What is the economic contribution of rail in Scotland?

Prepared for Transport Scotland and the Rail Delivery Group

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What is the contribution of rail to the Scottish economy?

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The rail industry and its supply chain:

contribute up to **£670 MILLION** in gross value added per year

EMPLOY UP TO **13,000 PEOPLE**

PROVIDE TAX RECEIPTS OF UP TO **£290 MILLION**

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

£1 BILLION PER YEAR

The rail sector leads to up to:

£64 MILLION

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

up to £26 MILLION

in increased output due to reduced transport costs

Rail delivers environmental benefits, reducing CO_2 by up to

0.5 MILLION TONNES

Rail leads to reduced road congestion, resulting in up to **£241 MILLION** **in travel time savings per year**

Rail is one of the safest ways to travel, preventing up to **89** **serious casualties and fatalities per year**

Source: Oxera.

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Executive summary

The rail sector has an important role in providing employment and ensuring long-term benefits to the Scottish economy. This report quantifies this whole-industry impact for the first time, presenting a variety of metrics that demonstrate the sector's contribution today, and how that contribution has increased since devolution of rail powers to the Scottish Government in 2005. The report builds on Oxera's work for the Rail Delivery Group in 2014 and 2015 on the contribution to the UK economy of the GB rail sector.

Economic footprint of the Scottish rail sector

The economic footprint is the scale of a sector in terms of the activities that are involved in producing goods and services in that sector (as opposed to the net benefits those goods and services provide). This can be measured in different ways. In this analysis we consider three measures: gross value added (GVA), employment, and tax receipts.

GVA indicates the value of outputs created by the industry, less the costs of inputs purchased.[1] Oxera has calculated the Scottish rail sector GVA as **£668m**[2] a year. This is made up of £462m of direct GVA from the rail sector itself and £206m of indirect GVA, which comes from firms supplying the rail sector.

The level of employment in a sector is a key aspect of its economic contribution. Direct employment figures have been sourced from data provided by Transport Scotland and RDG. 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 **12,800** employees. This is made up of 9,200 direct employees and 3,600 indirect employees.

We estimate the contributions from three of the largest tax bases: PAYE income tax, corporation tax, and a high-level estimate of other tax receipts.[3]

The results suggest that the Scottish rail sector and its supply chain contribute:

- **£131m** in PAYE income tax and National Insurance contributions (NICs);
- **£13m** in direct and indirect corporation tax payments;
- **£148m** in other direct and indirect tax receipts.

This gives a total estimated tax contribution of the Scottish rail sector and its supply chain of **£292m**.

User benefits

Rail users are the most direct beneficiaries of the services that the rail sector provides. In order to quantify the user benefits, and the wider benefits in the following section, it is necessary to specify a 'counterfactual'.[4] The impact on users is measured by comparing this counterfactual against the status quo. 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

[1] GVA plus taxes on products minus subsidies on products equals gross domestic product (GDP).
[2] All figures are in 2014/15 prices unless stated otherwise.
[3] 'Other taxes' include capital gains tax, VAT, fuel duties, and any other tax that is not corporation tax, PAYE income tax or NICs.
[4] The 'counterfactual' is the scenario where the rail industry is smaller. The impact on users can then be measured by comparing this counterfactual against the status quo.

absence of the rail sector (i.e. 100% lower traffic volumes). The results suggest that:

- the total user benefits per year are between **£101m** and **£1,014m**. 94% of this figure is comprised of benefits to passengers, while the remainder is comprised of benefits to freight users;
- the benefits to passengers can be split between different types of users, with 47% accruing to commuters, 27% accruing to business passengers, and 26% to leisure travellers.
- the Scottish rail sector contributes between **£6m** and **£65m** in freight benefits.

Wider economic impacts

Wider economic impacts arise when there is 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.

We estimate a range of wider economic impacts of the rail sector using established transport economics techniques. These benefits take the form of increased clustering of businesses, reduced congestion on the road network and increased output. Oxera estimates that these are worth between **£64m** and **£652m** to the Scottish economy.

Environmental and social impacts

The environmental and social impacts of the rail sector are important components of the sector's overall impact on Scotland. This analysis has highlighted that the rail sector makes a significant contribution to reducing greenhouse gas emissions. The reduction is worth between **£3m** and **£30m** per year. The sector also has an important role in reducing the number of accidents on roads. We calculate that rail travel prevents up to 89 fatal and serious accidents on the road network.

Performance of the Scottish rail sector since devolution

Rail passenger demand (measured by journeys and passenger kms) has shown a large increase since devolution of powers to the Scottish Government in 2005. Freight performance has been more mixed, with a spike in volumes moved in 2005/06 influenced by the movement of minerals, predominantly coal. Subsequent years have seen rapidly declining volumes of coal being transported for the energy supply industry, albeit offset by growth in intermodal markets.

Financially, the rail sector in Scotland has seen significant revenue growth since 2005, both in absolute terms and per passenger. This, alongside increased industry efficiency, has given successive governments confidence to invest to support new infrastructure and services across the network. Net Government funding[5] to the Scottish rail sector in 2013/14[6] was £716m. This analysis demonstrates that the railway in Scotland provides £1bn in user benefits and £331m in wider economic benefits.

[5] From the Scottish and Westminster Parliaments.
[6] Office of Rail and Road (2015), 'GB rail industry financial information 2013-14', February.

