
What is the contribution of rail to the UK economy?

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Rail Delivery Group

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What is the contribution of rail to the UK economy?

The rail industry and its supply chain:



Rail enhances the productive potential of the economy by up to **£10.2 billion PER YEAR**

User benefits for passengers and freight from travelling on rail are up to:



The rail sector leads to up to:

£1.4 BILLION

of benefits from sharing of knowledge and technology due to firms locating in clusters near rail links



up to £0.4 BILLION

in increased output due to reduced transport costs

Rail delivers environmental benefits, reducing CO₂ by up to

7.4 MILLION TONNES

Rail leads to reduced road congestion, resulting in up to

£12 BILLION in travel time savings per year



Rail is one of the safest ways to travel, preventing up to **950 serious casualties and fatalities per year**

The change in industry model may have delivered benefits of up to

£7.2 billion in 2013



Executive summary

Key messages

- The rail industry in Great Britain and its supply chain employ 212,000 people, generating £9.3bn of gross value added (GVA) a year.
- The rail sector returns £3.9bn in tax to the Exchequer a year, offsetting nearly all of the £4bn that it receives in government funding.¹
- The sector provides benefits worth up to £13bn a year to its passenger and freight users.
- The sector contributes considerable enduring benefits to the productive potential of the economy, including alleviating congestion in the road network and facilitating the development of clusters of economic activity. Oxera has valued these benefits at up to £10.2bn a year.
- In addition to the economic impacts, the rail sector delivers significant environmental and social benefits. The sector reduces CO₂ emissions by up to 7.4m tonnes, valued at £430m annually. It also lowers the numbers of people killed or seriously injured on the transport network in Great Britain (relative to what would be expected to happen if those journeys were made by car or lorry) by up to 950 a year, valued at £330m annually.
- The sector has been highly resilient in the recent recession, performing better than the rail sectors in other large European countries (despite the UK experiencing a more significant reduction in national gross domestic product, GDP), and better than in previous recessions.
- The industry model changed in the mid-1990s from one of public ownership to the current model, where freight operating companies (FOCs) compete for freight contracts, and passenger services are largely specified by the government and delivered by train operating companies (TOCs). First Railtrack, and then Network Rail, have managed the rail infrastructure, with the Office of Rail Regulation (ORR) regulating both bodies in turn. While it is difficult to be precise about the impact of the change in industry model, Oxera has estimated that it may have provided benefits of up to £7.2bn in 2013.

Source: Oxera.

By most measures, the GB rail sector is a success.² Over the last 20 years, since the creation of the new industry model (in which freight rail services are operated by competing FOCs, passenger rail services are specified by the government and delivered by the TOCs, and first Railtrack—and then Network Rail—have managed the infrastructure, with the ORR regulating both in turn), the number of passenger journeys has risen, and now stands at 115% higher than it was 20 years ago.³ The distance travelled by trains has increased by 36% over the same period, and there has been an improvement in safety and an

¹ All monetary values in this report are in 2013 prices.

² Throughout this report, the 'rail industry' refers to the combination of passenger TOCs, FOCs and Network Rail. The 'rail sector' refers to both the industry and its supply chain.

³ Office of Rail Regulation, National Rail Trends, 'Passenger journeys by year', available at: <http://dataportal.orr.gov.uk/displayreport/report/html/027a8556-588a-43c7-9581-08298c4e4677>, accessed 30 May.

increase in passenger satisfaction.⁴ There has also been a 70% increase over this time period in the amount of freight transported by rail.⁵

The rail sector plays an important role in providing employment across Great Britain, both directly in the industry (through employment by TOCs, FOCs and Network Rail) and in the supply chain. In addition, as a key component of the transport infrastructure in Great Britain, the rail industry provides significant economic benefits by enabling other sectors of the economy to be more productive.

Despite the importance of the rail sector to the UK economy, its economic impact has not been analysed at a national level, although some studies have considered parts of the sector or parts of Great Britain.⁶ To fill this gap in the literature, the Rail Delivery Group (RDG)⁷ commissioned Oxera to provide an independent assessment of the contribution of the GB rail industry to the UK economy.

This report looks at the impact of the rail sector on the UK economy from different perspectives, including:

- the employment, tax, investment and GVA generated by the sector (the 'economic footprint');
- the benefits that accrue to passenger and freight users of the rail network from the consumption of the products and services of the rail sector (the 'user benefits');
- the long-term effects of the sector on the wider economy—i.e. the benefits outside the rail sector (the 'wider economic impacts');
- the environmental and social impacts of the sector.

The RDG also asked Oxera to provide analysis of two other issues:

- the rail industry's performance in the recent recession compared with previous recessions, and relative to rail industries in other European countries;
- the economic impacts that arose from the change in the industry model in the mid-1990s.

The economic footprint: the contribution of the rail industry and its supply chain

There is some overlap between the first three perspectives outlined above, so they should not be simply added together. This is because, while the economic footprint captures the impact of the rail sector on the economy in the short term, it does not reflect the likelihood that, if the rail sector were smaller, the resources

⁴ Based on data from 1997/98 to 2012/13; for passenger satisfaction, the data is measured from 1999. Association of Train Operating Companies (2013), 'Passenger rail: dataset on financial performance, passenger benefits, and value of franchising model 1997/98-2011/12', 10 July.

⁵ Measured in net tonnes per km. KPMG (2014), 'Keeping the lights on and the traffic moving: Sustaining the benefits of rail freight for the UK economy'. The process for freight privatisation was different to that for passenger services (see section 6).

⁶ For example, Network Rail (2010), 'Value and importance of rail freight', July; and University of Strathclyde (2013), 'Scotrail – economic and performance impacts, 2004-2013', a report to Scotrail from the Fraser of Allander Institute, September.

⁷ The Rail Delivery Group is an association of Great Britain's TOCs, FOCs and Network Rail, and provides leadership to the industry.

(labour, capital, land, etc.) that are currently used in providing rail services would be used elsewhere in the economy. Nevertheless, this economic footprint provides an important guide to the size of the rail sector and the effects that it has on the national economy.

Oxera has used data from Network Rail and the FOCs and TOCs, together with national accounts from the Office for National Statistics (ONS), to measure the employment and GVA created by the rail sector. The conclusions from this analysis are that:

- the rail industry and its supply chain employ 212,000 people, generating £9.3bn of GVA a year;
- the rail industry and its supply chain generate £3.9bn of tax a year, offsetting nearly all the £4bn of public support provided to the industry.

User benefits

An alternative approach is to consider the benefits that accrue to passenger and freight users of rail services.⁸

To quantify the user benefits, it is necessary to specify a 'counterfactual'—i.e. what would happen if the rail industry were smaller—against which the benefits can be compared. In standard economic appraisal where the objective is to calculate the economic impact, one would typically consider a counterfactual in which the industry does not exist. However, a counterfactual of 'no rail sector', while providing valuable insights into the size of the sector in the economy, is not a realistic option for evaluating the impact of different policy scenarios, and it is very difficult to estimate what a 'no railway' situation would look like. Therefore, to provide an indication of the magnitude of the impact of the sector, Oxera has considered two additional counterfactuals, where passenger and freight volumes on the network are 10% and 50% lower.

The volumes of passenger and freight traffic on the rail network might decline as a result of fewer rail links, an increase in price, an increase in journey time—due to fewer trains or lower frequency—or a reduction in the quality of the network (e.g. more crowded trains). These scenarios should not be considered as representing the outcomes from any particular policy choices, but should rather be considered as indications of the sorts of costs that may arise as a result of policies that have the effect of reducing rail traffic by these volumes. Of course, a decline in rail traffic of 50% would only be likely to arise from a major shock (or shocks) to the rail sector.

Oxera has estimated that the user benefits of the rail industry are between £1.3bn (arising from a 10% reduction in traffic) and £13bn (if there was no rail industry) for passengers (leisure, business and commuter) and freight users.

⁸ Technically, the consumer surplus.

Wider economic impacts

The wider economic impacts describe how the rail sector facilitates increased output in the rest of the economy. This is one of the factors that makes transport different from many other sectors of the economy—if the rail sector were smaller, not only would there be a loss to the economy from the reduced economic footprint (which would be likely to be relatively short-lived as resources would be used elsewhere in the economy), but productivity in other sectors of the economy would also be likely to decline.

In assessing these effects, Oxera has used the same counterfactuals as in the user benefits analysis outlined above. There are a number of well-established mechanisms by which the rail sector improves the long-run productive potential of the rest of the economy, as follows.

- **Reduced congestion on the road network:** the existence of the rail sector reduces congestion on the road network for both passenger and freight users. Oxera's analysis indicates that the value of this reduced congestion is between £0.9bn (the 10% reduction in rail scenario) and £12bn (the 100% reduction in rail scenario) a year, of which just over one-third could be allocated to business users and freight, providing a benefit to the economy.
- **Increased agglomeration benefits:** rail services lead to an increase in the density of employment (i.e. the number of employees in a particular area, such as a city centre). This typically raises the productivity of these employees through information- and knowledge-sharing. This increase in productivity is estimated to be worth between £0.1bn and £1.4bn to the UK economy each year.
- **Increased output:** the rail sector reduces transport costs relative to making the same journey by road,⁹ which would result in an increase in output in other sectors of the economy. This benefit is assessed to be between £40m and £400m a year.

In addition to these mechanisms, there are a number of other ways in which the rail sector may lead to increased productivity in the economy. For instance, the provision of rail services may enhance trade between firms. Therefore, one can also consider the benefits to the UK economy by adopting a top-down perspective—i.e. considering the total impact without separating out the different mechanisms that contribute to that total in order to capture the mechanisms above as well as additional effects. Overall, Oxera estimates that the rail sector may contribute between £0.9bn and £10.2bn a year to the UK economy from the wider economic impacts.

Social and environmental impacts

The rail sector also provides environmental and social benefits to the UK. This report focuses on a subset of the social and environmental effects of rail, including the effects on journey quality, the number of accidents, accessibility and resilience, greenhouse gas emissions, noise and air quality. Oxera has used the same counterfactuals in this section as for the analysis of user benefits and the wider economic impacts. Oxera's analysis suggests that:

- the rail sector produces significant environmental benefits, saving between 0.7m and 7.4m tonnes of carbon emissions a year. This is valued at between

⁹ For those journeys made by rail and accounting for the total (generalised) cost.

£40m and £430m annually. The noise and air quality benefits provided by the rail sector have not been quantified;

- the rail sector leads to a reduced number of serious or fatal accidents of between approximately 95 and 950 a year (compared with a situation where the journeys were made by road), valued at between approximately £33m and £330m annually.

Performance in recession

It is informative to examine how the rail sector performed in the recent recession, relative both to previous recessions and to the sector in other European countries. Both the passenger and freight areas of the sector performed strongly during the recession, relative to performance in previous recessions.

Passenger operations performed substantially better than would have been expected from previous recessions, and continued to exhibit strong growth for much of the recession, despite declines in GDP and employment. While this has been a pattern repeated across the comparator countries, passenger volumes in the UK have increased by more than in European comparator countries, despite the UK experiencing a more severe recession than other countries.

While freight operations saw volumes decline during the recent recession, they performed better than in previous recessions. In contrast to many other European countries, they also maintained their market share relative to other forms of transport.

While it is not possible to conclude on the basis of these statistics alone that this improvement in performance is due to the differences in the industry model from those in previous recessions and other European countries, it seems likely that a good deal of the improvement could be attributable to the change in the industry model.

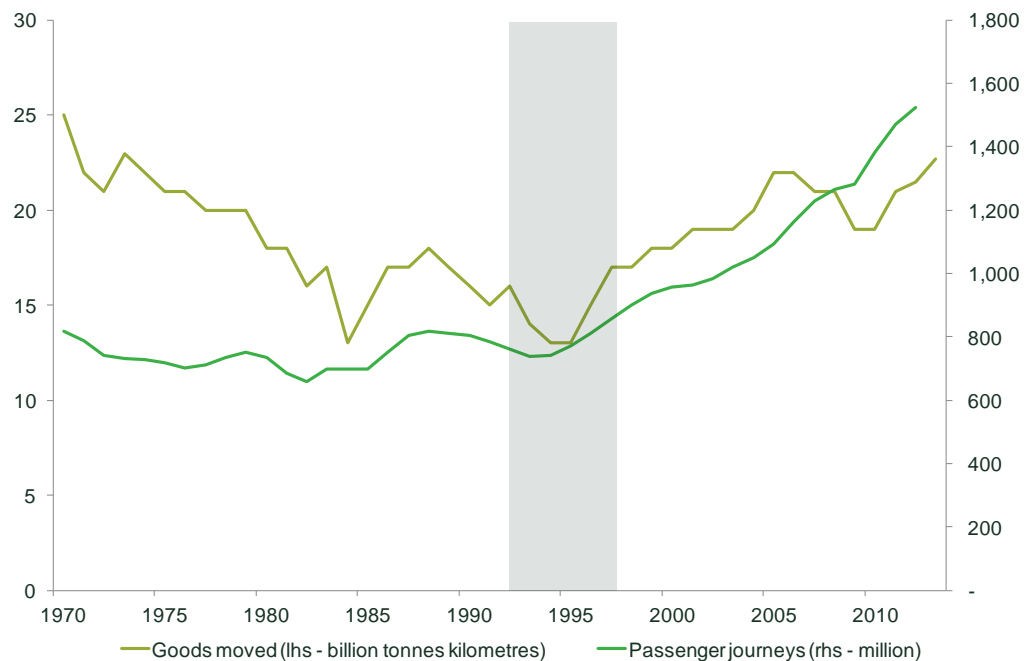
Change in the industry model

As set out above, prior to the mid-1990s, the rail industry in Great Britain was owned and run by the public sector. However, in the mid-1990s, the industry model changed to one in which the government specifies the passenger services to be delivered, and the TOCs provide these services, with the FOCs competing in an open market. The infrastructure has been owned first by Railtrack and then by Network Rail, with both being regulated by the ORR.¹⁰

The figure below illustrates the change in passenger rail journeys and rail freight in Great Britain since 1970/71. As can be seen, the average growth rate since the mid-1990s is greater than before the mid-1990s. The important question is then to what extent the change in the industry model caused the increase in average growth (as the change in ownership per se is unlikely to be sufficient to increase revenue).

¹⁰ There have been a number of changes in the precise way in which the public sector specifies the passenger services that it wishes to procure.

Passenger rail journeys and rail freight in Great Britain



Note: The area shaded in grey indicates the period of industry transition as a result of the change in the industry model.

Source: ORR.

To answer this question, it is necessary to specify the counterfactual—i.e. what would have happened to the passenger and freight aspects of the rail sector in the absence of the change in industry model in the mid-1990s. As with any exercise of this type, there are many possible counterfactuals, with different implications for the extent of the benefits provided by the change in the industry model. For this reason, Oxera has developed a transparent set of assumptions around the counterfactual, which generates a range of effects that cannot be attributed to the nature of the industry model, and thus suggests what effects the change itself might have had. Nevertheless, there remains significant uncertainty as to how the rail sector would have evolved, and therefore the estimates presented in this report should be considered indicative—and the area would benefit significantly from further research.

For freight operations, given the decline in freight volumes prior to the introduction of the new industry model, and the significant changes since then, it does not seem unreasonable to attribute most of the change in trend in volumes to the change in the industry model.

However, the picture for passenger operations is more complex, given the much greater role of the government in specifying the services to be run, controlling the level of certain fares, and determining the amount of public investment. Therefore, Oxera's approach to estimating the extent to which the increased passenger growth observed since the mid-1990s is attributable to the change in the industry model has been to calculate the percentage of that growth that can be explained by factors outside the control of the rail sector (using standard industry approaches).

Our analysis starts by identifying the difference in the average annual growth rate between the 20 years prior to the change in the industry model and the

nearly 20 years since. This figure, which is broadly robust to selecting different time periods, is approximately 4%.

We then assessed the extent to which this difference in growth could be accounted for by factors outside the sector's control, including the macroeconomy and the cost of owning and using a car. This analysis suggests that approximately 2% a year of the growth in passenger rail demand since the mid-1990s can be explained by these factors.¹¹

The difference between the increased growth rate and the changes outside the control of the sector is likely to be explained by a number of factors, including:

- factors not adequately captured in the demand forecasting framework;
- the change in the industry model;
- changes that would have happened anyway had the industry model not changed.

There have been some substantial changes in the rail industry since the change in the industry model, including:

- access to larger volumes of private sector capital (particularly investment in rolling stock);
- the establishment of five-year funding periods for Network Rail (and, importantly, a move away from annual expenditure limits), which has enabled continued government support to the industry—even when the funding of the Department for Transport (DfT) was being reduced—in marked contrast to the pattern during the period when British Rail (BR) was in operation (i.e. before the change in the industry model);
- a change in the incentives on TOCs to grow the market and reduce costs where possible, with contractualised levels of funding for the duration of the franchise;
- increases in costs, offset by increases in government funding and revenue growth, which have enabled the average price per passenger mile to be held at a similar level since the change in the industry model;
- the availability of heavily discounted advance fares.

Given the uncertainty inherent in any exercise of this type, Oxera has assessed the implications of 25–75% of the difference between the growth attributed to the factors outside of the control in the industry and the increased growth in passenger demand around the mid-1990s being attributed to the change in the industry model. A qualitative assessment of the factors above—including access to multi-year funding agreements with government and private capital, and contractual incentives to grow the market and improve passenger experience—suggests that the evidence would support a value towards the upper end of this range.

As outlined above, the extent to which these features of the sector have arisen (or been adopted faster) because of the change in the industry model, and the

¹¹ Specifically, we have used parameters from the Passenger Demand Forecasting Handbook (PDFH) to calculate the impact on rail demand from changes in fuel costs for car users, changes in car ownership, GDP per capita, employment, and population growth over this period.

extent to which they would have happened anyway under BR, is a matter of some debate (but not one that can be settled by this report). The key question is the extent to which these changes were caused by the change in the industry model. It is possible that these changes would have occurred in the absence of the change in the industry model, but any assessment will need to take a view on the likelihood of this happening.

Through the same mechanisms as explained in the section on user benefits, the effect of this change for both passengers and freight traffic can be calculated as between £2.2bn and £7.2bn in 2013. Reflecting the evidence above, Oxera's assessment is that the actual impact is likely to be towards the upper end of this range.

Conclusions

This report, produced by Oxera for the RDG, has analysed the economic contribution of the rail sector to the UK economy, reviewed the performance of the sector in the recent recession relative to previous recessions and the rail sectors in other European countries, and quantified the benefits arising from the change in the industry model in the mid-1990s.

The economic contribution of the industry is split into three perspectives:

- the contribution of the industry and its supply chain, which is the employment of approximately 212,000 people, the generation of £9.3bn in GVA each year, and the provision of £3.9bn of tax revenue to the Exchequer;
- up to £13bn in benefits to passengers and freight users a year;
- up to £10.2bn worth of additional productivity in the economy, which arises through the impact of the rail industry on other sectors of the economy.

The sector has performed better during the most recent recession than in previous recessions. While it is difficult to infer from the statistics that this is purely due to the change in the industry model, it seems likely that this change contributed to the improved performance.

In addition, using a set of plausible assumptions, the change in the industry model is thought to have delivered up to 345m additional passenger journeys of a total of approximately 1.6bn (or one in five journeys), and economic benefits of up to £7.2bn in 2013, through higher passenger and freight volumes. This increase in passenger and freight volumes may be due to a combination of greater stability of government funding and greater access to private capital over an extended period of time, together with incentives on TOCs and FOCs to grow the market.

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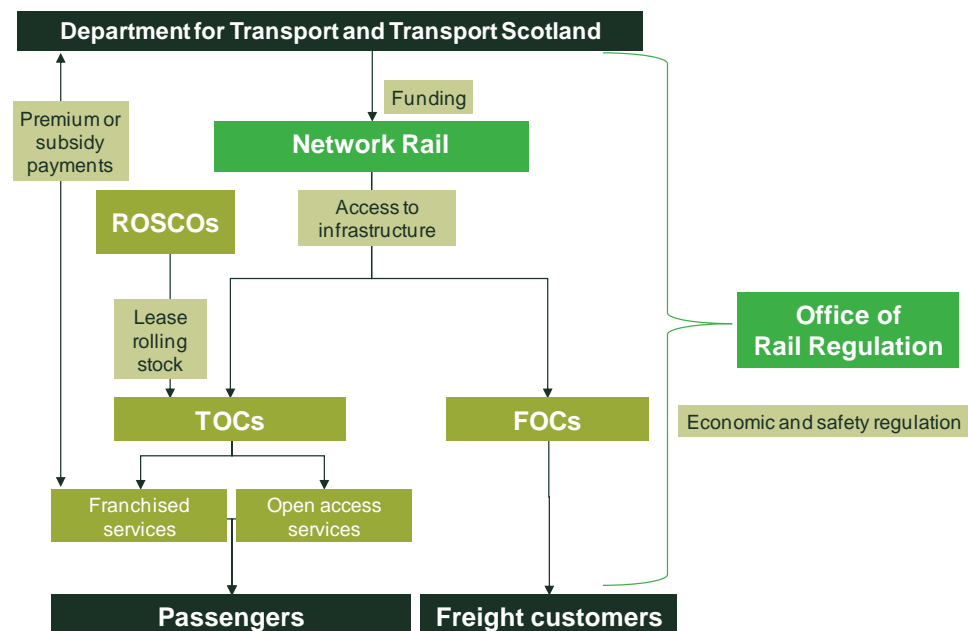
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1 Introduction

By most measures, the rail industry in Great Britain is a success.¹² Over the last 20 years, since the creation of a new industry model (described in section 7), the volume of passengers carried on the railway has risen significantly, and is now 115% higher than it was 20 years ago.¹³ The distance travelled by trains has increased by 36% since the change in the industry model, and at the same time there has been an improvement in safety and an increase in passenger satisfaction.¹⁴ There has also been a 70% increase in the amount of freight transported by rail over this period.¹⁵ In 2012/13, total passenger revenue was £7.7bn and total freight revenue was £0.9bn.¹⁶

The structure of the rail sector is set out in Figure 1.1.

