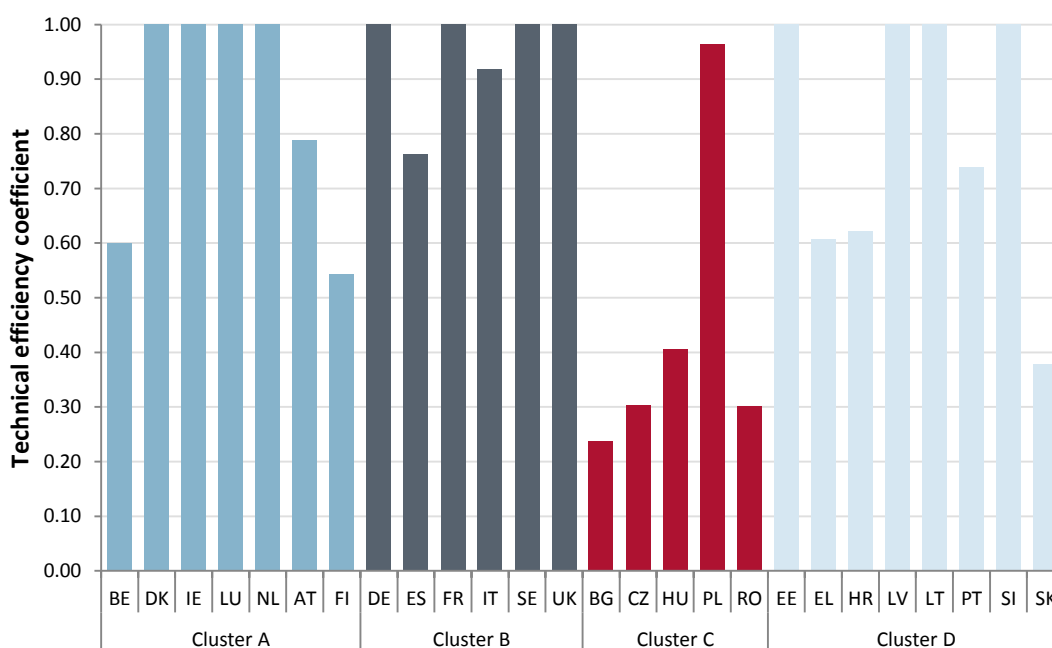
**Final clusters**

| Cluster A   | Cluster B | Cluster C      | Cluster D |
|-------------|-----------|----------------|-----------|
| Belgium     | Germany   | Poland         | Estonia   |
| Denmark     | France    | Hungary        | Greece    |
| Ireland     | Spain     | Czech Republic | Croatia   |
| Netherlands | Italy     | Bulgaria       | Latvia    |
| Austria     | Sweden    | Romania        | Lithuania |
| Finland     | UK        |                | Slovenia  |
| Luxembourg  |           |                | Slovakia  |
|             |           |                | Portugal  |

**Efficiency gap analysis**

For the purposes of this study, we used Data Envelopment Analysis (DEA) to assess the comparative efficiency of national rail systems. The results of our core analysis of total capital productivity (defined as including both track, freight train and passenger train related inputs simultaneously), are shown below. These indicate how efficient Member States have been in combining both track infrastructure and rolling stock assets to deliver outputs. With the exception of Poland, Member States in cluster C appear to perform particularly poorly against this specification of inputs and outputs.

**Total capital productivity technical efficiency scores (DEA model 1 VRS) – 2012**



**Scenario assessment**

After consideration of the range of policy levers available to the Commission that can be used to support improvements in the efficiency of the EU rail sector, it was agreed to focus on measures of capital productivity rather than staff or total factor productivity. While labour

productivity is a key determinant of overall productivity, it is arguably influenced more by corporate or national measures than by EU policy, and has therefore been excluded from the scope of this study.

In the total capital productivity scenario we explicitly capture all of the capital inputs Member States combine (both track and train) to deliver rail outputs (passenger km and tonne km). The basic premise of this core scenario is that all Member States currently operating away from the efficient frontier move to the frontier by 2050. We have further assumed that the savings gained are directly translated into additional railway outputs, as measured by passenger and freight tonne kilometres.

Using static input-output analysis to estimate the impact of changes in productivity in the rail sector on the wider economy, we have derived the results shown on the following page.