Figure 1.1 Structure of the rail sector



Note: TOCs, train operating companies; FOCs, freight operating companies; ROSCOs, rolling stock leasing companies.

Source: Oxera.

The rail sector has an important role in providing employment and in ensuring long-term benefits to the economy. However, as the overall impact of the sector has not been analysed at a national level, the extent of these benefits is unknown. Therefore, the Rail Delivery Group (RDG) commissioned Oxera to provide an independent assessment of the role of the GB rail industry and its contribution to the economy.

¹² In this report, the 'rail industry' is defined as TOC, FOCs and Network Rail. The 'rail sector' refers to the industry and the supply chain.

¹³ ORR National Rail Trends, 'Passenger journeys by year', available at: <http://dataportal.orr.gov.uk/displayreport/report/html/027a8556-588a-43c7-9581-08298c4e4677>, accessed 26 June 2014.

¹⁴ Based on data from 1997/98 to 2012/13, except for passenger satisfaction, where the data is measured from 1999. Association of Train Operating Companies (2013), 'Passenger rail: dataset on financial performance, passenger benefits, and value of franchising model 1997/98-2011/12', 10 July.

¹⁵ Measured in net tonne km. KPMG (2014), 'Keeping the lights on and the traffic moving: Sustaining the benefits of rail freight for the UK economy'.

¹⁶ Office of Rail Regulation (2014), 'GB rail industry financial information 2012-13', April.

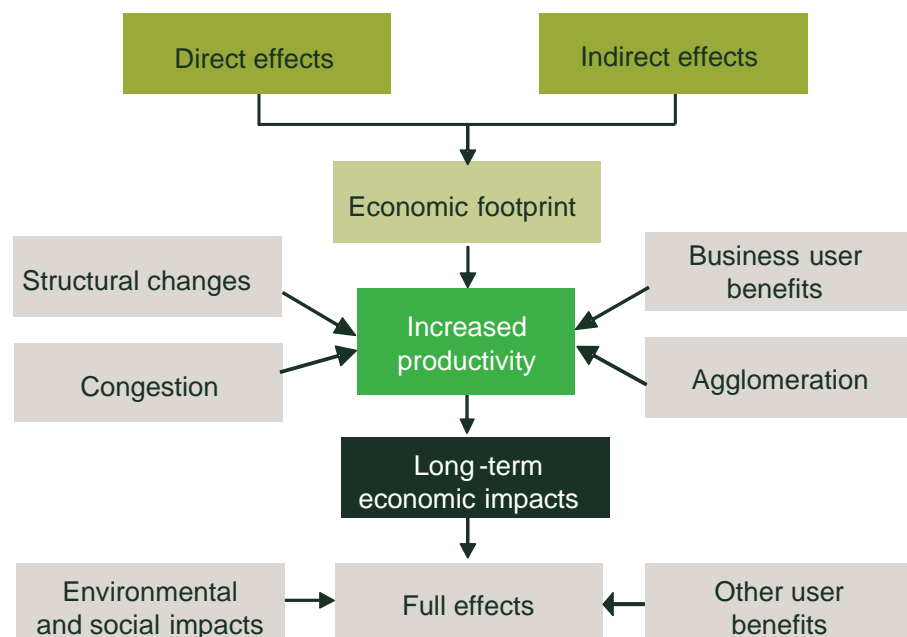
This report considers two key issues: the impact on the economy; and comparison between recessions and between countries.

The impact on the economy

The report looks at the impact of the rail sector on the economy, which can be considered from several perspectives. One is through the scale of the rail industry and its supply chain, which is analysed by considering employment, tax, investment and gross value added (GVA) generated by the sector. This is referred to as its 'economic footprint'.

The scale of the rail sector and its spending does not, in itself, provide an indication of its overall implications for the economy. For example, if the resources (people, land, etc.) involved in producing rail services would otherwise have been deployed in other, equally productive, sectors of the economy, there would be no overall economic benefit from the rail sector. The full benefit depends on the value of the services that the railway provides to users, as well as the effect on productivity in other sectors of the economy. Oxera's approach to estimating the impact of the rail sector is illustrated in Figure 1.2.

Figure 1.2 Conceptual framework



Source: Oxera.

These concepts and measures are covered in sections 2 to 5 below.¹⁷

Section 2 relates to the rail industry's economic footprint, covering the resources used in the industry, and the income that it generates, together with the supply chain. User benefits (**section 3**) and wider economic impacts (**section 4**) measure the value of rail services to users and the wider economy, which together determine the overall impact of rail on the economy. There are also environmental and social benefits of the rail sector, which are discussed in **section 5**.

¹⁷ Appendices A1 and A2 provide further technical details on the estimation.

Comparison between recessions and between countries

In **section 6**, the report then analyses how the rail sector in Great Britain fared in the recent recession relative to its performance in previous recessions, and the rail sectors in other European countries. **Section 7** considers the benefits produced by the current industry model, and how these benefits differ from those that may have been created under a public ownership model. We consider how the demand and supply of rail services might have evolved since the mid-1990s under both models. This enables us to provide an indicative estimate of the proportion of the current benefits to the sector of the change in the industry model 20 years ago.

2 Economic footprint

This section discusses the direct and indirect contributions of the rail sector to the UK economy. Together, these effects are termed the sector's 'economic footprint'. The key results from this section are outlined in the box below. Further details on methodology are included in Appendix A1.

Key findings

- The rail sector plays a significant role in the UK economy through a direct contribution of the rail industry from the activities of TOCs, FOCs and Network Rail, and through an indirect contribution from the economic activity of the supply chain.
- The rail industry and its supply chain employ 212,000 people, generating £9.3bn of GVA a year.¹⁸
- The industry and its supply chain also provide significant tax contributions of £3.9bn a year, offsetting nearly all of the government funding to the sector.

2.1 Approach to measuring the economic footprint

The economic footprint of the rail sector can be divided into two parts:

- a **direct impact**, which measures the economic value of the activities and output of the rail industry—essentially, the resources used in the rail industry to deliver services, including employment. This includes the TOCs,¹⁹ the FOCs and Network Rail;
- an **indirect impact**, which measures the value of the resources in the domestic (i.e. within Great Britain) supply chain used by the rail industry to undertake its activities. This includes industries such as rolling stock (leasing and maintenance), train manufacturers and those companies supplying materials to manufacturers, cleaners, and retailers.

The scale of the rail sector and the number of employees does not, in itself, provide an indication of its overall implications for the economy. For example, if the resources (people, land, etc.) involved would otherwise have been deployed in other, equally productive, sectors of the economy, there would be no overall economic benefit from the rail sector. Therefore, ideally one would need to compare what those same resources would deliver if they were instead used elsewhere in the economy, which would enable estimation of net rather than gross effects. Likewise, if there are other changes in the structure of the economy as a result of the redeployment of those resources (for example, due to trade or tourism), these should be taken into account to determine the overall benefit attributable to the rail sector (see section 4). However, given the complexity of such an analysis, it is standard in exercises of this type to present the gross impact (i.e. not to consider what the resources would do if they were redeployed elsewhere in the economy).

¹⁸ All monetary values in this report are in 2013 values, unless otherwise stated.

¹⁹ This does not include Eurostar, due to the difficulty in determining the relevant domestic contribution. It does include London Overground or the open access operators (Grand Central and Hull Trains), or Heathrow Express.

A number of indicators that can be used to consider the economic contribution of the rail sector for this purpose are discussed below for each of the direct and indirect impacts.

2.2 Direct impact of the rail sector

The direct impact of the rail sector can be measured in various ways, and includes the impact of the 57bn passenger km travelled on rail, 270,000 freight train movements, and the operation of 2,495 stations per annum.²⁰

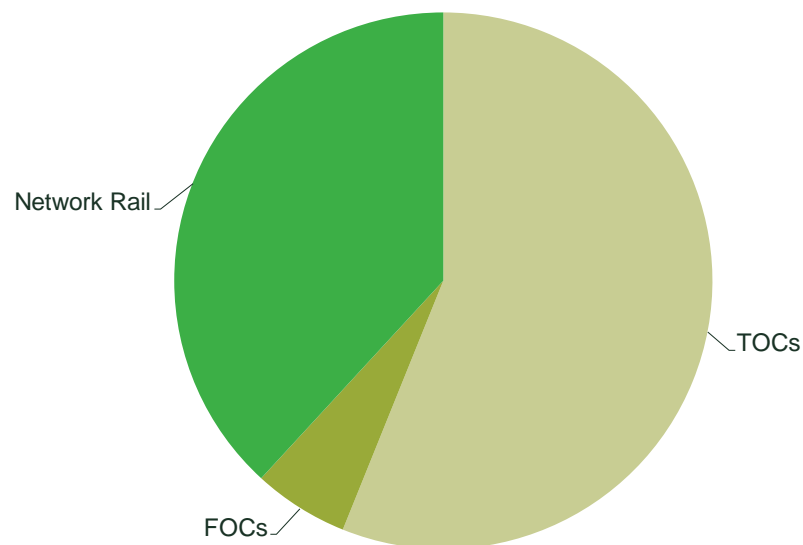
The direct impacts are estimated using industry and company accounts, consultant reports and annual accounts, and Office for National Statistics (ONS) data. More detail for each of the indicators is provided in the following sub-sections.

2.2.1 Employment

The level of employment in a sector is a key aspect of its economic contribution. This is relatively simple to measure by adding together the numbers of those employed by companies deemed to be operating in the sector.

Oxera has calculated the direct employment impact by using employment data for Network Rail, TOCs and FOCs.²¹ The total amount of direct employment is approximately **93,000**, broken down as indicated in Figure 2.1.

Figure 2.1 Direct employment, 2011/12



Source: Annual accounts, ORR National Rail Trends and Rail Industry Monitor.

2.2.2 GVA

GVA indicates the value of outputs created by the industry, less the costs of inputs purchased.²² In essence, GVA represents the sum of profits and wages (pre-tax) generated as a result of the economic activity of a sector or the economy overall.

²⁰ Office of Rail Regulation (2013), 'GB rail industry financial information 2011-12', April; and ORR National Rail Trends.

²¹ All figures used in this section are based on 2011/12 data.

²² GVA plus taxes on products minus subsidies on products equals gross domestic product (GDP).

The direct contribution of the rail sector, in terms of its GVA, is recorded in the national accounts produced by the ONS. For the purposes of this assessment, the rail sector is defined as comprising the ONS class 'Rail transport services' (SIC 49.1-2) and part of the class 'Warehousing and support services for transportation' (SIC 52).²³ This second SIC class represents the activities of Network Rail that ultimately feed into the rail sector. This is estimated as being worth an additional £1.4bn of direct GVA based on the size of the interaction between those two sectors. While there is activity related to the rail sector in other ONS SIC classes, these contain significant amounts of non-rail activities and have therefore been excluded in calculating the direct impact (although they are included in calculating the indirect effect).²⁴

Oxera has calculated direct GVA as **£5.8bn** a year.

2.2.3 Tax contribution

The capacity to generate tax is also important to consider in terms of the industry's direct impact on the economy.

Oxera has estimated a total annual corporation tax contribution of **£90m** a year, with the TOCs making up approximately 80% of that total.²⁵

Data on income taxes—the largest of which are pay-as-you-earn (PAYE) income taxes and national insurance contributions (NICs)—is not available directly from company accounts. However, it is possible to calculate indicative estimates of these using data from the ONS Annual Survey of Hours and Earning (ASHE).²⁶

Oxera has used ASHE data on the number of employees and mean gross incomes to estimate the total gross wages of the employees of the TOCs, the FOCs and Network Rail. These are compared to total wages across all sectors in the economy to give an estimate of the share of wages in the rail sector. PAYE income tax and NICs are assumed to be distributed in the same way across sectors. This approach results in an estimated **£642m** in PAYE income tax and **£494m** in NICs from the industry activity. TOCs account for the majority of this, making up 55% of the total, while Network Rail accounts for a further 35%. The breakdown of taxes between the various entities is shown in Figure 2.2 below.

The rail industry also makes significant contributions to other tax receipts. As many of these other taxes are levied on transactions or specific assets, it is difficult to estimate robustly receipts based on data in the sector accounts. Using data from the Office for Budget Responsibility,²⁷ Oxera estimates that these other receipts total £272bn in 2011. Assuming that the rail industry contributes to other taxes and duties in line with its contribution to overall national GVA, this would add another £1.2bn in tax receipts.

²³ Network Rail is included in SIC class 52 among other non-rail activities. Oxera has therefore included all of SIC 49.1-2 in calculating the direct impact, and a pro-rata amount of SIC 52 based on the share of Network Rail employment in total industry employment in SIC 52. A similar approach to incorporating SIC 52 is used in other calculations in this section.

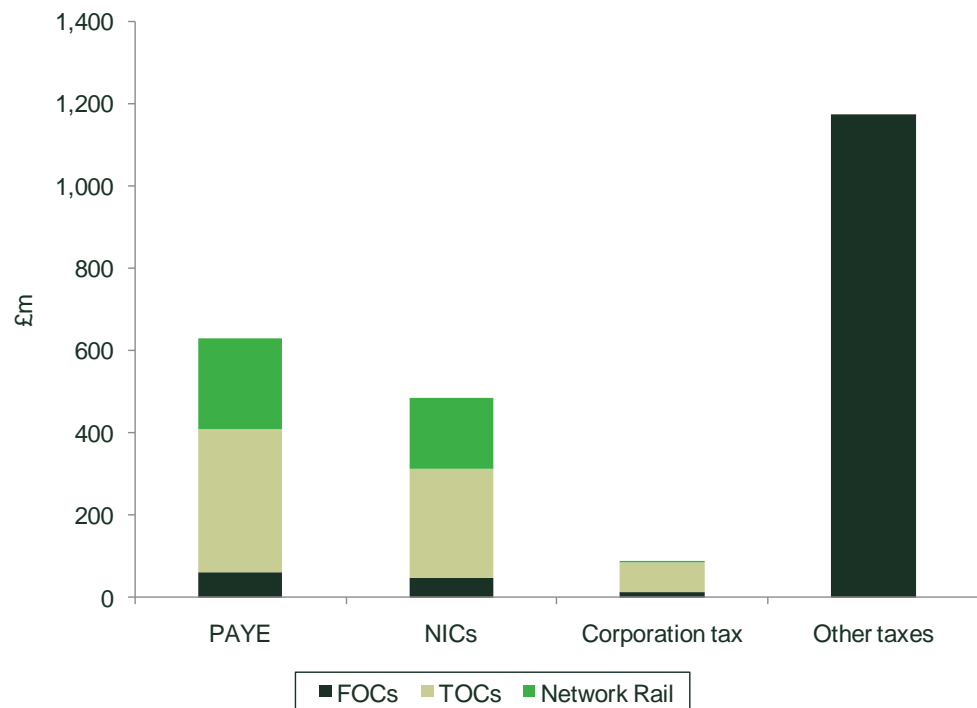
²⁴ Due to the highly interrelated nature of the two classes used to define the broader rail sector, it is possible that there is some double-counting of economic impact. The results presented here should be treated as an upper bound.

²⁵ Based on the Rail Industry Monitor and Network Rail (2012), 'Network Rail Infrastructure Limited Annual Report and Accounts 2012'.

²⁶ This approach does not account for the distribution of income across the sector.

²⁷ Office for Budget Responsibility (2013), 'Economic and fiscal outlook charts and tables', March

Figure 2.2 Direct tax contribution, 2011/12



Note: Other taxes are not disaggregated by source as they are estimated industry-wide based on GVA, which is not available for TOCs and FOCs separately.

Source: Oxera.

In total, **tax receipts** from the industry are approximately **£2.4bn**.²⁸

2.2.4 Investment

The investment undertaken by the rail industry is calculated by considering capital expenditure (CAPEX) for the TOCs, the FOCs, and Network Rail.²⁹ Oxera has calculated that direct investment by the rail industry was approximately **£5bn** in 2011/12. Most of this investment is undertaken by Network Rail, which receives grant funding from the government as well as income from private operators and passengers.

2.3 Indirect impact of the rail supply chain

Calculating the indirect impact of the rail supply chain is less straightforward than calculating the direct impact of the rail industry, as data on the indirect impacts is not collected by companies or a statistical authority. Indirect effects take account of the links between the rail industry and the sectors that make up its supply chain, and represent the economic impact of firms that supply the rail industry but do not produce rail services themselves. The broad approach that Oxera has used to estimate the indirect impact is outlined in Box 2.1, with further details provided in Appendix A1.

²⁸ In this report, direct tax refers to tax generated by the industry, while indirect tax refers to tax generated by the supply chain. This is not the standard use of the terms 'direct' and 'indirect' tax in the tax literature, but it is consistent with the nomenclature adopted elsewhere in this report.

²⁹ For Network Rail, this includes renewals and enhancement CAPEX. For the TOCs and the FOCs, it includes investment in rolling stock, land and buildings, fixtures and equipment, and other assets.

Box 2.1 Estimating the indirect impact

To assess the impact of one industry on another, input–output (IO) tables can be used. This is a widely used methodology in impact assessment of an industry or a policy.

An IO table represents the relationships across sectors in an economy between the use of resources in production and consumption, and provides a picture of the flows of products and services in the economy. For example, it shows the amount of insulated wire and cable sector services used in the production of one unit of rail services. These production relationships, which are given for the whole economy, and which form the basis of the indirect contribution of rail, are represented in the ONS's Analytical IO tables.³⁰

The first step of the estimation uses the Analytical IO tables to calculate the amount of gross output produced in the economy from a given level of rail input through its supply chain. The indirect GVA generated by rail in the economy is then assessed from the amount of value added corresponding to the output produced by each sector. The latest version of the Analytical IO tables presents such relationships disaggregated by 127 sectors for the year 2010.³¹

Source: Oxera.

2.3.1 Employment

To estimate the total employment of the rail supply chain, the supply chain is aggregated into groups for which employment data is available from the ONS's Business Population Estimates dataset. The level of total employment is then calculated as the number of employees that would produce the level of GVA outlined below, given the level of productivity in each part of the rail supply chain.

As discussed above, direct employment has been sourced from company accounts. Indirect employment is then calculated as the difference between total and direct employment. The data suggests that the rail supply chain is responsible for approximately **120,000** employees.³²

2.3.2 GVA

The estimates of indirect output can be used to estimate the indirect GVA from the rail supply chain based on the assumption that the ratio of GVA to output is constant. On this basis, the total estimate for the indirect GVA for the rail supply chain is **£3.5bn**. As noted in section 2.2.2, this estimate has been calculated by summing the indirect output and GVA of the rail transport services SIC code. The £1.4bn that was added to direct GVA to represent the activities of Network Rail has been removed from the estimate of indirect GVA to avoid double counting.³³

2.3.3 Tax contribution

As with employment and GVA, it is possible to calculate indicative estimates of income tax revenues using the results of the IO modelling. The tax year 2011/12 corresponds most closely to the IO model results. In this year, HMRC collected a total of £132bn in PAYE tax receipts. The total (direct plus indirect) PAYE contribution of the rail sector has been estimated using HMRC's published

³⁰ See <http://www.ons.gov.uk/ons/guide-method/method-quality/specific/economy/input-output--uk-national-accounts/index.html>, accessed 26 June 2014.

³¹ These tables were published in 2013.

³² Two sectors ('activities of household as employers' and 'public administration') are not covered by the Business Population Estimates. These sectors are therefore excluded from the analysis.

³³ This is less an adjustment for Network Rail's output that would not be sold to the rail sector.

statistics on the distribution of PAYE receipts by sector of the economy. These are then factored by the share of the rail supply chain in the total GVA for each sector of the economy and scaled by the labour share of production in the relevant sectors.³⁴ This results in an estimate for both direct and indirect PAYE. Subtracting the direct PAYE estimate from section 2.2.3 suggests that PAYE receipts from the rail supply chain totalled **£407m** in 2011/12.

The total (direct plus indirect) corporation tax contribution of the rail sector is estimated using a similar methodology. However, HMRC data on corporation tax payments is not available in the same breakdown as the ONS input–output data.³⁵ It is possible to estimate the rail supply chain’s corporation tax by factoring the share of the rail supply chain in the total GVA for each SIC code by each SIC code’s gross operating surplus (GOS).³⁶ This provides an estimate for the total GOS for direct and indirect rail activity as a share of the whole economy, and the estimate of corporation tax is derived under the assumption that corporation tax is distributed in a similar way to GOS.

Subtracting the direct corporation tax estimate outlined in section 2.2.3 from the direct and indirect tax contribution suggests that corporation tax payments from the rail supply chain accounted for **£119m** in 2011/12. This estimate should be treated as indicative, however, because although GOS broadly represents capital returns in the national accounts, it is not equivalent to taxable profit, and different activities will attract varying rates of effective corporation tax (for example, due to varying rates of capital allowances or other deductible expenses).

As with corporation tax, NIC payments by SIC code are not available. To estimate indirect NIC contributions, it is assumed that NICs will vary in proportion to Compensation of Employees (COS), which is the measure of returns to labour used in GVA calculations. As with corporation tax, this estimate should be treated as indicative. The data suggests that NICs from the rail supply chain are **£337m**.

Using the methodology outlined in 2.2.3, Oxera estimates that the total contribution to other taxes from the rail supply chain is £0.7bn. Taken together, these estimates suggest a tax contribution from the rail supply chain of £1.6bn in 2011/12.

2.4 Summary

Oxera has considered several indicators of the economic footprint of the rail sector. The measures are closely related to one another and can provide an initial illustration of the importance of the sector.

Oxera calculates that the direct effect from rail, and the indirect effects from the rail supply chain, generate **£9.3bn** of GVA for the UK economy, create employment of **212,000** jobs,³⁷ and produce tax receipts of **£3.9bn**, as shown in Figure 2.3.³⁸

³⁴ This scaling factor is based on the return to labour (Compensation of Employees) as a share of total GVA relative to the average across the whole economy. It takes into account the differing levels of labour intensity across sectors.

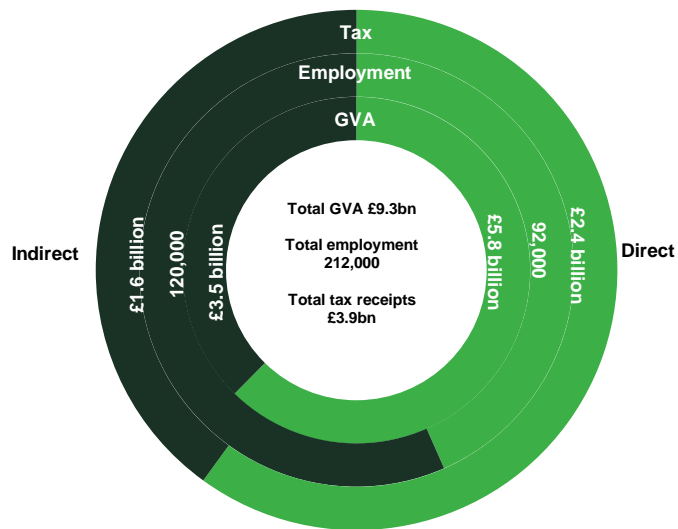
³⁵ HMRC uses the Standard Trade Classification (STC) coding system rather than the Standard Industrial Classification (SIC).

³⁶ GOS is the primary measure of returns to capital.

³⁷ Numbers may not sum due to rounding.

³⁸ These are gross figures. Net figures could be determined by considering how the resources and employees in the rail sector would be redeployed in the absence of the sector.

Figure 2.3 Summary of impacts



Note: Personal taxes paid by employees, etc., have not been allocated to direct and indirect effects. Numbers may not sum due to rounding.
Source: Oxera.

Overall, the rail sector and its supply chain contribute approximately **0.7% of UK GVA** or **over £2 for every £1 of public support**.

3 User benefits

Section 2 outlined the economic footprint of the rail sector on the UK economy. However, as also explained in section 2, if the rail sector were smaller and the resources (people, land, etc.) currently used in the rail sector were redeployed to equally productive use elsewhere in the economy, there would be no overall economic benefit from the rail sector. Therefore, the standard approach to assessing the overall economic impact of a sector is to consider the benefits received by users of the sector and the impacts which that sector has on the productivity of other sectors of the economy (which is explored in section 4).³⁹

The box below sets out the key findings of this section.

Key findings

- The total user benefit per year is between £1.3bn and £13bn. The £1.3bn comprises £1.2bn in benefits to passengers and £60m in benefits to freight users.
- The benefits to passengers can be split between different types of user, as follows: £600m for commuters, £370m for business passengers, and £260m for leisure travellers.

3.1 Determining an appropriate counterfactual for estimating user benefits

In order to quantify the user benefits, and the wider benefits in the following section, it is necessary to specify a counterfactual. In standard economic appraisal, one would typically consider a counterfactual where an entity does not exist in order to calculate the economic impact. However, while this counterfactual provides useful information on the overall economic impact of the rail sector, it is not realistic to suggest that the entirety of the rail sector will be removed. Therefore, the approach adopted in this report is to provide a range of counterfactuals to estimate the user benefits and wider economic impacts, in order to provide information on the potential impact of changes in rail policy and the overall impact of the sector. Oxera has considered three counterfactual scenarios where the passenger and freight volumes on the network are 10% lower, 50% lower, and a situation in the absence of the rail sector (i.e. 100% lower traffic volumes). We have undertaken quantification of the effects for the 10% scenario, while the 50% and 100% scenarios are scaled (linearly) on the basis of the 10% scenario.

The volumes may decline on the network as a result of fewer rail links, an increase in price, an increase in journey time—due to fewer trains or lower frequency—or a reduction in the quality of the network (e.g. more crowded trains). Passengers and freight would either have to change to other forms of transport, or stop travelling altogether. By capturing how much worse off consumers would be without today's rail provision, we are able to quantify the benefits that GB rail is currently providing.

³⁹ This is similar to the approach adopted by the DfT in its appraisal guidance: WebTAG.

3.2 Estimating user benefits

This section considers the loss in user benefits if 10%, 50% or 100% of passenger and freight traffic is diverted away from the rail network and either shifts to other forms of transport or stops altogether.

To divert the traffic away from rail, we assume that generalised cost (GC) increases for rail passengers and calculate the increase that would be needed to reduce usage by 10%. This relationship is determined by a GC elasticity, which is a parameter that details the responsiveness of demand to a change in GC.⁴⁰ We used a financial cost increase for the freight traffic calculations only, as a relevant GC elasticity for freight traffic could not be obtained.

In the calculation, we also distinguished between passengers, broken down by journey purpose between commuter, business and leisure; and freight.⁴¹ This is needed because business-user benefits contribute directly to lower business costs and increased productivity. They therefore comprise part of the longer-term impact of the rail sector on the economy, and are important when estimating the wider economic benefits, as presented in the following section.

In the passenger user benefits calculations, as explained above, we have assumed that the decrease in journeys is due to a higher GC arising from lower frequency, longer journey times and/or higher fares. Oxera has conducted this calculation by assuming that GC increases. The current GC for passenger rail travel has been calculated using average fares, average generalised journey time (GJT), and values of time, sourced from the DfT.⁴² Using GC elasticities from the academic literature,⁴³ we calculate that GC would need to increase by approximately 8% to reduce passenger rail journeys by 10%.⁴⁴ The generalised cost rises necessary to deliver much bigger reductions in rail use are difficult to estimate with precision, and therefore we assume that the loss of consumer surplus increases linearly, for the reasons set out in Appendix A2.

The total loss of benefits to users is determined by calculating the loss in consumer surplus. In general terms, consumer surplus can be defined as the difference between the price a customer is willing to pay and what they actually end up of paying. The consumer therefore benefits from paying less than they were actually willing to pay. For this case, GC has been used instead of just the price/train fare, as journey time also plays a significant role in determining passenger rail demand. The calculation of consumer surplus is split into parts:

⁴⁰ For example, a GC elasticity of -0.8 implies that a 10% increase in the GC would lead to an 8% reduction in demand.

⁴¹ The average commuter, business and leisure fare was estimated using results from the National Rail Travel Survey (https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/73094/national-rail-travel-survey-overview-report.pdf).

⁴² Average fares were calculated using passenger revenues by ticket type from the ORR (available here: <https://dataportal.orr.gov.uk/displayreport/report/html/e3408545-0395-481d-8636-ec972f959e00>, accessed 26 June 2014). The number of journeys per ticket type was estimated using results from the National Rail Travel Survey (available here: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/73094/national-rail-travel-survey-overview-report.pdf, accessed 26 June 2014). Average fare for each user type could then be calculated by dividing passenger revenue by the number of journeys.

⁴³ The Victoria Transport Policy Institute (2013), 'Understanding Transport Demand and Elasticities', March, available at <http://www.vtpi.org/elasticities.pdf>, accessed 26 June 2014. This source provides a range of elasticities from -0.6 to -2; Oxera has adopted the midpoint of -1.3.

⁴⁴ We assume that passenger journeys in each category (business, leisure, and commuting) reduce proportionally.

- the loss to those who continue to travel by rail, which results from the higher GC;
- the loss to those who no longer travel by rail.⁴⁵

Based on the GC changes discussed above, the loss in passenger user benefits, for those who continue to travel using rail, would be £1.2bn a year in the 10% scenario.

The loss in consumer surplus for passengers who no longer travel by rail is £65m a year in the 10% scenario.

These passengers may choose to travel by a different form of transport (e.g. road) or not travel at all and spend their money on other goods/services. In either case, they will gain some welfare from the alternative. However, the additional welfare they would gain from undertaking a different activity (e.g. people who no longer travel may choose to spend the money on local cultural activities instead), or from travelling by road, is uncertain. Due to this uncertainty, we have presented the total consumer surplus loss and have not sought to calculate the additional welfare that customers may gain in the counterfactual, which is a standard approach in economic analysis.

The loss of both consumer surplus and remaining user benefits in the 50% and 100% scenarios crucially depends on the shape of the demand curve, and how the elasticity varies with demand as it falls to zero. Given the lack of evidence, it is not possible to make accurate predictions without modelling the entire UK transport network in the absence of a rail industry. As such, we have assumed, in the absence of more detailed modelling, that the loss of user benefits will increase linearly with the reduction in the rail industry. As such, the user benefits that are lost in the 50% reduction in the rail scenario are estimated to be five times those lost in the 10% scenario. A more detailed discussion of the logic behind this assumption is presented in Appendix A2.

Combining the loss in user benefits for people who continue to travel by rail and those who no longer travel by rail leads to a total annual reduction of **£1.2bn** in consumer surplus in the 10% scenario. For illustrative purposes, we calculate that, given the assumption that the loss of benefits varies in a linear fashion with reductions in demand, the consumer surplus would amount to £6.2bn in the 50% scenario and £12.3bn in the 100% scenario. In practice the numbers would almost certainly be different, and one could plausibly argue that the loss would increase more than proportionately as demand is reduced to zero as a result of eliminating even the most valuable services.

The user benefits of rail can also be considered according to passenger type. In the 10% scenario, the illustrative benefits are as follows: £260m for leisure travellers, £600m for commuters, and £370m for business passengers. In the 100% scenario, the benefits are £2.6bn for leisure travellers, £6.1bn for commuters and £3.7bn for business passengers.

It is difficult to determine the distribution of these benefits across the network, although a consideration of where passengers travel to/from can give an indication.

⁴⁵ These individuals may choose to travel by another mode (e.g. car or air), or may choose not to travel, and are treated in the same way for the purposes of this calculation. More detail about the diversion of these individuals is included in section 4.

Figure 3.1 Passenger journeys by region ('000)



Note: 2012/13 data. Journey figures are those to/from/within regions, and therefore sum to more than the total rail journeys in Great Britain.

Source: Office of Rail Regulation.

Oxera has used a similar methodology to estimate freight user benefits. The main difference is that traffic is assumed to decrease because of an increase in the price/cost of transporting goods by freight rather than an increase in GC, owing to the absence of a GC elasticity for freight. While time, as well as cost, will be an important factor for transporting goods by freight, and the relative importance of each will differ according to the type of good transported, cost is typically considered to be a more significant factor.

The average cost of transporting one tonne of freight by rail was calculated by dividing rail freight revenue by the number of tonnes transported. A cost elasticity of -1.38 was applied to determine the increase in cost necessary to price 10% of freight away from rail.⁴⁶

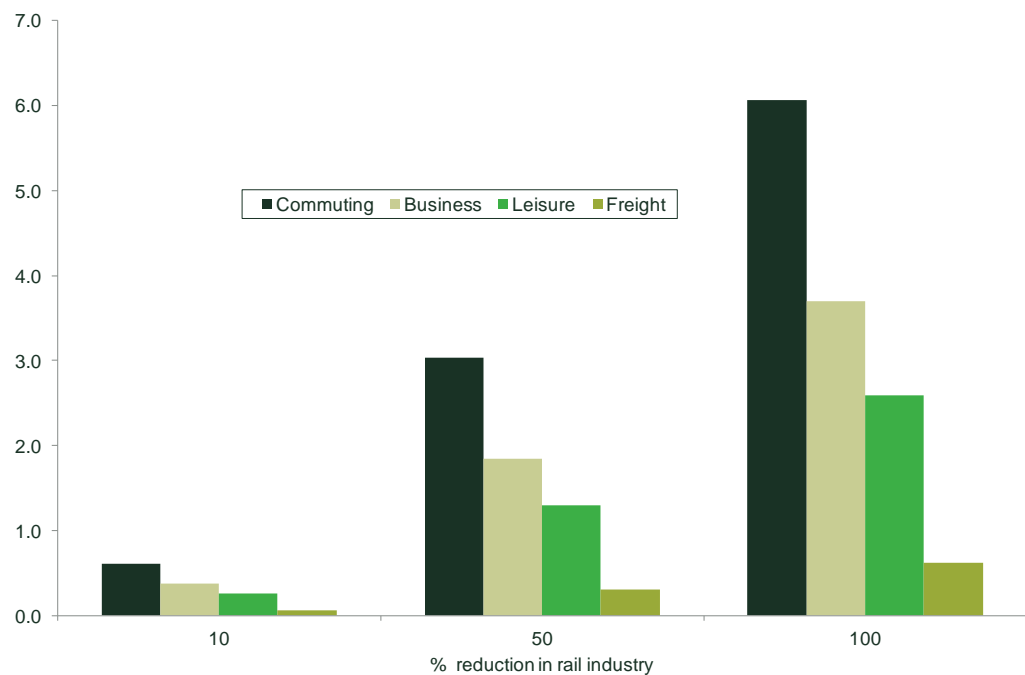
Based on these assumptions, the loss in consumer surplus for freight users who continue to transport goods by rail would be £60m per year in the 10% scenario. For those switching to roads, the loss in consumer surplus from rail is £3m in the 10% scenario. As in the passenger calculations, the welfare gain from switching from rail under their alternative choice is not clear, and has not been quantified.

Therefore, the total annual loss of consumer surplus for freight users is approximately **£60m** in the 10% scenario, **£300m** in the 50% scenario, and **£600m** in the 100% scenario.

3.3 Summary

The total user benefits to passengers are indicated in Figure 3.2, broken down between commuter, business and leisure; and freight traffic.

Figure 3.2 Summary of user benefits calculations



Source: Oxera.

As illustrated, the total annual user benefits for freight and passengers are **£1.3bn** in the 10% scenario, **£6.5bn** in the 50% scenario and **£13bn** in the 100% scenario, demonstrating the significant benefits associated with the sector.

⁴⁶ Victoria Transport Policy Institute (2013), 'Understanding Transport Demands and Elasticities', 12 March.

4 Wider economic impacts

The overall economic impact of the rail sector depends on the value that the rail sector provides to users and the wider benefits to the economy. This section considers these wider economic impacts. The box below provides a summary of the key impacts.

Key findings

- The rail sector has a number of impacts on productivity at the national level. These impacts on productivity enable higher output and long-term growth, and could be worth as much as £10.2bn a year to the economy.
- Turning to the individual channels through which this overall impact could arise, the rail network relieves congestion on roads, which could lead to up to £4.7bn in benefits to business passengers and freight, while improved connectivity could bring up to £1.4bn per year in productivity gains from increased worker density (agglomeration) and up to £400m from increased output. The business rail user benefits, with an upper value of £3.7bn as identified in section 3, should also be included in the wider economic impact as they contribute directly to lower business costs and increased productivity. Adding these figures together provides a total economic effect of approximately £10.2bn, which is similar to the result of the top-down calculation of £9.5bn.
- However, people travelling for leisure and commuting also benefit from the reduced congestion provided by the rail sector (even if this is not a benefit to national economic output). Oxera has estimated that these benefits could be up to £7.3bn per year.

4.1 Methodology for estimating wider economic impacts

Wider economic impacts are the effects of a change in the transport network, and accrue to people and businesses beyond the users and providers of the network. These effects enable higher long-term economic output and growth, and can be interpreted as the medium- to long-term spillover benefits of the rail sector to other industries, and to the overall performance of the economy.

Unlike the effects that measure the economic footprint of the rail sector, these wider effects would not generally be reproduced if the resources used in delivering rail services were redeployed in other parts of the economy—i.e. these particular benefits are not offset by the crowding out or displacement of resources that might otherwise be used elsewhere. Instead, these effects reflect the means by which efficiency in the use of existing resources in the rest of the economy might be enhanced specifically by rail.

The provision of rail transport links and services can be expected to have an impact on the efficiency of the wider economy in a number of ways, including by reducing business costs and road network congestion, and by increasing agglomeration benefits. The effect of these particular mechanisms on the UK economy can be considered (see section 4.2). However, as these specific mechanisms will not capture the total impact, it is also useful to consider the effect from a top-down perspective, which would incorporate additional mechanisms (see section 4.3).

This section uses the same counterfactual as that identified in the previous section to estimate the wider economic effects if there were to be a 10%, 50% or

100% reduction in passenger and freight traffic on the rail network. The same assumption is made here that the effects of reducing the size of the industry would be approximately linear.

4.2 Mechanisms leading to wider economic impacts

4.2.1 Road network congestion

Congestion costs are typically among the largest external costs when assessing transport issues. The effect differs by region; rural areas are less likely to suffer from congestion. As such, we have estimated congestion costs separately for London, urban, and rural areas.

Reduced rail services would cause some passengers and freight to switch to road and possibly other modes. This would cause adverse environmental impacts, which are discussed in section 5.1. However, there would also be economic impacts. An increase in the number of people and freight travelling by road would lead to increased congestion on the roads for all travellers. This can be measured by the additional time costs incurred by those travelling by road. The cost to business can be translated into a reduction in productivity from increased travel time for passengers travelling for business. While the impact on people travelling for leisure and commuting cannot be counted as an economic impact, there is a welfare benefit experienced by these passengers being able to make their journeys more quickly.

To estimate the effect of the rail sector on congestion, Oxera has calculated the rail passenger reduction for each of the London, urban and rural areas that would result from a reduction in 10%, 50% and 100% of passengers on the rail network.⁴⁷ We then use diversion factors to estimate the number of these passengers who would travel by road, and the number who would not travel at all. These diversion ratios indicate that approximately 75% of passengers would divert to road and 25% would no longer travel.⁴⁸ For the passengers diverted to road, it is assumed that they would travel by car or by bus in equal proportions to existing car and bus users. Average vehicle occupancies from the DfT are used alongside the average length of a rail journey to calculate additional vehicle miles.⁴⁹ It is assumed that all freight diverted off the rail network would be transported by lorry on the road network.⁵⁰

We then calculated the percentage increase in vehicle miles on the road network as a result of the reduction in rail use. The relationship between vehicle miles and average speed on the road network was extrapolated from the results of the DfT's National Transport Model.⁵¹ The reduction in average speed as a result of an increase in road users is used to estimate time lost by all vehicles on the road network. Values of time per vehicle (which are weighted by vehicle occupancy and journey purpose) from the DfT and values of time per tonnes of freight were then used to calculate the lost value to the UK economy.

⁴⁷ This focuses on the additional costs of congestion, and does not account for the fact that rail may also be able to transport passengers and goods more reliably than road.

⁴⁸ These percentages apply to London and urban areas. For rural areas it is assumed that 80% of passengers divert to road, 6% to air and 14% no longer travel, based on results from TRL (2004), 'The demand for public transport: a practical guide', TRL593.

⁴⁹ We have assumed that extra road journeys are of equal length to rail journeys, which is likely to be a conservative assumption.

⁵⁰ This is consistent with KPMG's assumption in its recent report, KPMG (2014), op. cit.

⁵¹ This uses average vehicle miles and vehicle speeds across all traffic from the DfT's National Transport Model to obtain an elasticity of speed with respect to miles for three regions: London, urban (which combines large urban and other urban) and rural. The National Transport Model includes data for each of England and Wales. As data for Scotland is not provided, we have mapped passengers in Scotland into the three regions in the same way as for Wales. We have also mapped rail journeys to correspond to these three regions.

This indicates that the total value of lost time would be **£0.9bn** with a 10% reduction in annual volumes on the network, **£5.3bn** with a 50% reduction, and **£12bn** with a 100% reduction. The majority of these costs are incurred in London, where the rail network is particularly dense, and the road network already near capacity. Table 4.1 illustrates the breakdown between regions. It shows that congestion costs rise proportionately more the larger the fall in rail demand; it is well known that congestion increases more rapidly than total traffic on the network.