#### Estimates of the impact of economic impact of improvements in total capital productivity (to 2030)

| Impact                                     | Value   |
|--|---------|
| Direct GVA (€m PV)                         | 32,300  |
| Indirect GVA (€m PV)                       | 31,400  |
| Direct employment                          | 1,630   |
| Indirect employment                        | 1,620   |
| External benefits (€m PV)                  | 75      |
| Increase in passenger km in 2030 (million) | 200,000 |
| Increase in tonne km in 2030 (million)     | 260,000 |

Source: Steer Davies Gleave analysis; Net Present Values expressed in million euros (2010 prices, 2010PV) for the period 2015-2030. Employment is expressed in full-time equivalent (FTE) units. Figures may not tally due to rounding.

We have also carried out supplementary scenario analysis in which we explore the impact of changes in relative prices between transport modes, given that the main model developed to capture the impacts of productivity improvements does not include an assessment of price dynamics. To this end, we have produced an off-model calculation that assesses the impact of a change in road costs (a so called 'motoring cost shock') on modal shift and estimates the additional rail demand that would result if the price of road transport were to increase.

Our assessment of the change in relative prices between rail and road suggests that at the European level, the additional rail demand resulting from a change in relative prices would be lower than the additional demand that could be accommodated by reinvesting the efficiency savings under the core scenario.

#### Comparison between the supplementary scenario analysis and the core scenario by cluster (to 2030)

| Cluster | Passenger km (million) from supplementary scenario analysis vs core scenario | Tonne km (million) from supplementary scenario analysis vs core scenario |
|---------|--|--|
| A       | 2,600  | 6,900  |
| B       | -4,600   | -3,500   |
| C       | 13,600   | 20,700   |
| D       | 2,200  | 5,100  |

Steer Davies Gleave analysis. Positive figures indicate that the additional demand from the core scenario is higher than that from the supplementary scenario.



In all clusters except Cluster B, the additional demand generated by the motoring cost shock is less than the additional capacity supplied in the core scenario (i.e. the additional demand can be accommodated without further investment expenditure). However, for Cluster B, where the potential for productivity improvements is lowest, a considerable amount of excess demand would need to be accommodated and this might require further investment.

### **Policy implications**

As noted above, the 2011 White Paper, *Roadmap to a Single European Transport Area – Towards a competitive and resource efficient transport system*, sets out a vision for the European transport sector in which rail transport plays a much greater role than at present. However, while this framework includes policy interventions designed to address a number of general issues arising across the sector, this study has demonstrated the need to consider country-specific constraints and weaknesses that are currently undermining rail industry efficiency and competitiveness.

Against this background, the interaction between EU and national rail policy requires careful coordination. On the one hand, it is important that necessary restructuring and network consolidation at the national level does not undermine the further development of a single market in rail services. On the other key European policy initiatives, for example support for TEN-T projects from the Connecting Europe Facility and research funded by the Shift<sup>2</sup>Rail Joint Undertaking, will need to be implemented in a way that helps to reinforce national policy measures designed to improve efficiency.

Arguably, the most important area of policy interaction relates to industry restructuring among Member States in Eastern Europe, in particular Bulgaria, the Czech Republic, Hungary and Romania (included in cluster C in the analysis reported above). At the same time, we consider that caution should be exercised in the development and implementation of programmes of this kind for a number of reasons:

- First, reductions in the size of the asset base (for example, because of a reduction in the size of the operational infrastructure network or the national rolling stock fleet) may not always result in proportionate cost savings.
- Second, reductions in the size of the network, while they may deliver both efficiency improvements and significant cost savings, may also prove inappropriate in the long term.
- Finally, excessive rationalisation of infrastructure capacity could discourage or even prevent competitive entry into the rail market, whether inadvertently or by design.

In view of these concerns, and recognising the difficulties of obtaining comparable and robust data encountered in the course of this study, we suggest some consideration be given to collection of data on infrastructure management, possibly drawing on experience in the European air navigation industry. In addition, it may be appropriate to develop a framework for ensuring that stakeholders are properly consulted on the effects of rail rationalisation. At the same time, it will be important to encourage exchange of experience and good practice in areas such as forecasting future capacity needs and driving efficiency improvements, in particular through EU-wide forums including the European Network of Rail Regulatory Bodies and the Platform of Rail Infrastructure Managers in Europe.