Table 4.1 Congestion costs, 2013 (£m)

Sector	Scenario		
	10%	50%	100%
London	-800	-4,700	-10,800
Urban	-100	-400	-800
Rural	-30	-170	-360
Total	-900	-5,300	-12,000

Note: Numbers may not sum due to rounding.

Source: Oxera analysis.

If these benefits are allocated according to journey purpose then approximately £3.8bn of these benefits would accrue to business passengers, approximately £7.3bn to leisure and commuting passengers, and £0.9bn to freight users. The benefits to business passengers and freight, of £4.7bn, ultimately lead to enhancements in the productive potential of the economy and should be included as wider economic benefits.

4.2.2 Agglomeration

Agglomeration describes the productivity benefits that arise as some firms derive benefits from being located close to one another. The extent of the benefits will depend on the effective density of employment—that is, the economic size of a location depends on the number of jobs in a location and neighbouring areas.⁵²

These benefits could arise from a number of sources.⁵³

- **Technology and knowledge spillovers.** Proximity to other firms may facilitate more sharing of knowledge and learning about technology or innovations.
- **Input market effects.** By locating close to one another, suppliers and purchasers can minimise transport and transaction costs and share costly infrastructure. For instance, better rail freight transport links can reduce transport or inventory holding costs by enabling companies to spread the sourcing of inputs across a wider area and to increase the potential responsiveness of the supply chain.
- **Labour market effects.** If a firm locates near many workers, it is likely to find employees who are better matched to its requirements, lowering search costs. Workers are also likely to benefit as they can find desirable jobs more quickly.

⁵² While agglomeration effects would be positive in the areas that see improvements, there could be negative effects in other locations, which also need to be taken into account.

⁵³ Department for Transport (2005), 'Transport, Wider Economic Benefits, and Impacts on GDP', Discussion Paper, July.

A reduction in rail links between cities would lead to an increase in the time taken for workers to reach city centres for work and a decline in commuter traffic. This may have a negative effect on clusters of economic activity or the co-location of related firms. Indeed, in the absence of the rail sector, there may be reduced employment in cities served by rail commuters. Agglomeration economies that increase productivity would be much reduced, especially in London, but also in major cities with rail commuter networks elsewhere in the country.

Oxera has estimated the agglomeration effect for London and non-London urban areas separately, as follows.⁵⁴ We have considered the number of rail commuters who would no longer travel as a result of the increase in GC on the rail network. This is calculated using diversion ratios, which indicate that 75% of those switching from rail would travel by car instead, while 25% would no longer make the journey. We assume that these individuals would no longer work in a city, and would find work nearer to home instead.⁵⁵ Commuters who divert to other modes (e.g. road) are assumed to continue to travel to the same destination and would therefore not affect the agglomeration benefits.

This assumption was combined with the number of people who work in London, and in other cities in urban areas, to provide an estimate of the reduction in the density of workers, which is equal to a reduction in approximately 17m jobs in London and urban areas.⁵⁶ An academic estimate of the relationship between density of workers and average productivity was then used to ascertain the cost to the economy due to the reduction in density. We have used an estimate that a doubling of density leads to a 5% change in productivity.⁵⁷

It is estimated that the cost to UK annual GDP of a 10% reduction in passenger traffic as a result of agglomeration effects is **£100m** (in 2013 prices). 50% and 100% reductions in passenger traffic would lead to lost benefits of **£700m and £1.4bn** respectively to the UK economy (in 2013 prices).

4.2.3 Increased output

The provision of the rail network increases the productivity of firms that use rail services, and hence will result in cost reductions for these firms.

In most markets, prices are normally higher than marginal costs.⁵⁸ If better transport reduces costs and induces firms to increase output, wider benefits arise because the value placed by users on the additional output (indicated by the price paid—or the willingness to pay—for the additional output) exceeds the cost of producing it.

Where improved transport delivers cost savings to firms, one would therefore expect output to increase by more than the cost reduction. The DfT recommends

⁵⁴ The calculation does not include the rural region from the congestion calculation as the academic studies on which our estimate is based focus on the productivity benefits from the density of workers in towns and cities, rather than in rural areas.

⁵⁵ It is also possible that individuals would respond to the increase in GJT on rail by moving closer to their workplace rather than changing jobs, although the additional costs of moving would need to be considered. People could also choose to use technology/homeworking options instead.

⁵⁶ Based on data from the ONS and Centre for Cities (2014), 'Cities Outlook 2014.'

⁵⁷ Ciccone, A. and Hall, R.E. (1996): 'Productivity and the density of economic activity', *American Economic Review*, **86**, pp. 54–70.

⁵⁸ In markets that are perfectly competitive, competition drives prices down until they are closely aligned with marginal cost. Therefore, any cost reduction for businesses arising from the use of rail services will be passed to users through lower prices, all else being equal, and the welfare effects will be fully captured by the benefits to those users.

that this impact be estimated using a simplified approach, calculating it as a 10% uplift to business user benefits.⁵⁹

In this case, where we are considering a reduction in the provision of rail services that reduces traffic volume, one can consider the increase in costs for firms, and hence the reduction in output that might occur leading to a loss in wider benefits. Following the DfT's guidance,⁶⁰ Oxera has therefore estimated this as a loss of 10% of business user benefits.

Using the estimate of business user benefits from section 3, we have estimated that this benefit is equal to between **£40m** and **£400m** a year using the range of counterfactual scenarios.

4.2.4 Leisure and tourism spending

A reduction in travel by rail would lower people's ability to travel around the UK, resulting in reduced tourism and possibly welfare. The welfare impacts to tourists are captured as part of the user benefits (section 3). This might also cause households to switch to other forms of expenditure.

However, this is unlikely to cause a net effect on national output or productivity. Oxera does not consider that there are wider economic impacts from reductions in tourism that are not captured elsewhere in the appraisal, as there is no robust evidence that the tourism sector is more productive than other sectors in the economy. Therefore, there would be no clear loss in productivity if the sector were to become smaller. That said, there might be a loss in social benefits associated with a reduction in tourism—see section 5.

4.3 Top-down perspective on wider economic benefits

An alternative approach to assessing the wider economic benefits is to calculate the overall impact of the sector on the economy without attempting to measure the individual mechanisms directly. This is helpful because, in addition to the mechanisms described above, there may be other benefits that the rail sector provides to the economy that might enable higher output and long-term growth.

In particular, the rail sector provides improved connectivity, which is likely to lead to changes in the economy that increase productivity and raise growth in the long term. This is the case for both passengers and freight, as rail may be the most reliable and efficient way to transport goods and individuals over particular distances or to specific cities.

There may be a number of additional channels through which rail is likely to enhance productivity that have not been fully captured by the mechanisms discussed above, and which are more difficult to estimate precisely. For instance, rail links may lead to increased trade between companies. While these links, alone, are not sufficient to create trade, companies are more likely to do business with other firms located in places that are well connected. When trade increases with a region, this could also expand the rail market and the number of passengers travelling to that region, further facilitating trade links.

The links provided by the rail sector may encourage trade through various mechanisms, leading to greater productivity in the UK economy.

⁵⁹ Department for Transport (2014), 'TAG Unit A2.1: Wider Impacts', January, para. 4.1.9.

⁶⁰ Department for Transport (2005), 'Transport, wider economic benefits, and impacts on GDP', discussion paper, July, para. 100.

- **Increased specialisation.** Rail can increase the potential for rapid shipping, and therefore the frequency of trade, which encourages the development of specialisations. Regions may be better able to specialise in activities where they have a comparative advantage, and trade with other regions or countries specialising in other goods and services. This leads to a more efficient allocation of resources, and, consequently, productivity benefits and a reduction in the cost per unit of output (and hence price).
- **Economies of scale.** Related to the effect above, specialisation and trade could further lead to reduced costs and prices, as producers can now benefit from cost advantages from economies of scale. In other words, each region may specialise in the production of fewer goods and serve multiple regions, and therefore the costs per unit of output may decline.
- **Reduced inventory holding costs.** Lower transport costs can increase the responsiveness of the supply chain. This can allow firms to hold less stock, reducing the costs of production.

Another effect that may not have been captured by the impacts included in section 4.2 is innovation. Increased rail links may encourage more effective collaboration between companies located in different places. It could also increase investment and speed up the adoption of innovations in the economy.

The rail network may also make Great Britain more attractive as a location for businesses to locate or expand, encouraging foreign direct investment in the country by companies and individuals, increasing the total capital available with which labour can work. Output per employee, and hence productivity, will be positively related to the volume of investment in the economy in the long run.

As these mechanisms are difficult to estimate precisely, they can be calculated together with the other mechanisms outlined in the rest of this section by adopting a top-down perspective looking at the increase in productivity in the economy as a whole as a result of the rail sector. This top-down perspective would also capture the mechanisms identified above. Therefore this estimate cannot be added to the estimates of the wider effects of agglomeration, congestion and increased output.

In particular, to consider these benefits, it is relevant to use the same counterfactual as adopted when estimating the mechanisms above. One paper suggests that a reduction in all journey times in the UK by 10% would lead to an overall UK productivity gain of 1.21%.⁶¹ This includes journey time on the railway, as well as on the roads.

Oxera has therefore estimated the effect on the economy as follows using the same counterfactual scenarios as discussed above. The modelling of the road congestion effects, and the estimate of the increase in GC necessary to reduce the number of rail passengers, include estimates of the average reduction in road and rail speed. The proportions of all passenger and freight journeys made by road and rail were then combined with these numbers, to give a weighted average of the reduction in speed of the UK transport network. This reduction in speed, and hence journey times, was then combined with the above estimate of the relationship between journey time and productivity to give the reduction in UK productivity in each scenario. This figure can be used and applied to the

⁶¹ This assumes that the qualifications and location of the labour force are held constant. Rice et al. (2006), 'Spatial determinants of productivity: Analysis for the regions of Great Britain', *Regional Science and Urban Economics*, 36, pp. 727–52.

same counterfactual scenarios to obtain a range of estimates in each scenario. Oxera has estimated that these benefits are £950m in the 10% scenario, £4.8bn in the 50% counterfactual and £9.5bn in the 100% counterfactual.

These figures represent an induced productivity gain and include user benefits and the costs of congestion for business travellers, but not for leisure passengers or commuters.⁶²

The figures can also be more readily compared with recent estimates by KPMG for the rail freight sector. KPMG estimates that this sector generates £1.5bn a year in economic benefits for the UK economy, including £1bn through improved productivity.⁶³

4.3.1 Summary

In summary, there is a range of wider economic impacts of the rail sector, as illustrated in Table 4.2. These figures cannot all be added together to determine the wider impact of rail given that reduced congestion, agglomeration, increased output and business user benefits all form part of the top-down wider productivity estimate alongside other possible factors.

Table 4.2 Summary of effects on economy per year (£bn)

	10%	50%	100%
Reduced congestion (business passengers and freight)	0.4	2.1	4.7
Agglomeration	0.1	0.7	1.4
Increased output	0.04	0.2	0.4
User benefits (business passengers only)	0.4	1.8	3.7
Total	0.9	4.8	10.2
Top-down (not additional)	0.9	4.8	9.5

Note: There are also approximately £7.3bn of benefits per year which accrue to people travelling for leisure and commuting from the reduction in congestion.

Source: Oxera.

⁶² Rice et al. (2006), 'Spatial determinants of productivity: Analysis for the regions of Great Britain', *Regional Science and Urban Economics*, **36**, pp. 727–52.

⁶³ The other £0.5m includes reduced congestion and wider environmental benefits.

5 Environmental and social impacts

The previous sections have adopted different approaches to determine the economic impact of the rail sector and the potential loss of benefits if the sector were to carry fewer passengers and/or freight. This section uses the same methodology to consider the environmental and social impacts of the rail sector. While some of these effects are quantified, others are discussed qualitatively owing to the difficulty in providing precise estimates. The box below presents the key findings from this section.

Key findings

- Travel by rail is more environmentally efficient than travel by both road and air for passenger and freight journeys. A reduction in passenger and freight volumes by 10% and 100% could cause an increase in carbon emissions of between 0.7m and 7.4m tonnes annually. The net cost of these changes would be £40m and £430m per year, respectively.
- There are also a number of social benefits associated with the rail sector, including improving accessibility and journey quality. The rail sector prevents between approximately 95 and 950 serious and fatal accidents per year, or between £33m and £330m in value of accidents per year.

5.1 Environmental impacts

There are a number of environmental costs of rail, and more generally, the transport sector, including noise, air quality, biodiversity, carbon, and flood risk. Of the many environmental costs, this section focuses on the three that are expected to have the most material impact: greenhouse gas emissions, air quality and noise.

5.1.1 Greenhouse gas emissions

Transport accounted for about 21% of greenhouse gas emissions in the UK in 2012, almost entirely through CO₂ emissions.⁶⁴ The main greenhouse gas, CO₂, accounted for 82% of total UK greenhouse gas emissions in 2012.⁶⁵

Even though rail has a market share estimated at approximately 9% for freight and 3% for passenger traffic,⁶⁶ it contributes less than 2% of the emissions from the transport sector (i.e. 0.4% of total emissions).⁶⁷ This compares favourably to the road sector, which contributes 92% of the emissions of the transport sector and 20% of the UK's total emissions.⁶⁸ A comparison between rail, road and other transport sectors is illustrated in Figure 5.1 below.

⁶⁴ Department of Energy and Climate Change (DECC) (2014), '2012 UK Greenhouse Gas Emissions, Final Figures', Statistical Release, 4 February.

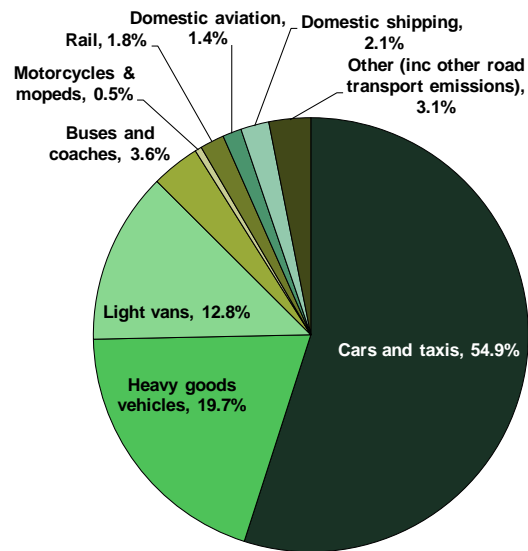
⁶⁵ Department of Energy and Climate Change (DECC) (2014), '2012 UK Greenhouse Gas Emissions, Final Figures', Statistical Release, 4 February.

⁶⁶ For 2012. Based on National Rail, urban metros and modern trams. Department for Transport (2012), 'Passenger transport: by mode, annual from 1952', Table TSGB0101.

⁶⁷ UIC and CER (2008), 'Rail Transport and Environment: Facts and Figures', June, pp. 1–36, International Union of Railways and Community of European Railway and Infrastructure Companies. Department for Transport Table ENV0201, October 2014.

⁶⁸ Ibid.

Figure 5.1 UK domestic transport greenhouse gas emissions



Note: Based on 2011 data.

Source: Department for Transport.

While Figure 5.1 looks at the emissions of the different transport modes, this could be affected by different volumes of traffic. It is therefore also important to consider the relative energy efficiency of the modes per passenger or freight journey. Such a comparison indicates that, for passenger transport, rail is more efficient than both air and road travel in terms of greenhouse gas emissions per journey. For instance, consider a passenger journey from London to Newcastle by rail, air and road. The CO₂ emitted from rail is just under 24kg, compared with 49kg for car and 75kg for air.⁶⁹

Based on a sample of routes using the EcoPassenger tool, on average a given passenger journey by car will lead to twice the CO₂ emitted by rail, while the same journey by air will lead to nearly three times as many emissions. This is also broadly consistent with data from the DfT's Transport Direct emissions calculator, which indicates that rail is on average four times more efficient than road and three times more efficient than travel by air. Therefore, a shift of traffic from rail to other forms of transport, such as road or air, would be likely to lead to an increase in greenhouse gas emissions.

For freight journeys, rail is also more efficient than transport by road and significantly more efficient than transport by air. Depending on the length of the journey, travel by sea may be more efficient than rail, but sea shipment is not a feasible option for many journeys within Great Britain.

Oxera has quantified the effect of diverting rail traffic to other forms of transport using the same counterfactuals as discussed in the previous section. The number of additional car, bus, lorry and plane miles required owing to the reduction in the rail network was taken from the congestion calculation. The percentage increase in total miles for each vehicle type was then calculated.

⁶⁹ EcoPassenger tool, available at <http://www.ecopassenger.org/>. This covers emissions associated with the production and distribution of electricity and fuel. Based on average load factors for trains, 1.5 passengers for cars and average value for aircraft. Based on a journey from King's Cross station in London for car and rail; for air, the tool does not take account of the journey to/from the airport.

This was combined with DfT figures of total CO₂ emissions from each vehicle type to give the increase in emissions. The increase in emissions can then be valued using non-traded carbon prices from the Department for Energy and Climate Change (DECC).

The cost of additional carbon emissions is estimated to be **£40m** if traffic reduces by 10%, **£200m** if traffic reduces by 50% and **£430m** if traffic reduces by 100%. This cost is associated with increased emissions of between 0.7m and 7.4m tonnes.

This calculation does not include an estimate of the increased emissions across the road network that would result from additional congestion. It also does not include the associated health benefits of reduction in carbon emissions. Therefore, the result is likely to be an underestimate of the true cost.

5.1.2 Air quality

In addition to the impact on greenhouse gas emissions, rail and other transport modes have important local implications for air quality. The main concerns over local air quality relate to nitrogen oxide (NO_x) and particulate matter (PM) emissions.

Much as with greenhouse gas emissions, rail tends to cause less air pollution per passenger km than both road and air transport, although the differences are smaller.

Apart from the differences in magnitude, the main considerations for local air quality relate to how these pollutants are produced and their location of dispersion. These effects have the following characteristics.

- Air transport tends to concentrate local pollutants around airports, where emissions of such compounds are highest due to take-off and landing, and where they will have a more direct impact on the local population because of the lower altitude of the aircraft. Since airports are more likely to be located away from major population centres, concerns about local pollution frequently relate to people using the airport or travelling through the area.
- Road pollution is spread along the transport corridor, although some parts may be particularly affected, especially where there is congestion. The DfT has noted that road transport is one of the major sources of local air pollution and that, in urban areas, emissions from road traffic can have a significant effect on the concentration of pollutants.⁷⁰
- Rail pollution will be spread between origin and destination (e.g. in the case of diesel trains), or, in the case of electric trains, concentrated in the vicinity of the relevant power plants; in both cases, therefore, the pollution tends to be away from population centres.

The change in NO_x and PM emissions was quantified using the same method as for CO₂ emissions. The percentage change in miles for each vehicle type was combined with the total annual NO_x and PM emissions from each vehicle type in Great Britain to give the change in emissions. The net result was a reduction in both NO_x and PM emissions in the counterfactual scenarios (i.e. there are environmental benefits associated with a reduction in rail travel). This occurs because although emissions of NO_x and PM per passenger km are lower for rail

⁷⁰ Department for Transport (2014), 'TAG Unit A3: Environmental Impact Appraisal', May.

than for road and air transport, this is offset by the reduction in passenger journeys in the counterfactual (as it has been estimated that some passengers would no longer travel given the reduction in rail services).

The reduction in NO_x emissions in the counterfactual, and therefore the disbenefit to rail, is estimated to be between **£0.3m** and **£3m** a year, while the reduction in PM emissions is valued at between **£4m** and **£40m** a year.

5.1.3 Noise

Noise is one of the key concerns for people living near transport infrastructure. Consistent exposure to noise levels from transport has been shown to impose significant costs, including sleep disturbance, annoyance, and increased risk of acute myocardial infarction. While rail gives rise to several sources of noise and vibration, the impact may be lower than expected since trains tend to travel at relatively low speeds in densely populated areas.

Indeed, a European Commission report in 2004 showed that the quality of life for those living close to a railway line is higher than for those living close to a major road or an airport in terms of the level of constant noise to which residents are exposed. The scale of this difference is significant, with the percentage of people highly disturbed from a set level of rail noise being roughly half the percentage of people highly disturbed from the same level of noise emitted from road.⁷¹ A 2011 World Health Organisation (WHO) report on the burden of disease from environmental noise confirms this difference. A road noise level emitted at night is estimated to 'sleep disturb' roughly twice as many people as the equivalent level of noise emitted by rail.⁷²

In light of these studies it is clear that the existence of the rail industry, by reducing the level of road traffic, should lessen the burden of environmental noise on aggregate.

5.2 Social impacts

The economic and environmental impacts of rail have been reviewed in the previous sections. In addition to these effects, by enhancing transport links, rail also widens the scope of travel opportunities, reduces travel time between cities, and increases mobility and connectivity. In turn, the improved accessibility may change travel patterns and allow passengers to travel more safely, comfortably and conveniently, ultimately having a positive impact on individuals' quality of life.

In particular, the core social benefits that are relevant to consider are a reduction in accidents, improvement in journey quality, option value and greater accessibility.⁷³ These are discussed in turn.

5.2.1 Reduction in accidents

One of the main benefits that rail delivers is a much lower rate of accidents than other forms of transport, notably road transport, which benefits both users and non-users. For instance, on average between 2003 and 2012, 26 individuals per 1bn passenger km were killed, seriously or slightly injured on rail. This compares with 241 for cars, 151 for bus/coach, 62 for van and 4,145 for motorcycles. The

⁷¹ UIC and CER (2008), 'Rail Transport and Environment Facts and Figure', November, pp. 1–40.

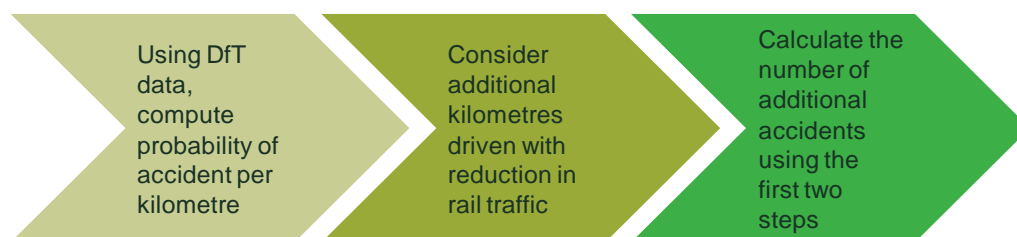
⁷² WHO (2011), 'Burden of Disease from Environmental Noise', p. 59.

⁷³ The DfT also considers other social impacts in its guidance, including physical activity, security, severance, and personal affordability, but these are not considered to be significant in this context and are not discussed further.

only form of transport (including walking and cycling) with a lower accident rate than rail is air travel.⁷⁴

To estimate the impact of a reduction in rail travel on accidents, a forecast of the number of accidents that would occur in the counterfactual needs to be considered. An estimate of the monetary value of the difference in accident numbers between the two scenarios can then be calculated. Figure 5.2 sets out the approach for quantifying the impact. The calculation should be interpreted as an order of magnitude rather than a precise quantification.

Figure 5.2 Approach to accidents quantification



Source: Oxera.

Oxera has used the above approach to provide an estimate of the benefit of rail in terms of the number and cost of accidents prevented. If the number of journeys made on the rail network were 10% smaller, we estimate that there would be an increase of nine fatal accidents and 86 serious accidents. This is equivalent to £33m in benefit to the economy per year.⁷⁵ The table below gives results for the three scenarios of 10%, 50% and 100% of reductions in rail traffic.

Table 5.1 Impact of additional accidents

	10% rail reduction	50% rail reduction	100% rail reduction
Additional serious accidents	85	427	853
Additional fatal accidents	9	46	93
Value of prevention of serious and fatal accidents (£m per year)	33	163	326

Source: Oxera.

5.2.2 Journey quality

Journey quality is another social impact that is important, but difficult to measure. Providing travellers with comfortable carriages, enabling them to relax, enjoy the scenery, work and/or avoid the stress of driving are important benefits of rail travel.

It can be argued that these effects are implicitly captured in calculating user benefits. The price that rail passengers are willing to pay through fares, compared with the cost of undertaking the same journey using another form of

⁷⁴ Department for Transport (2013), 'Passenger casualty rates by mode: 2003-2012' November. For air, the statistics are based on passenger casualties in accidents involving UK-registered airline aircraft in UK and foreign airspace; for rail, passenger casualties involved in train accidents and accidents occurring through the movement of railway vehicles. Figures up to 2008/09 include franchised train operators only; from 2009/10, they also include the non-franchised operators First Hull Trains and Grand Central, until it ceased operating in January 2014.

⁷⁵ This includes the cost of lost output, human costs, and medical costs. To convert the number of additional accidents, monetary figures provided by the DfT on the average value of prevention per casualty are used. These values include the cost of lost output, human costs, and medical costs. The figures vary by severity of casualty.

transport, reflects, among other factors, the quality differences that passengers perceive between rail and an alternative mode, including speed, ambience, and flexibility. Most passengers will also obtain an element of consumer surplus, as their willingness to pay exceeds the fare they actually have to pay.

Some quality aspects of rail travel can, in principle, be valued. The Passenger Demand Forecasting Handbook (PDFH)⁷⁶ provides values for different levels of crowding and other features of rail travel, such as cleanliness and WiFi availability, allowing changes in these factors to be translated into changes in passenger numbers. Such values should also allow for changes in the ability of business travellers to work on trains as well as other aspects of journey ambience.

Oxera considers that quality changes are best thought of as part of the user benefits discussed in section 3, and are thus covered indirectly. The increases in GC required to deliver any given reduction in rail travel will include some combination of fare increases and service quality reductions that are not specified explicitly.

5.2.3 Accessibility

Increased accessibility is another important benefit of the rail system, especially for those without cars or car owners who would contemplate undertaking only long journeys by train. The DfT estimates that one in four households does not have access to a car for reasons including costs, disability and choice.⁷⁷

By providing rail links between cities and towns, the rail sector expands the scope for travel opportunities and may increase the propensity to travel. It could improve mobility by providing a broader range of travel opportunities to more destinations at a more affordable cost. In turn, this could have various effects, such as increasing cultural and leisure experiences and improving people's quality of life. It could also allow people to maintain better contact with friends and family, and improve living standards by increasing access to additional products or services.

Box 5.1 provides some additional detail and statistics with respect to the benefits of rail for all types of travellers, including elderly and disabled persons.

Box 5.1 Accessibility of rail

Rail offers a way for disabled individuals to travel by providing step-free access at many stations and the possibility of assistance from members of staff to get on and off trains. In the last financial year (March 2013 to March 2014), disabled passengers made approximately 4.7m journeys, which is a 240% increase since 2000/01.

Rail also offers opportunities for seniors to travel at affordable costs. Approximately 27.8m journeys were made by senior passengers in the last financial year, which amounts to an increase of 125% since 2000/01.

Source: Oxera and RDG.

⁷⁶ Association of Train Operating Companies (2013), *Passenger Demand Forecasting Handbook v5.1*, April.

⁷⁷ Department for Transport (2014), 'TAG Unit A4-1: Social Impact Appraisal', January.

5.2.4 Option value

In addition to the user benefits, the rail sector provides non-users with another travel option when their usual transport mode is unavailable and the disruption may be temporary or permanent. This could occur due to weather conditions, infrastructure failure, or the removal of a route by an airline or closure of a motorway. The existence of the rail service provides a valuable option to those needing to make journeys along the relevant corridor. This benefit is additional to the user benefit since it is the premium a person is willing to pay above their expected use value to ensure that the service exists as a type of insurance.

While there are approaches set out for estimating option values when appraising transport schemes, Oxera does not regard this as a practical proposition for the rail system as a whole, and has therefore not quantified this benefit. Even the DfT notes that the evidence base for monetising option values is relatively weak, and therefore these benefits should be presented qualitatively.⁷⁸ However, recent research by Oxera⁷⁹ and others⁸⁰ does suggest that these option values can be substantial, particularly where the likelihood of disruption is quite high.

5.3 Summary

The environmental and social impacts of the rail sector are important components of the sector's overall impact on the UK. This section has highlighted that, although the monetised environmental impacts of rail are small relative to the economic impacts, the rail sector makes a significant contribution to reducing greenhouse gas emissions and improving air quality. The sector also has an important role in reducing the number of accidents on roads and providing a range of social benefits, including improving the quality of journeys, accessibility and the resilience of the GB transport network.

This review of the environmental and social impacts completes the assessment of the effects of the rail sector on the UK economy. The following section considers the extent to which the change in the industry model has been responsible for delivering these benefits.

⁷⁸ Department for Transport (2014), 'TAG Unit A4-1: Social Impact Appraisal', January.

⁷⁹ Cartea, Á., Meaney, A., Oxley, P., Riley, C., Worsley, T. and Zamani, H. (2008), 'How Should Real Transport Options be Measured?', *Papers and Proceedings of the European Transport Conference*, Leeuwenhorst, October.

⁸⁰ Laird, J.J., Batley, R.P., Nash, C.A. and Geurs, K. (2006), 'Option values, non use values and transport appraisal', report to the UK Department for Transport.

6 How has the sector fared in recession?

In considering the impact of the change in the industry model in the mid-1990s, analysing how the rail sector in Great Britain has fared in the recent recession (both relative to performance in previous recessions in the UK and relative to the rail sector in other European countries) provides useful evidence of whether the change in industry model is consistent with good recent performance in the industry.⁸¹

Over the last 50 years the UK has had four recessions of note:

- the early 1970s;
- the late 1970s/early 1980s;
- the early 1990s (much less severe than the previous two);
- the late 2000s.

In the following sub-sections, Oxera analyses how passenger and freight volumes have performed against a number of economic variables in each of these recessions (from the year before each recession started to the lowest point of the recession) and against other European countries in the most recent recession. The key findings are outlined in the box below.

Key findings

- Passenger rail travel has been resilient in the recent recession and has increased in a way which is different to the performance of the industry in previous recessions. Rail passenger journeys in GB have also increased at a faster rate than in comparable European countries during the recent recession.
- While rail freight volumes have declined in the recent recession, freight operations have performed better (in terms of maintaining volumes) than would have been expected given its performance in previous recessions. The modal share of rail freight has also remained relatively stable and has not experienced the decline seen in some other European countries.
- The key trends in the sector which have occurred since the change in industry model may have played a role in ensuring the resilience of the sector to the recession.

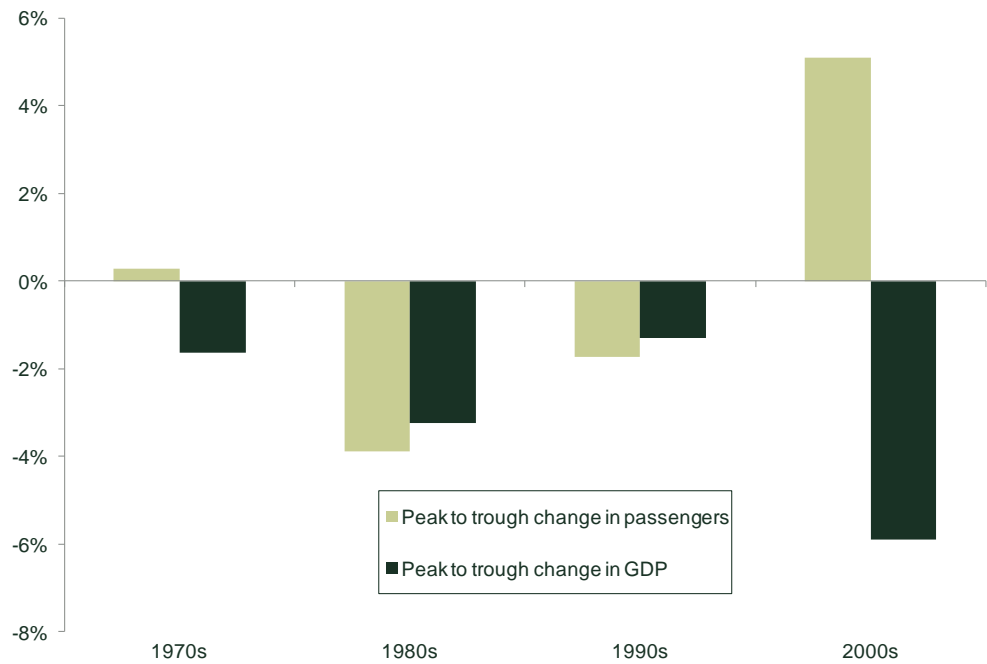
6.1 Passenger rail demand

6.1.1 Performance in recent recession relative to previous UK recessions

Figure 6.1 shows that the relationship between passenger numbers and GDP has changed in the last recession relative to previous recessions, with a large fall in GDP not reflected in a fall in passenger volumes.

⁸¹ It is important to remember the difference between correlation and causality—i.e. just because two things display a relationship does not mean that one causes the other. Therefore, while the data presented in this section does not prove causation, it does show correlation.

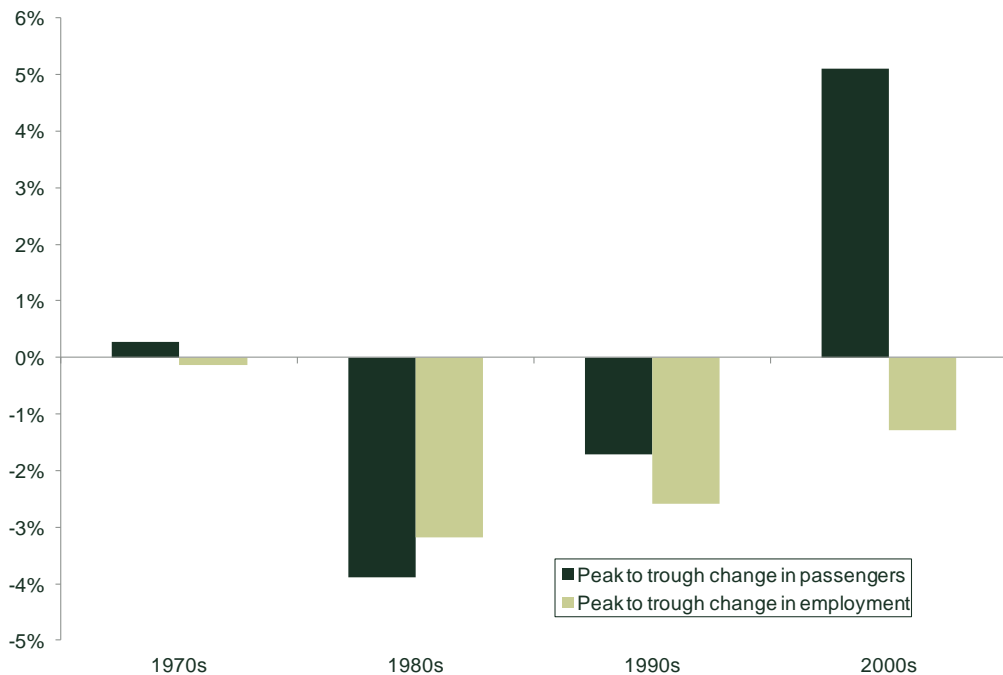
Figure 6.1 Comparison with previous UK recessions: GDP (% change)



Source: DfT and Datastream.

One of the more unusual features of the recent recession is the relative lack of decline in employment in the UK. However, as Figure 6.2 demonstrates, passenger numbers have continued to increase as employment declined slightly, so the increase in passenger volumes cannot be attributed to increases in employment.

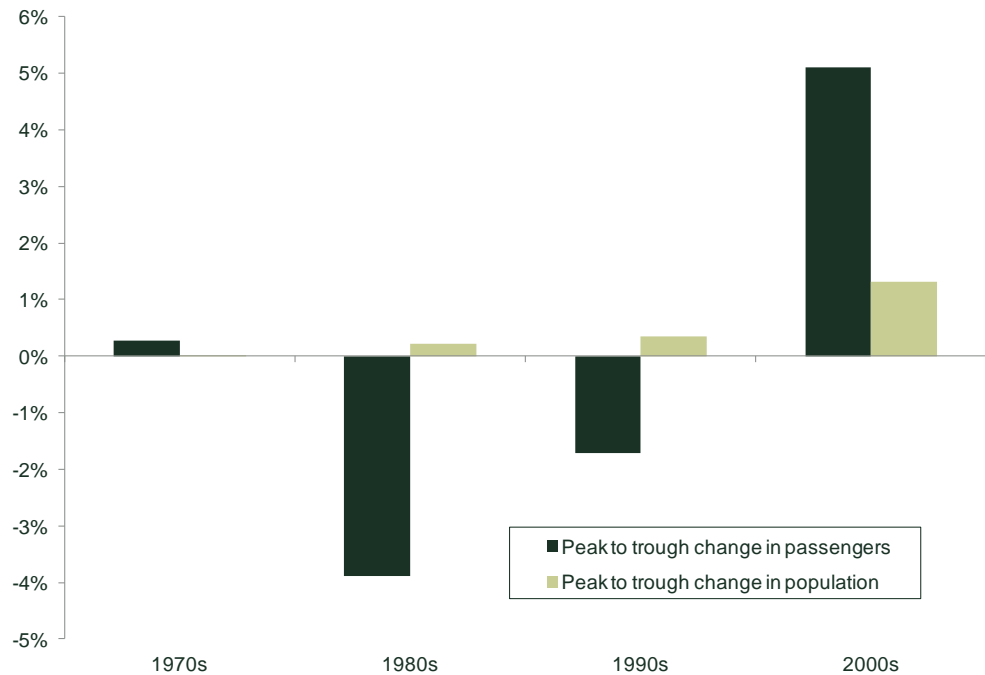
Figure 6.2 Comparison with previous UK recessions: employment (% change)



Source: DfT and ONS.

While there has been a small increase in population in the UK (see Figure 6.3), it seems unlikely that the increase in rail demand can be attributed to this rise. Additionally there were small increases in population during the recessions of the 1980s and 1990s and rail demand decreased significantly during those recessions.

Figure 6.3 Comparison with previous UK recessions: population (% change)



Source: DfT and ONS.

Therefore, it is unclear what the macroeconomic factors are (if any) which supported the continued growth of the rail industry during the most recent recession.

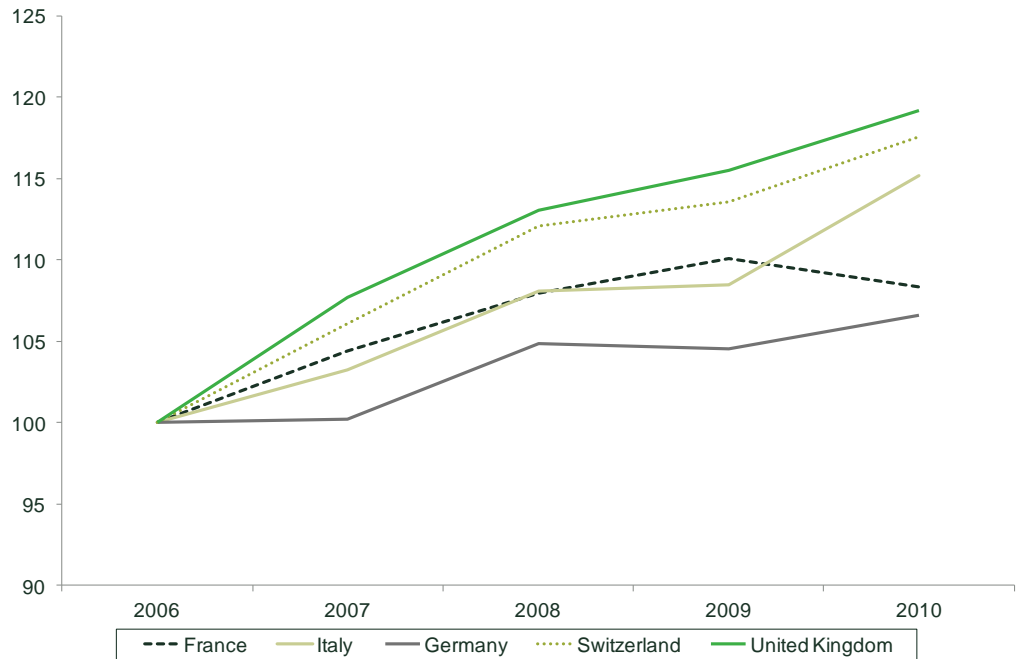
As these figures have demonstrated, passenger rail operations have performed resiliently throughout the most recent recession, in a way that is markedly different to its performance in previous recessions. Rail has also increased its modal share substantially during the most recent recession in a way not seen since the recession of the early 1970s.

This is consistent with trends in the sector which have occurred since the change in the industry model and which are outlined in section 7.4.3. For example, the sector's resilience in the recent recession may be partly attributed to TOCs' greater use of revenue management tools to maintain volumes, in a way that did not occur when the industry was under public ownership. With the change in industry model, TOCs have been more heavily incentivised to increase growth on the network while maintaining high levels of performance.

6.2 Performance relative to other countries

In addition to comparing the performance of the rail sector in the UK in the recent recession to past recessions, it is useful to compare how it has performed relative to other countries (see Figure 6.4). This comparison provides a more complete picture in case there has been a structural change in European countries which has led to increased demand for rail travel.

**Figure 6.4 Comparison with other European countries
(index of passenger journeys, 2006=100)**



Note: These figures include passengers from Northern Ireland.

Source: UN statistics.

As can be seen from Figure 6.4, continued growth in rail passengers in the recent recession is common to all the major European economies. However, rail demand in the UK has increased by the largest amount. This is in contrast to the macroeconomic performance, as shown in Figure 6.5, where the decline in real GDP in the UK between 2006 and 2010 is greater than in France, Germany, or Switzerland.

Figure 6.5 GDP in European countries (2006=100)



Source: IMF, World Economic Outlook.

6.2.1 Summary

This sub-section has compared the performance of passenger rail operations in Great Britain during the most recent recession with the performance in previous recessions and in other countries.

The analysis has shown that passenger rail travel has continued to increase in a way that appears to be substantially different to the performance of the sector in previous recessions and is not repeated in the number of car journeys made in Great Britain. While this finding is not unique to Great Britain (and therefore cannot be attributed entirely to the change in industry model), rail passenger journeys have increased at a faster rate in Great Britain than in comparable countries in Europe during the most recent recession. The differences in industry model between the British and other European comparators are therefore likely to have contributed in some way to this resilience in rail passenger demand.

6.3 Freight

In contrast to passenger operations, freight volumes (measured by tonne km) have declined during the recession, as illustrated in Figure 6.6 below. However, given the severity of the recession, freight volume has fallen by less than would be expected based on its performance in previous recessions.

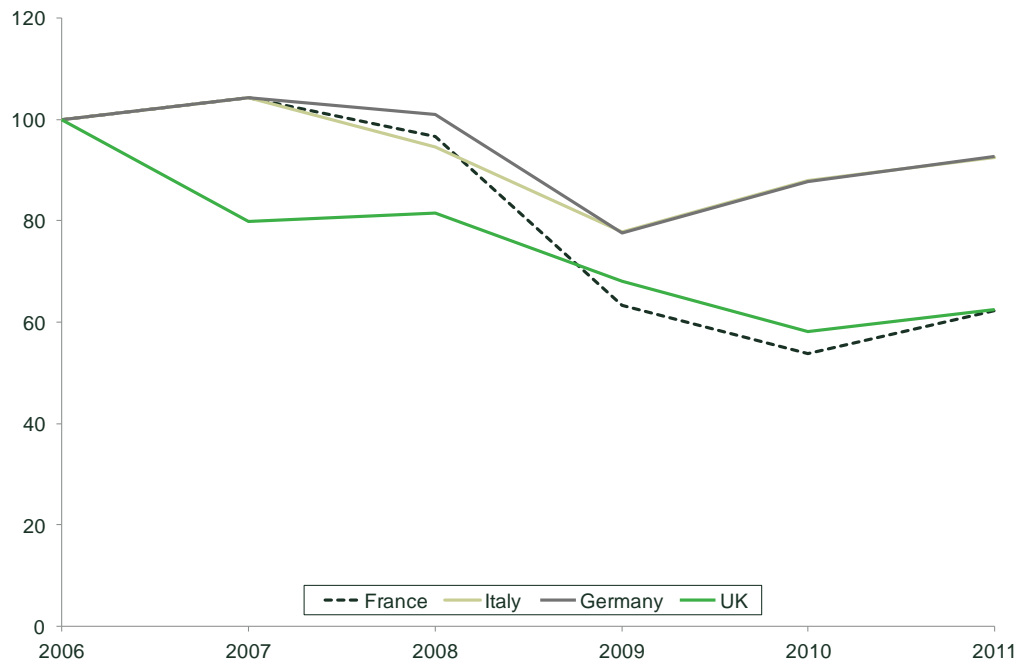
Figure 6.6 Comparison with previous UK recessions: freight (% change)



Source: DfT and ONS.

Relative to other European countries, rail freight in the UK experienced one of the largest declines in volumes, as demonstrated in Figure 6.7.

Figure 6.7 Comparison with other European countries: freight (index, 2006=100)



Source: Eurostat.

However, the UK also experienced a deeper recession than other large European countries (see Figure 6.5). To provide a comparison, Table 6.1 shows the annual growth rates in GDP and freight volumes in select European countries between 2007 and 2011.⁸²

Table 6.1 Freight and GDP compound annual growth rate (%)

	Freight	GDP
France	-7.6%	0.1%
Italy	-1.3%	-0.9%
Germany	-1.3%	0.5%
UK	-7.6%	-0.7%

Source: Oxera analysis of Eurostat data.

It is unclear from this analysis whether the performance of rail freight operations in GB is any better than the performance in other large European countries. However, rail freight operations do appear to have performed better (in terms of maintaining volumes) than would have been expected given the performance in previous recessions. The modal share of rail freight has also remained relatively stable over the recession and has not experienced the decline seen in some other countries, such as France.⁸³

⁸² In contrast to the UK-specific calculations, which consider the peak to trough changes in variables, in this section the calculations are based on the period from 2007 to 2011 to reflect that the recession had different profiles in different countries.

⁸³ Rail Delivery Group (2014), 'Keeping the lights on and the traffic moving: sustaining the benefits of rail freight for the UK economy', available from: <http://www.ons.gov.uk/ons/guide-method/method-quality/specific/economy/input-output--uk-national-accounts/index.html>, accessed 26 June 2014.

7 Change in industry model

7.1 Introduction

This section considers the benefits to the economy that have arisen from the change in the industry model in the mid-1990s. The key findings are outlined in the box below.

Key findings

- There is significant uncertainty around the benefits that have arisen from the change in the industry model, and further research into this area will be required.
- For the freight industry, given the decline in freight volumes prior to the change in the industry model, and the significant changes in freight operations since the change in the industry model, 75% of the change in trend in volumes has been attributed to the change in the industry model. Oxera calculates that the economic benefit arising to freight users from the change in industry model was equal to £0.4bn in 2013.
- For passenger operations, Oxera calculates that the change in the industry model may have led to an additional growth in passenger journeys of between 0.5% and 1.5% per year. A qualitative assessment of the evidence, such as investment in rolling stock and access to multi-year funding, is consistent with a value towards the upper end of this range, or up to 2.7bn additional rail journeys since 1995, or an average of 150m per year.
- Through the same mechanisms as explained in the section on user benefits, the effect of the change in the industry model can be estimated as between £2bn and £7bn in 2013. Oxera places more weight on estimates towards the upper end of this range.

The current industry model is based on a partnership between the government, TOCs, FOCs and Network Rail. On the passenger side, this means that the government specifies services that the TOCs deliver, while on the freight side specification is left to the market, and services are delivered by the FOCs, with Network Rail managing the infrastructure and being subject to regulation by the ORR.⁸⁴

In terms of organisations:

- Network Rail is responsible for renewing, maintaining and enhancing the rail infrastructure;⁸⁵
- TOCs deliver passenger services under contract to the DfT, Transport for Scotland and Transport for London (or on an open access basis);
- FOCs are responsible for delivering freight services with no government contracts;

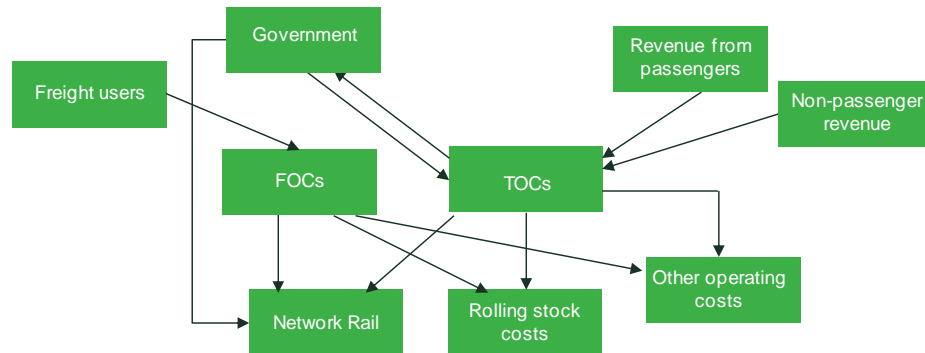
⁸⁴ Infrastructure projects required to enable improvements in freight services do, however, require input from public sector funders.

⁸⁵ Network Rail debt will be classified by the ONS as public sector debt from September 2014. This will not affect its status as a not-for-dividend company, limited by guarantee.

- a number of funders are responsible for setting industry outputs/outcomes, and providing funding to Network Rail and passenger services that would otherwise not be commercially viable.

These activities are supported by an extensive supply chain. The sector structure is illustrated in Figure 7.1.

Figure 7.1 Flow of funds in the GB rail sector

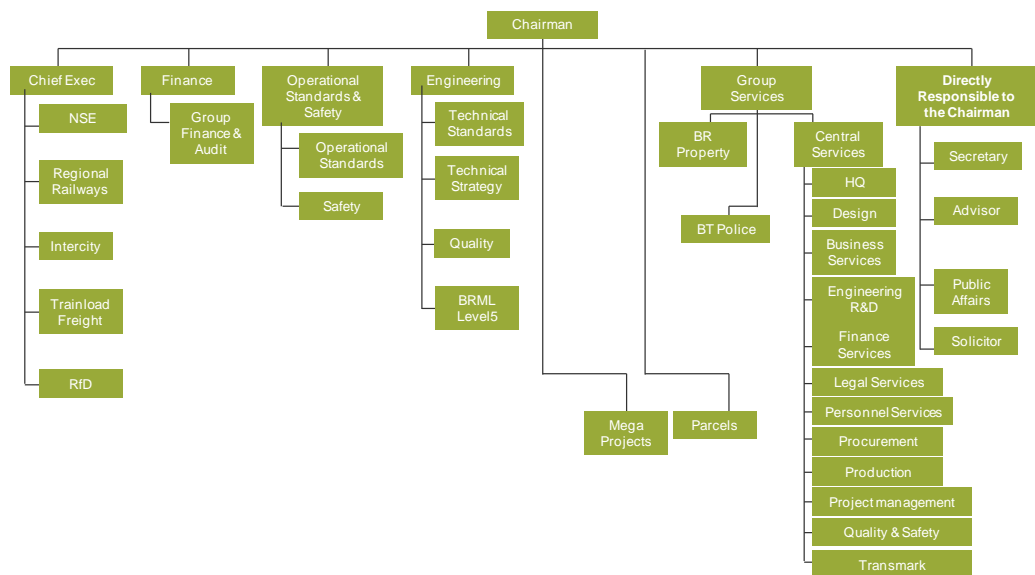


Source: Office of Rail Regulation (2014), 'GB Rail Industry Financial Information, 2012-13', April.

In order to assess the economic contribution of the current industry model, it is necessary to consider what would have happened had the industry model not changed in the mid-1990s—i.e. the counterfactual. In any exercise of this type, there is considerable uncertainty and a wide range of potential counterfactuals. Our approach is to specify what could have happened to the passenger and freight aspects of the rail sector in the absence of the change in industry model in the mid-1990s, by looking at a number of factors.

The sector structure outlined above is significantly different from the structure of the rail industry prior to the change in the industry model in the mid-1990s. In the early 1990s, BR was organised into a number of divisions (Railfreight, Intercity, Network SouthEast, and Provincial), but reported to a central board—see Figure 7.2.

Figure 7.2 British Rail structure



Source: Gourvish, T. (2002), *British Rail 1974-97: From Integration to Privatisation*, Oxford University Press.

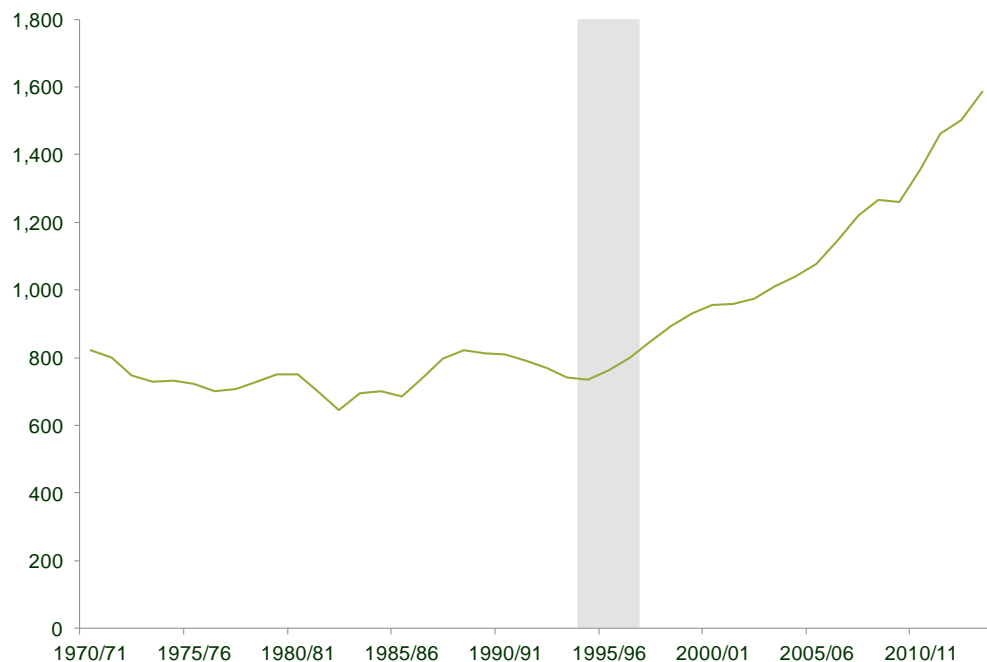
The question that then arises is: 'how has the industry evolved since the early 1990s?' The following sub-section explores some of the trends in key industry variables.

7.2 Key trends

This sub-section provides time-series data on a range of important inputs and outputs of the rail sector, including passenger and freight volumes, and the degree of government support. The trends in these variables provide valuable context in developing the counterfactual.

First, as can be seen from Figure 7.3, prior to the change in the industry model, the number of passenger journeys made on the GB rail network was relatively flat, with a compound average annual growth rate (CAGR) of approximately -0.5% between 1970/71 and 1994/95. In comparison, after the change in industry model, the CAGR between 1995/96 and 2013/14 was approximately 4%.

Figure 7.3 Passenger journeys (m) in GB rail

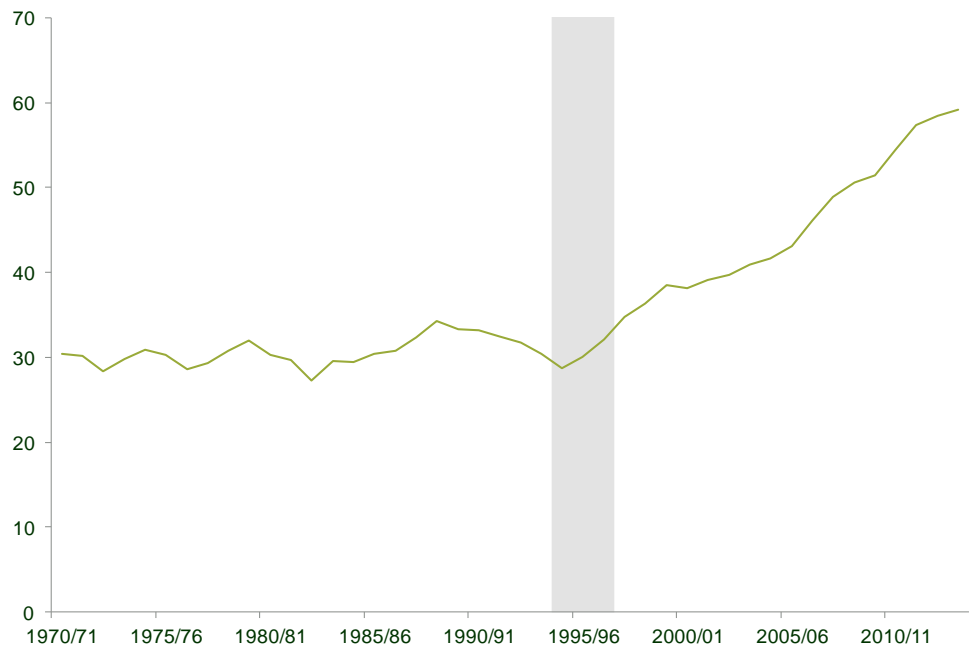


Note: The area shaded in grey indicates the period of industry transition as a result of the change in the industry model.

Source: ORR.

Similarly, there was a significant difference in growth in passenger km before and after 1994/95, as shown in Figure 7.4 below. Total passenger km experienced a slight decline between 1970/71 and 1994/95, with a CAGR of approximately 0%. In contrast, between 1994/95 and 2013/14, total passenger km had a CAGR of approximately 4%.

Figure 7.4 Passenger kilometres (bn) in GB rail

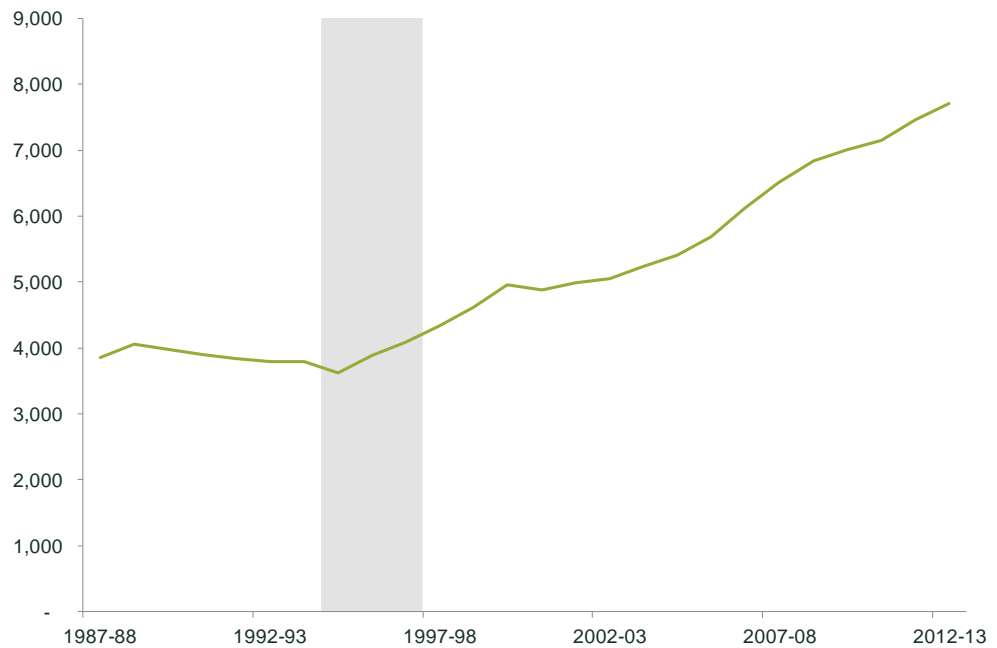


Note: The area shaded in grey indicates the period of industry transition as a result of the change in the industry model.

Source: ORR.

This change in passenger volume growth and passenger journeys was associated with an increase in revenue from passengers, as illustrated in Figure 7.5. However, it is worth noting that real yield (revenue per passenger journey) remained relatively stable over the period, with a CAGR of approximately 0%.

Figure 7.5 Passenger revenue (£m) in GB rail, 2013 prices

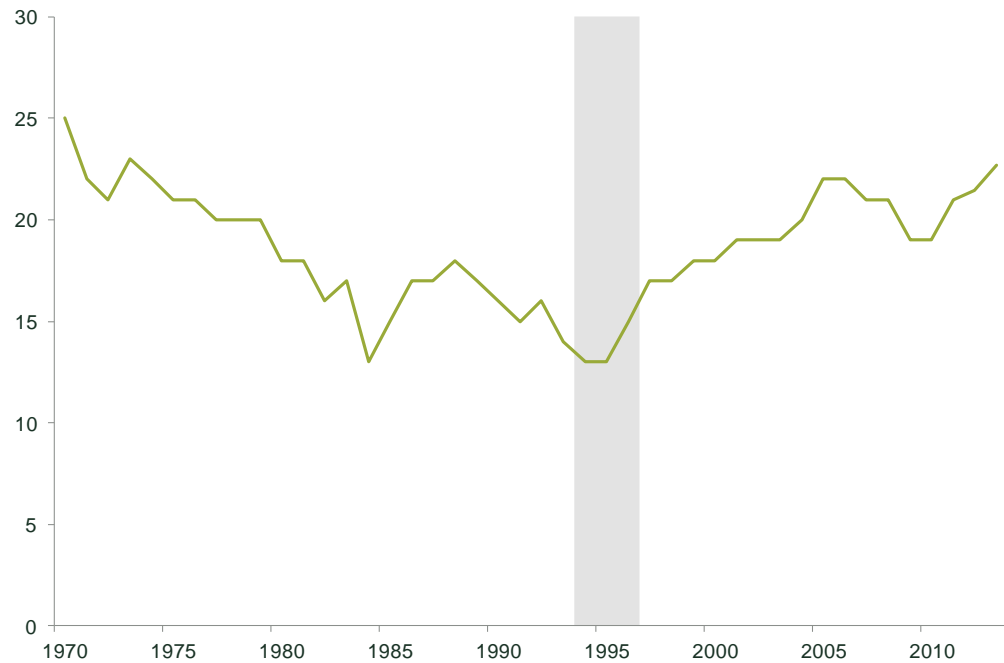


Note: The area shaded in grey indicates the period of industry transition as a result of the change in the industry model.

Source: ORR.

There were significant changes in the freight market as well as the passenger market. Figure 7.6 shows that a long-term decline in freight volumes ended around the time of the change in the industry model, with a CAGR of freight tonne km of approximately -3% between 1970 and 1995 and approximately 2% between 1996 and 2013.

Figure 7.6 Freight volumes in GB rail (bn tonne kilometres)

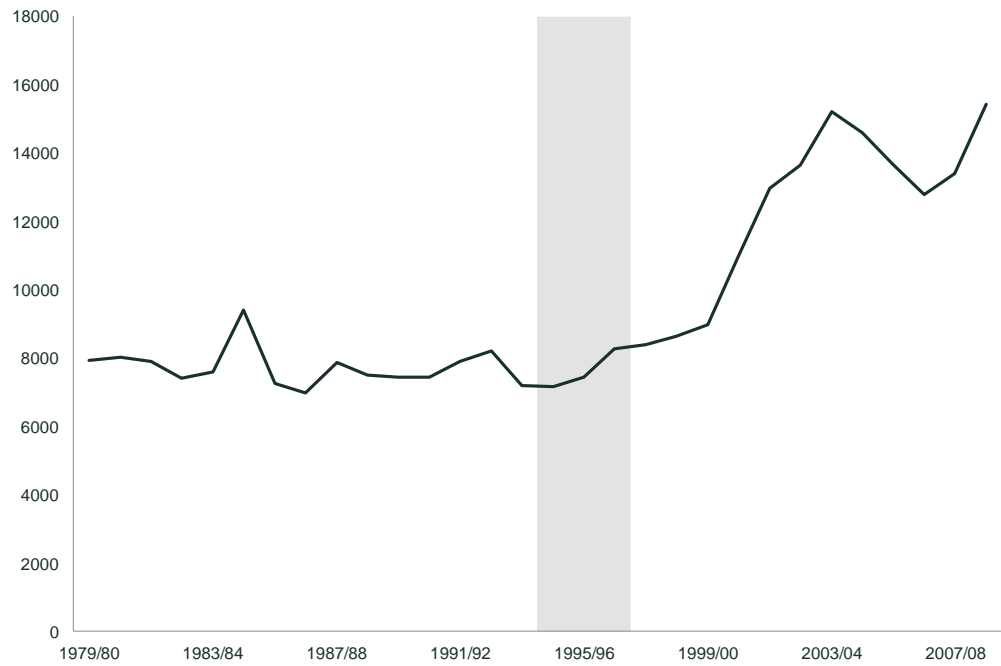


Note: The area shaded in grey indicates the period of industry transition as a result of the change in the industry model.

Source: DfT and ORR.

The increase in passenger and freight volumes has occurred alongside an increase in total industry costs, as Figure 7.7 demonstrates. This increase in costs is likely to have been driven by a number of factors, including, amongst others, increased expenditure on infrastructure maintenance and renewals following Hatfield and additional levels of investment.

Figure 7.7 Total industry costs (£m)

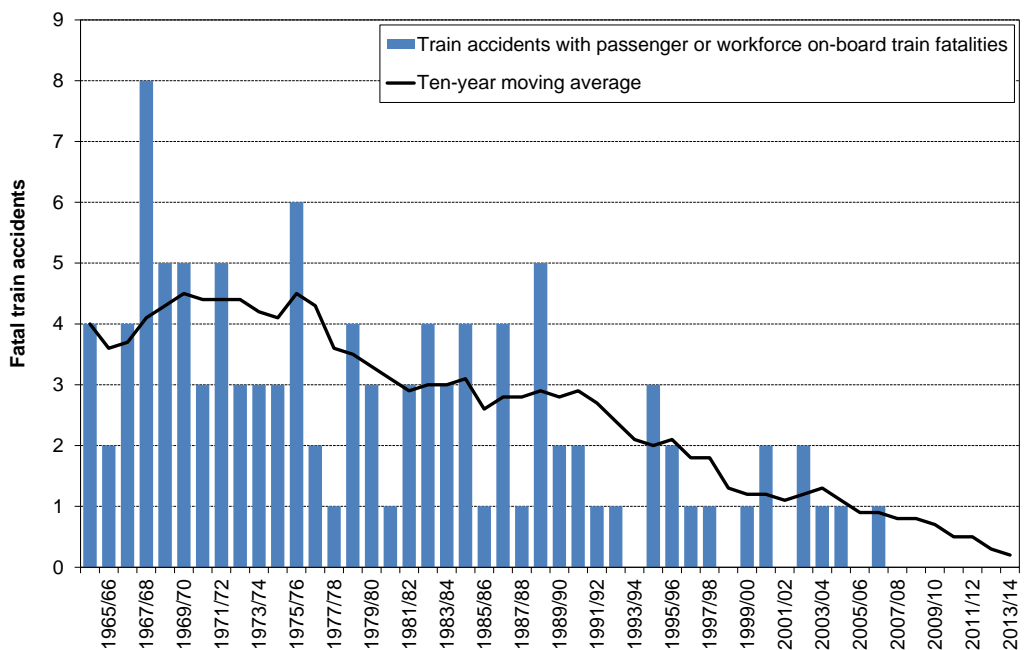


Note: The area shaded in grey indicates the period of industry transition as a result of the change in the industry model. Neither the ORR nor the DfT publishes time-series data on total industry costs. The ORR has begun to publish information on total industry expenditure, which it calculates as approximately £12bn in 2012/13. See ORR (2014), 'GB rail industry financial information 2012-13', April, p. 6.

Source: Robins, D.L. (2011), 'Evaluating the long term impacts of transport policy: the case of passenger rail privatisation in Great Britain', thesis for the degree of Doctor of Philosophy, May, p. 170.

The increase in both passenger and freight activity has been accompanied by a continued reduction in fatal accidents, as shown in Figure 7.8.

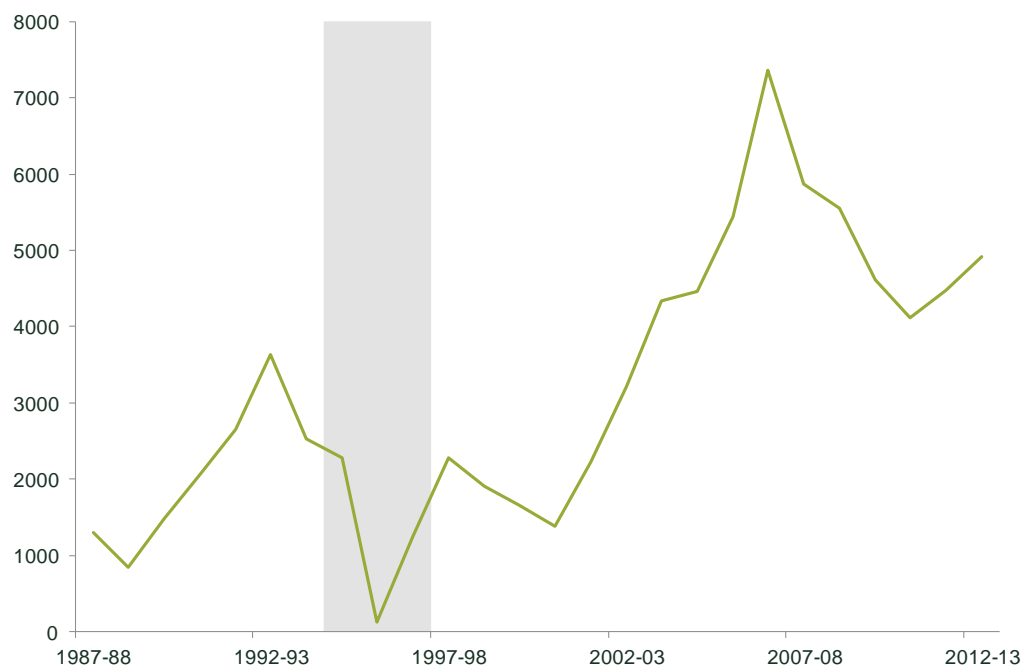
Figure 7.8 Safety in GB rail



Source: ORR and RSSB Safety Management Information Systems.

This increase in safety and activity has been supported by an increase in government funding to the rail industry, as illustrated in Figure 7.9.

Figure 7.9 Government support (£m) to GB rail

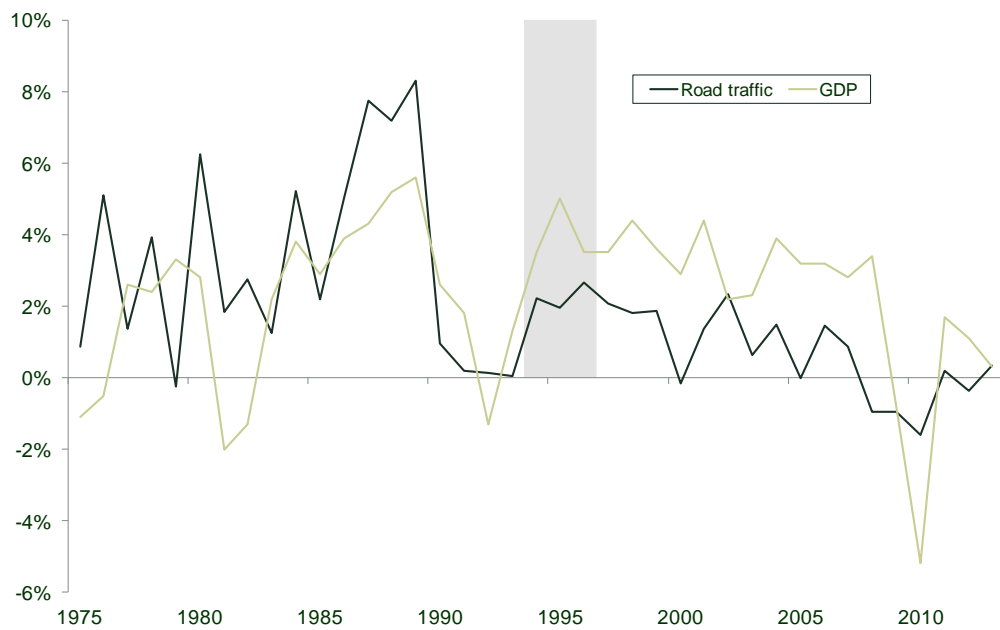


Note: Figures exclude Passenger Transport Executive grants, but include freight grants, central government grants, direct rail support, and other elements of government support. This chart includes both ongoing government support for operations and funding for enhancements to the network and major projects—e.g. Crossrail. The area shaded in grey indicates the period of industry transition as a result of privatisation.

Source: ORR.

For much of the period up to the change in industry model, the growth in road traffic, on average, exceeded the growth of GDP (see Figure 7.10). Since the early 1990s, however, these relative growths reversed, with road traffic growth lower than economic growth on average. The reasons for this are complex, but are likely to include a substantial increase in journey times due to higher congestion in urban areas, which made road travel less attractive. Many of the same factors will have made travel by rail more attractive in the last two decades.

Figure 7.10 Road traffic and GDP (year-on-year percentage change)



Note: The area shaded in grey indicates the period of industry transition as a result of the change in the industry model.

Source: DfT and ONS.

The trends in key variables in the rail industry provided in this section give a picture of an industry that changed significantly around the mid-1990s. The relevant question is then how much of this change can be attributed to the change in the industry model.

In developing the counterfactual, it is necessary to take account of developments that are outside the control of the GB rail sector, and how these might have affected the evolution of the sector since the mid-1990s in the absence of the change in the industry model. One aspect explored below is changes in external factors driving demand; another is European legislation, in which there has been considerable activity since the early 1990s, as outlined in

Box 7.1 below.

Box 7.1 European rail legislation

Directive 91/440/EEC for the development of European Economic Community railways was enacted on 29 July 1991 to create a management of railway infrastructure and the railway transport activities of railway undertakings within the Community.⁸⁶ This Directive recognised the need for greater integration of the European rail industry to account for growing competition in the market. The Directive also took into account the need for the two areas referred to above (infrastructure and operations) to be managed separately in order to facilitate the future development and efficiency of the Community's railways.⁸⁷

Since the early 2000s, the European Commission has introduced four 'packages' of legislation, which have aimed to open the rail networks in Europe to competition and to increase the degree of interoperability between the networks.

First Railway Package

In 2001, the First Railway Package was adopted, enabling rail operators to have access to the trans-European network. The Commission proposed improvements for the freight rail industry by creating a one-stop-shop to market freeways. This would entail the train paths to be improved, establish a tariff structure, reduce delays, and introduce quality criteria.

The assessment of the implementation of this railway package conducted by the Commission in 2006 showed that the process was still ongoing, the relative position of the other transport modes had stabilised, railway safety had improved, and rail traffic performance had been good where the rail freight market opened early for competition.⁸⁸

Second Railway Package

On 23 January 2002, the Commission proposed measures to revitalise the railways through the rapid construction of an integrated European railway area. These measures were aimed at improving safety, achieving operational cohesion, and opening up the rail market.⁸⁹

The Second Railway Package accelerated the liberalisation of rail freight services by opening up the market to competition in early 2007. This package also created the European Railway Agency, which focuses on establishing common technical rules across the European railway sector.⁹⁰

Third Railway Package

On 3 March 2004, the Commission proposed further measures. When the Third Railway Package was adopted in October 2012, it introduced open access rights for international rail passenger services. It allowed operators to pick up and set down passengers at any station on an international route, including stations located within the same member state.⁹¹ Furthermore, it introduced a driving licence that allowed train drivers to work within the entire European network.

The third railway package also strengthened railway passenger rights, in which long-distance travellers obtained a wider range of rights, and there would be guaranteed minimum quality standards to all passengers on all lines.

Recast

The recast of the First Railway Package was introduced due to the problems encountered during its implementation, the three main ones being the low level of

⁸⁶ <http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:31991L0440&from=EN>, accessed 26 June 2014.

⁸⁷ http://europa.eu/legislation_summaries/transport/rail_transport/l24057_en.htm, accessed 26 June 2014.

⁸⁸ http://ec.europa.eu/transport/modes/rail/packages/2001_en.htm, accessed 26 June 2014.

⁸⁹ http://ec.europa.eu/transport/modes/rail/packages/2001_en.htm, accessed 26 June 2014.

⁹⁰ http://ec.europa.eu/transport/modes/rail/packages/2001_en.htm, accessed 26 June 2014.

⁹¹ http://ec.europa.eu/transport/modes/rail/packages/2001_en.htm, accessed 26 June 2014.

competition, inadequate regulatory oversight, and the low levels of private investment.⁹² The key aim of the recast was to modernise and simplify the legislation by merging and consolidating the existing Directives with their amendments in order to better tackle the issues referred to above.⁹³

Fourth Railway Package

In 2013, the Fourth Railway Package was announced, unveiling a vision for establishing a Single European Railway Area, which would ensure EU competitiveness for EU transport in the long term by dealing with growth, fuel needs and decarbonisation.

This is to be accomplished through improvement to rail efficiency via progressive market openings, the establishment of independent railway undertakings, and the separation of accounts.⁹⁴ This was bolstered by the introduction of legislation in 2012 which bolsters existing provision on competition, regulatory oversight and the financial architecture of the rail industry.⁹⁵

Source: Oxera.

As can be seen from the box above, the tenor of European legislation has been towards increased liberalisation, initially in freight operations and then in international passenger traffic, with the most recent proposed legislation focusing on domestic passenger traffic. In addition, greater separation between infrastructure maintenance and renewal and train operations in Great Britain was likely, given the requirements of European legislation. However, there are substantial differences in how European countries have implemented the requirements of the legislation, and how they would have been implemented in Great Britain is particularly unclear.

This suggests that a trend towards greater liberalisation was likely, regardless of the change in the industry model. However, given that Great Britain was one of the earliest and most complete adopters of a change to the industry model, it is pertinent to ask how much of the legislative developments in the past decade would have occurred in the absence of supportive developments in the GB market. Arguably, the European changes do little more than reflect the changes already introduced in GB, rather than requiring any further changes of significance, and therefore the evolution of European rail legislation might have been very different had the industry model in Great Britain not changed in the mid-1990s.

This sub-section has provided a short introduction to the key trends and European legislation affecting the shape of the GB rail industry from the mid-1990s onwards. The remainder of this section considers:

- the likely evolution of freight and passenger operations in the absence of a change in the industry model and its associated benefits;
- the economic benefits that the change in industry model has enabled (drawing on the mechanisms outlined in section 3).

⁹² European Commission (2012), 'Background: Frequently asked questions on the recast of the first railway package', MEMO/12/520, 3 July.

⁹³ European Commission (2012), 'Background: Frequently asked questions on the recast of the first railway package', MEMO/12/520, 3 July.

⁹⁴ European Commission (2013), 'The Fourth Railway Package – Completing the Single European Railway Area to Foster European Competitiveness and Growth', COM(2013) 25 final.

⁹⁵ European Commission (2013), 'The Fourth Railway Package – Completing the Single European Railway Area to Foster European Competitiveness and Growth', COM(2013) 25 final.

7.3 Freight

Prior to the change in the industry model, BR had a separate freight business in which volumes were declining—see Figure 7.6. While there have been significant attempts to open European freight markets to competition, success in many countries has been relatively limited. Therefore, in the absence of the change of industry model, it seems likely that BR would have continued to have a very high rail freight market share, and that growth in volumes would have been low or negative.

When this is compared with rail freight operations currently, which have significantly reduced unit costs⁹⁶ and have generated high levels of private investment, it does not seem unreasonable to assume that much of the increase in rail freight volumes since the change in the industry model since the mid-1990s has arisen because of the change in the industry model. However, there has been a generally positive policy stance since the late 1990s towards the rail freight industry (which has also benefited from the more general improvements to the rail infrastructure) to encourage modal shift, and it is therefore unrealistic to suggest that all of the additional rail freight can be attributed to the change in industry model.

Rail freight volumes depend on the state of the economy, but as Table 7.2 below suggests, there was a relatively small change in long-run average economic growth rates between the period before and after the mid-1990s. Therefore, Oxera assumes that up to 75% of the difference in growth rates in rail freight before and after the change in the industry model can be attributed to the change in the industry model. The economic benefits arising from this are outlined in section 7.5.

7.4 Passenger

While the impact of the change in the industry model on freight operations is relatively straightforward, the impact of the change in the industry model on passenger operations is more complex because of the greater role of government in this area.

In particular, although (with the exception of Directly Operated Railways) the TOCs are private companies, the services they deliver are largely specified by government.

The remainder of this sub-section examines the extent to which passenger demand differed before and after the change in industry model, and whether factors outside of the control of the rail sector may be responsible for the change in the trend in passenger demand. It then looks at the extent to which any growth that cannot be 'explained' by these factors may be attributable to the change in industry model.

7.4.1 Change in demand

A first step in considering the impact of the change in industry model on rail passengers is to quantify the extent to which demand differed before and after privatisation. Using the same data as in Figure 7.3, Oxera has found that demand growth has been much higher in the period since privatisation. Table 7.2 shows that this finding does not depend on the period under scrutiny.

⁹⁶ Department for Transport and Office of Rail Regulation (2011), 'Realising the potential of GB Rail: final independent report of the rail value for money study: detailed report', May, p. 225.

Comparing the 20 years before the change in industry model with the period between the change and today, demand has grown by approximately 4% more per year.

Table 7.1 Passenger rail journeys: growth per year

Pre-privatisation (1975–94)	0.1%
Post-privatisation (1995–2010)	3.9%
Difference	3.9%
Pre-privatisation (1972–97)	0.3%
Post-privatisation (1998–2012)	3.9%
Difference	3.7%

Source: ORR.

7.4.2 External factors

In considering the extent to which the change in the industry model may be responsible for the change in the trend in passenger volumes described above, it is important to look at factors that are outside the control of the rail sector, such as developments in the car market, economic growth, and demographics. If these factors are not accounted for, the impact of the change in the industry model may be over- or understated. We now turn to consider a range of factors that are outside the control of the rail sector, and determine their likely effect on the demand for passenger rail travel.

The sector has a well-developed approach to predicting the impact on passenger rail demand resulting from changes across a wide range of variables. This approach involves using elasticities⁹⁷ drawn from the Passenger Demand Forecasting Handbook (PDFH)⁹⁸ and the percentage change in key factors of interest to calculate the impact of those changes on passenger rail demand.

Oxera has adopted this approach in this study and has considered a range of factors, including:

- GDP per capita;
- population;
- employment;
- the cost of fuel (per km) for car drivers;⁹⁹
- changes in car ownership.¹⁰⁰

The growth rates of these factors are outlined below.

⁹⁷ An elasticity captures the percentage change in the quantity of interest in response to a 1% change in another factor. For example, if the elasticity of rail demand with car cost is 0.8, a 1% increase in car cost is predicted to result in a 0.8% increase in the demand for passenger rail travel.

⁹⁸ Association of Train Operating Companies (2013), *Passenger Demand Forecasting Handbook v5.1*, April.

⁹⁹ Measuring in fuel cost per km takes account of improvements in fuel efficiency.

¹⁰⁰ Changes in car ownership are likely to provide a proxy for a wide range of factors that affect the demand for passenger rail travel, including changes to company car taxation and the cost of car insurance. This is more limited than some other measures of the cost of owning and operating a car, but has been used to be consistent with standard industry practice.

Table 7.2 External factors

	GDP per capita	Population	Employment	Fuel	No. of cars	Total
Change per year (pre-change in industry model) (A)	2.4%	0.2%	0.2%	0.1%	-1.8%	
Change per year (post-change in industry model) (B)	2.1%	0.5%	0.8%	1.8%	-1.3%	
Difference in growth rate (C=B-A)	-0.3%	0.3%	0.7%	1.7%	0.5%	
Elasticity (D)	1.18	1.00	1.27	0.50	0.53	
Impact on per-annum rail demand (E=C*D)	-0.3%	0.3%	0.8%	0.8%	0.3%	1.9%

Note: The values are averaged for 1975–94 for the pre-change in industry model period and for 1995–2013 for the post-change in industry model period. The final row shows the incremental impact that each factor has between the pre- and post-periods. The elasticities are derived by taking averages within the three GB rail sectors: London and South East; long-distance; and regional.

Source: ONS, PDFH.

Table 7.2 shows that, after the change in the industry model, these factors led to an additional increase of 1.9% per year in rail demand when compared with their effect before the change in the industry model.

Table 7.2 does not provide the complete picture on growth driven by external factors before and after the change in industry model because there is not sufficient data to ensure that all aspects of passenger behaviour are captured. For example, it is difficult to find data on the impact on rail demand of different levels of expenditure on motorway construction or urban regeneration. Nevertheless, while some factors are either not included or have not been researched fully, the quantification in Table 7.2 is consistent with the industry standard approach.

7.4.3 Key changes within the industry

The previous sub-section described some of the key factors that are expected to have changed the demand for passenger rail travel regardless of the industry model. Many other factors can be expected to affect the demand for passenger rail travel, including the fare (and the range of fares available), the quality of service, and the general perception of the industry.

With any aspect that is within the control of the sector, it would be complex to identify what would have happened if the industry model had not changed. However, a number of key aspects of the sector (both positive and negative) are unlikely to have occurred had the industry model not changed (or at least not happened at the time they did with the change in the industry model). These factors include moving away from annual funding limits (capital and revenue spending); access to private capital; incentives on TOCs and FOCs to grow the market, control costs and innovate; and a degree of misalignment of incentives between infrastructure and operations. When reading this section of the report, it is important to remember the uncertainty around these factors and that further research would be valuable.

Long-term funding agreements

One of the major changes in the funding of the sector has been the establishment of five-year funding periods for Network Rail. This has enabled

continued government support to the industry, even when the DfT's funding was being reduced (e.g. at the 2010 Spending Review). This is in marked contrast to the pattern when BR was in operation, when it was subject to an annual funding settlement from the DfT. In turn, this has enabled a smoother flow of investment projects, but also the ability to reprofile investments across time to improve efficiency.

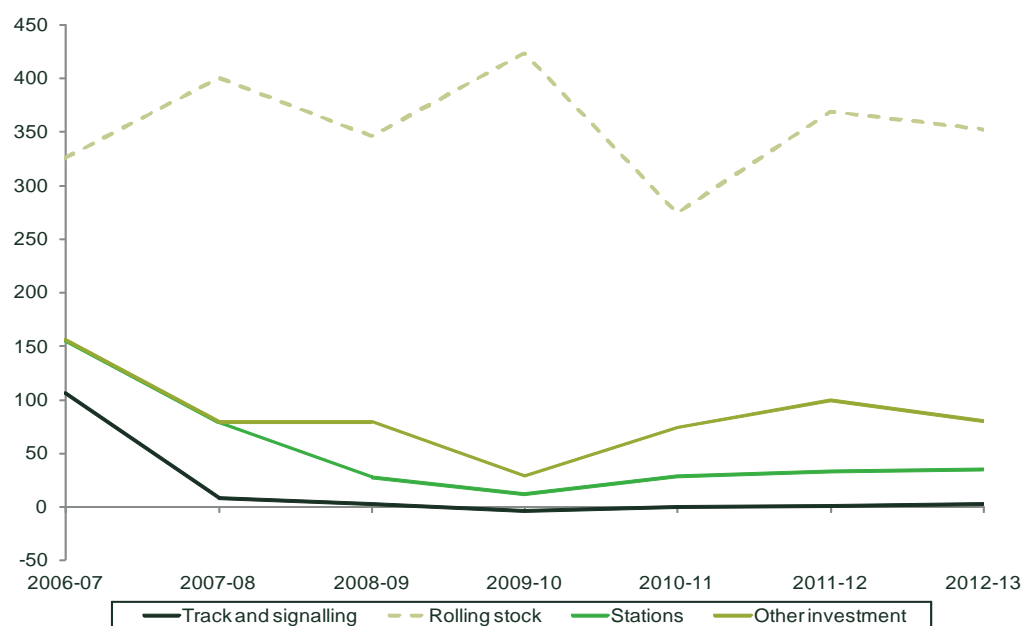
In addition, not only has CAPEX been protected, but contracts between TOCs and funders have, effectively, committed funders to providing revenue spend at a predictable level throughout the life of each franchise. Changes to the level of funding within the franchise trigger change provisions that provide a disincentive to making alterations in subsidy (especially any reductions in subsidy). This combination of increased certainty about the level of capital and revenue spend by funders has enabled the industry to move towards longer-term planning, and away from ensuring that the budget is spent every year, and raising fares or cutting services in response to short-term budgetary pressures. In particular, it has preserved service levels and ensured services for passengers, despite the cuts to public sector budgets since 2010.

Private capital

Figure 7.11 depicts private investment in the sector during the last decade. While there may plausibly have been some involvement of private sector capital through a public-private partnership (PPP) or Private Finance Initiative (PFI), given the extensive use of these arrangements in other areas of transport (including motorway schemes and London Underground), in the absence of the change in industry model, this private investment seems unlikely to have arisen in rail on the scale that has been seen.

The change in industry model has also enabled commercially beneficial investments to be made outside of the envelope of public sector budgets. Passengers have benefited from better trains and stations in a way that is likely to have happened either not at all, or much more slowly, had the change in industry model not taken place.

Figure 7.11 Private investment in GB rail, 2013 prices (£m)



Source: ORR.

Incentives to grow the market

In addition to the greater stability of funding, the change in the industry model has altered the incentives for the TOCs and FOCs to grow the market and reduce costs through innovation.

The way franchises were structured following the change in the industry model, with different companies bidding for franchises and the subsidy/premium payments being contractualised with the contracting authority, placed strong incentives on the winning bidder to both grow the market and reduce costs, while maintaining or improving safety. These incentives arose because the TOC was able to keep a proportion of any outperformance in revenue (subject to a range of revenue-sharing mechanisms that varied over time), and could retain any additional profit that arose from being able to reduce costs further than anticipated in the franchise bid.¹⁰¹ This is in contrast to the incentives placed on BR, which were to grow the market and manage costs to achieve (volatile) annual budgets.

One example of the innovation that has emerged since the change in industry model to grow the market is the range of advance purchase tickets that the industry makes available to passengers. This enables passengers to choose between a much wider range of tickets to suit their budget and other needs (such as timeliness) in a way that is not seen for users of GB rail's continental counterparts.¹⁰² These sorts of innovations are likely to have been driven by TOCs needing to grow their market in order to deliver against franchise bid expectations, and represent a benefit arising from the change in industry model. However, BR was moving towards introducing more market-based pricing prior to the change in the industry model, and so these products may have become available in due course. However, it seems relatively unlikely that either the range or pricing strategies would have been offered as soon by BR as by the TOCs.

A further impact from the change in the industry model is the focus in the industry on performance and reducing the impact of possessions. This has been enabled by systems quantifying the effect of minutes of delay on passengers, and of closing the railway to facilitate engineering work (albeit at a cost in terms of the number of people employed to administer the process). The systems were introduced as a necessary part of the change in industry model, and either do not exist, or are far less sophisticated in other European railways. They have brought considerable benefits in helping the industry to understand trade-offs when using the network, and in focusing on delivering performance.

The extent to which these incentives and contractualised funding have been responsible for generating the growth outlined in Figure 7.3 are clearly uncertain, but they are likely to have played a significant part.

Nevertheless, there have also been downsides to the change in the industry model, with some increases in costs. These have included a one-off cost arising from the change in industry model, and costs arising from a misalignment of incentives.¹⁰³ To some extent, these cost increases have been offset by

¹⁰¹ Some academic research finds that TOC costs did decline in the early years of the current model, but increased under management contracts. See, for example, Nash, C. and Smith, A. (2006), 'Passenger rail franchising—the British experience', paper given to ECMT workshop on competitive tendering for passenger rail services, Paris, 12 January.

¹⁰² Passenger Focus (2009), 'Fare and ticketing study', February.

¹⁰³ See Arup and Oxera (2010), 'Review of rail cross-industry interfaces, incentives and structures: options to reduce industry net cost', report prepared for the McNulty Review, 30 September.

increases in government funding and revenue growth, which have enabled fares to be held at relatively steady levels since privatisation.

The extent to which these changes have been responsible for generating the growth are uncertain, but they are likely to have played a significant part. Passengers have responded to more trains, better journey quality, and the availability of heavily discounted advance fares. Hence, Oxera has assumed that between 25% and 75% of the growth in passenger demand that cannot be explained by external factors is attributable to the change in the industry model. 25% is chosen as a lower bound as, due to the factors outlined above, it seems unlikely that the change in the industry model had no impact on passenger rail growth. 75% has been chosen as an upper bound because the factors outlined above may have had a significant effect on the number of passengers using the rail network. A qualitative assessment of the evidence seems likely to support a value towards the upper end of this range, although this is a matter of judgement.

7.4.4 Conclusion on changes to external factors

In conclusion, the difference in average annual passenger rail growth before and after the change in industry model is approximately 4%.¹⁰⁴ This can be attributed to three effects:

- changes in the growth in external factors;
- the change in the industry model;
- changes in the rate of change in other, unidentified factors (e.g. urban regeneration).

Given the uncertainty around the impact of the change in the industry model, Oxera has made the assumption that between 25% and 75% of the demand that is not explained by changes in external factors is driven by the change in the industry model. Note that this is an indicative estimate. This means that between 0.5% and 1.5% of annual growth in rail is due to the change in the industry model. The incremental effect of each factor is shown in the Figure 7.12 below. The calculation steps to derive this figure are given in Table 7.3.

Table 7.3 Decomposition of change in rail demand

Change in:

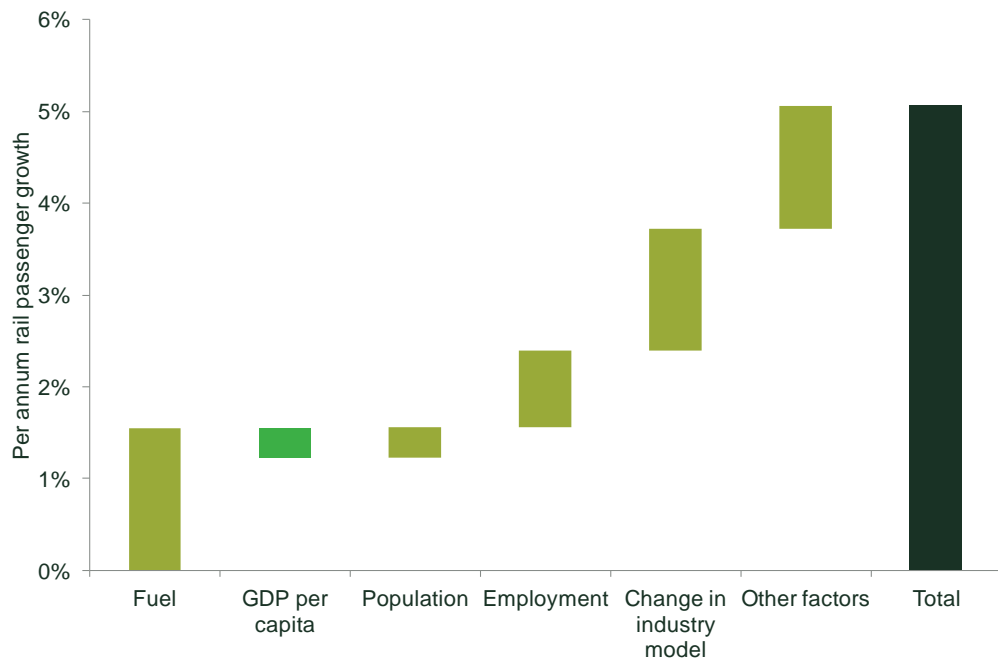
average per annum rail demand (A)	3.9%
average per annum rail demand due to external factors (B)	1.9%
average per annum rail demand due to privatisation and other factors (C=A-B)	2.0%
average per annum rail demand due to privatisation (D=C*0.75)	1.5%
average per annum rail demand due to other factors (E=C*0.25)	0.5%

Source: Oxera analysis.

The incremental effect of each individual factor is also shown in Figure 7.12, which shows the significant impact that privatisation has had on rail demand in the last 20 years. Using the annual rail demand growth rate of 1.5% due to privatisation, it can be calculated that there have been approximately 345m additional rail journeys in 2013 due to the change in the industry model.

¹⁰⁴ Based on data from ORR National Trends.

Figure 7.12 External drivers of rail demand



Note: A central estimate of 0.9% is used for the impact of the change in the industry model on rail demand.

Source: Oxera.

7.5 Economic benefits arising from the change in the industry model

To calculate the benefit to users of the change in the industry model, the results from the user benefit quantification in sections 3 to 5 can be used as follows:

- the calculations in sections 3 to 5 provide values for the user benefits (to both passenger and freight users) and wider economic impacts which would be lost if the rail sector was 10% and 50% smaller;
- using these values for the difference in the number of passenger journeys outlined above, we can interpolate between the 10% and 50% scenarios (again assuming that the change is linear) to provide indications of the benefits that would have been lost had the industry model not changed.

Table 7.4 Benefits arising from change in industry model

Change in:	25%	75%
average per annum rail demand	0.5%	1.5%
total rail demand	9%	31%
passenger and freight user benefits (£bn)	1.2	4.0
wider economic impacts (£bn)	1.0	3.2
Total	2.2	7.2

Source: Oxera analysis.

As outlined above, a qualitative assessment of the evidence suggests that the impact of the change in the industry model is more likely to be towards the top of this range.

8 Conclusions

This study has quantified the contribution of the GB rail industry to the economy. It has also provided an indicative estimate of the economic benefits that have arisen from the change in the industry model in the mid-1990s from a publicly owned industry to the current model of public sector specification and private sector service delivery.

A number of important conclusions arise from the analysis, including the following.

- The rail industry and its supply chain employ 212,000 people, contributing £9.3bn of GVA per year to the UK economy, and £3.9bn in tax revenue.
 - The user benefits of rail for passengers and freight are between £1.3bn and £13bn per year.
 - As stated in the report, the true value of the rail sector lies in how it facilitates activity in other sectors of the economy (known as wider economic impacts) as well as the benefits which it delivers to users. There are well-established mechanisms through which these effects arise when the rail industry increases in size (including reduced road congestion for people travelling on business and freight, increased productivity arising through increased agglomeration, and increased levels of national trade), and these are estimated to be between £0.9bn and £10.2bn per year. The benefits of reduced congestion also accrue to people travelling for leisure or commuting, the value of which is calculated to be up to £7.3bn per year.
 - The rail sector delivers substantial environmental benefits, including between 0.7m and 7.4m tonnes of CO₂ in reduced greenhouse gas emissions from users making journeys by rail rather than by car and lorry (valued at £40m–£430m). In addition, rail delivers significant social benefits, including a reduction in accidents of between 95 and 950 serious casualties and fatalities a year, valued at between £33m and £330m annually.
 - The rail industry (both passengers and freight) has performed well in the recent recession relative to previous recessions, with passenger volumes growing in absolute terms and freight volumes declining by less than would be expected given the depths of the recession. While the increase in passenger volumes in the recent recession was a trend seen across other large European countries, the growth in Great Britain was the largest, even though the country experienced the deepest recession.
 - The change in the industry model delivered significant benefits to the economy of between £2.2bn and £7.2bn in 2013. This is relative to a counterfactual of continued public ownership, where the level of freight volumes continued to decline, and passenger volumes increased at a slower rate.
-

A1 Calculation of economic footprint

A1.1 Input–output methodology

An IO table represents the relationships across sectors in an economy between the use of resources in production and consumption, and provides a picture of the flows of products and services in the economy. For example, it shows the amount of hotel and catering services used in the production of one unit of rail services. Similarly, it shows the amount of agricultural products that would be needed to produce that extra amount of catering service. These production relationships for the whole economy, which form the basis of the indirect contribution of aviation (discussed in section 2), are represented in the ONS's Analytical IO tables.

The first step of the estimation used the Analytical IO tables is to calculate the amount of gross output produced in the economy from a given level of rail input through its supply chain. The indirect GVA generated by rail in the economy is then assessed from the amount of value added corresponding to the output produced by each sector. The indirect impact on employment is quantified as the level of employment required to produce the calculated amount of indirect GVA, given the level of productivity in the economy. The latest version of the Analytical IO tables presents such relationships disaggregated by 127 sectors for the year 2010. This level of disaggregation allows a more precise estimate of the impact of rail.

The ONS also provides data on the output and GVA of the rail sector up to 2011. The rail sector is defined as SIC 49 'Rail Transport Services'. It is worth noting that other SIC codes are likely to contain relevant activity, such as SIC 30, which includes the manufacture of rolling stock, or SIC 52 'Warehousing and support activities for transportation'; however, these are out of scope for the purposes of this study.

A1.2 Assumptions in the Input–Output model

As discussed in section 2, the two distinct impacts—direct and indirect—have been calculated in terms of GVA, employment and tax. The direct GVA and rail figures are available directly from the ONS, while its indirect GVA and employment figures have been calculated using the IO Analytical tables for 2010. This part of the analysis requires certain assumptions that are implicit in the IO methodology, as follows.

- **Factor supplies meet demand:** the basic version of IO analysis assumes that the supply of factors of production (e.g. labour) do not constrain the production of output, and hence the supply of output of a sector will increase to match demand. This assumption may be unrealistic in periods of very high demand, which might cause labour shortage. However, the economy usually operates at the natural rate of employment, which is below the full employment rate; hence, it is reasonable that the increases in the output of sectors, if modest, will not be hindered by a lack of resources.
 - **Relative prices remain constant:** the analysis assumes that the relative prices of sectoral outputs remain constant.
 - **Factor proportions remain the same.** The IO tables used in the analysis do not take into account changes in production processes and technologies that might occur in the economy following the introduction of a new policy, and hence, are static in nature. This assumption might not be unrealistic in the
-

short run, since production technologies for most products do not change significantly over a period of a few years.

A1.3 Data sources

A range of data sources have been used to estimate the indirect economic indicators presented in section 2.3. These are described in the text and summarised in the table below.

Table A1.1 Data sources used for estimates of the indirect impact of the rail sector

Variable	Sector	Source
Output	All	ONS Supply and Use tables
GVA	All	ONS Supply and Use tables
Employment	All	ONS Business Population Estimates
PAYE income tax	UK	HMRC Income tax receipts: analysis by type
Corporation tax liabilities	UK	HMRC receipts
National insurance receipts	UK	HMRC receipts
Average wages	Rail, All	ONS Annual Survey of Hours and Earnings
GDP deflator	UK	ONS

A2 User benefits calculation


When estimating the change in consumer surplus from large changes in price (or large changes in GC), it is necessary to make some assumptions about the shape of the demand curve for rail. Given that this will depend on the precise nature of the smaller rail industry counterfactual, as well as on the nature of every alternative to rail travel, including costs of travel by road, this is a complex task. However, it is possible to make a number of qualitative arguments in this area.

First, as described in the section on congestion, the transfer of rail passengers onto the road network will lead to a reduction in road speeds, and consequently a rise in the time costs of travelling by road. As traffic grows and a greater number of roads approach capacity, congestion is likely to increase more than proportionally to the reduction in rail travel. Given that travelling by road is an alternative to travelling by rail, it is likely that the cost of travelling by rail will have to rise by a proportionately larger amount to price the same number of rail passengers off the network as the rail industry shrinks, because of the increasing feedback from higher road prices.

Second, as the industry shrinks, we would expect that rail demand would become increasingly concentrated on routes/journeys for which road and air are not close substitutes. Examples could include commuting in urban areas, and very long distance travel. With rail passengers concentrated in these areas, increasingly large cost increases may be needed if rail demand is to reduce even further. In line with the road congestion effect, this suggests a non-linearity, with proportionately greater cost increases necessary to discourage passengers as the quantity of rail travel falls.

A mitigating factor to the above two effects is the possibility of changing diversion ratios. The diversion ratios are estimates of the number of passengers coming off rail who will switch to travelling by road, and the number who will no longer travel. Given that, as outlined above, the road network will slow down as increasing numbers of rail passengers switch to road, it is possible that an increasing proportion of those passengers diverting from rail will choose not to travel. This should mitigate the above two effects to some extent, as the speed of the road network may not reduce as fast, and consequently the cost of rail may not need to rise so fast to discourage use.

Given the factors outlined above, we would expect the demand curve for rail to be non-linear. It is quite possible that the cost of reducing rail demand by increasingly large amounts would be disproportionately higher. A precise estimate of the scale of this non-linearity would require sophisticated modelling of the counterfactual, with detailed modelling of the separate parts of the UK transport network in the absence of a rail industry (or with a greatly reduced rail industry). Given the uncertainties involved, and the lack of evidence of what such a large change would involve in current conditions, this approach has not been attempted. We therefore present a stylised estimate for illustrative purposes, which assumes that the loss of consumer surplus in the 50% and 100% scenarios would increase linearly from the 10% scenario. The implication of this linear cost approach is that the demand curve is slightly non-linear. Given the qualitative arguments above, the non-linearity could be more pronounced in reality, and, if so, our 50% and 100% user benefits calculations would be underestimates of the true values. However, we do not have enough evidence to know whether and to what extent that would be so, or indeed whether, on balance, the non-linearity could work the other way to some degree.



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