1 Introduction

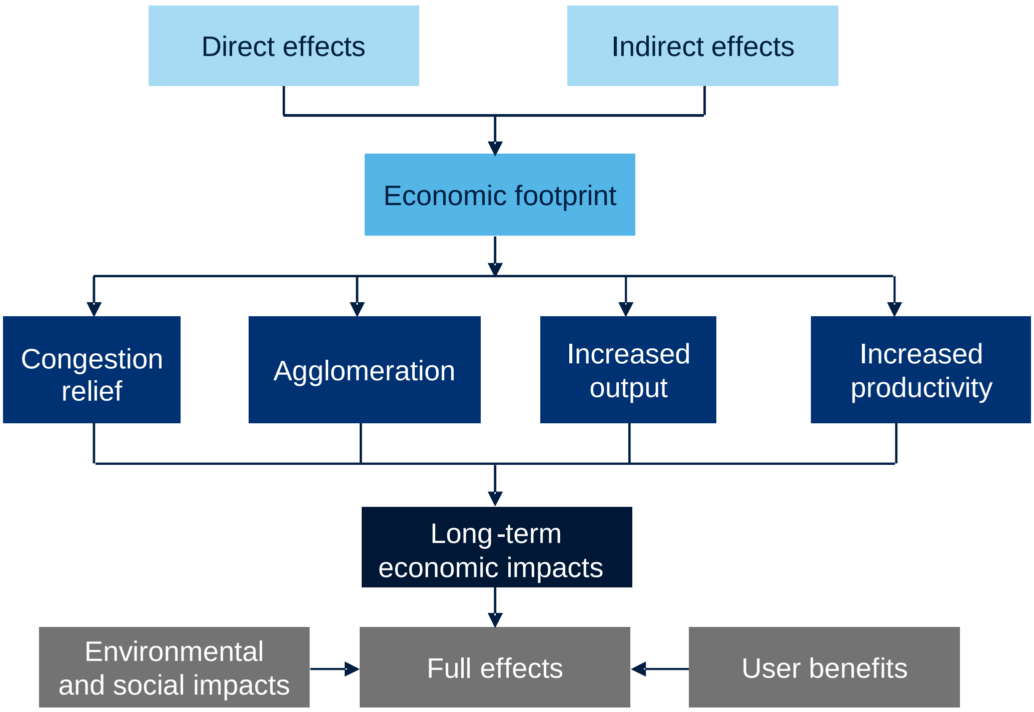
The rail sector has an important role in providing employment and ensuring long-term benefits to the economy. Oxera's 2014 study commissioned by the RDG provided a quantified assessment of the economic benefits of the GB rail sector to the UK economy.[7] This analysis was then updated for 2015.[8]

Subsequently, the RDG and Transport Scotland have commissioned Oxera to provide an independent assessment of the role of the Scottish rail industry and its contribution to the Scottish economy.

As with Oxera's previous analysis of the GB rail sector, this 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 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 1.1.

Figure 1.1 Conceptual framework



Source: Oxera.

[7] Oxera (2014), 'What is the contribution of rail to the UK economy?', July.
[8] Oxera (2015), 'What is the contribution of rail to the UK economy?', September.

1.1 Background to the Scottish Rail sector

1.1.1 Organisation of the industry

As with the rest of Great Britain, passenger rail services are predominantly provided through franchises. Scotland's main rail franchise, the ScotRail franchise, is run by Abellio with a ten-year agreement starting in April 2015. From this agreement emerged the ScotRail Alliance—a formal agreement between Abellio ScotRail and Network Rail to work collaboratively to ensure best performance.

The Caledonian Sleeper services have historically been let as part of the ScotRail franchise. However, from April 2015 the service has been let as part of a separate franchise, with Serco chosen as the first franchisee.

Scotland is one of eight strategic routes managed by Network Rail. The rail network in Scotland is subject to the same spending control and economic regulation as in England and Wales, except that Scottish Ministers take the place of the Westminster Government in publishing the High Level Output Specification (HLOS) and Statement of Funds Available (SoFA). The Office of Rail and Road (ORR) maintains regulatory responsibility for the whole of Great Britain, and the regulatory settlement for Scotland is published as part of the consolidated GB regulatory determination. The Scottish Government also issues guidance to the ORR, outlining its objectives for the Scottish railways.[9]

Network Rail was reclassified as a central government body in September 2014, primarily reflecting statistical European accounting standards. As a consequence of this reclassification, the Scottish Ministers have a formal role in a range of matters relating to Network Rail's finances and governance as they affect the Scottish route, which is enabled by a Memorandum of Understanding (MoU) between the Scottish Ministers and the UK Department for Transport (DfT). This includes senior appointments and business planning. Aligned to the MoU is a separate debt limit to cover Network Rail's borrowing requirements for Scotland for Control Period 5 (CP5), which provides safeguards around Scotland's investment programme committed to 2019.

1.1.2 Devolution of powers

Devolution of transport policy has been an ongoing process since the Scotland Act 1998, which originally established the Scottish Parliament and divided legislative powers between the UK Parliament (known as reserved powers) and Scottish Parliament (devolved powers). The provision of railway services is generally a reserved power held by the Westminster Government, except where rail services start and end in Scotland.[10]

There are a number of key pieces of legislation from which devolved powers are derived, including the Railways Act 1993 and the Railways Act 2005.

The Railways Act 1993 provided devolved powers for the award of the ScotRail franchise (and latterly the Caledonian Sleeper) to the Scottish Government, and empowered the Scottish Government to make grants to railway service providers. The Act reserved financial responsibilities for the Westminster

[9] Transport Scotland (2012), 'The Scottish Ministers' guidance to the Office of Rail Regulation', July, http://www.transport.gov.scot/system/files/documents/guides/The_Scottish_Ministers__Guidance_to_the_ORR_July_2012.pdf.
[10] The Caledonian Sleeper franchise is an exception to this, as it is administered by the Scottish Government.

Government, in particular taking on financial responsibility if the franchisee were to go bankrupt.

The Railways Act 2005 set out the majority of the Scottish Ministers' rail powers. Accordingly, Scottish Ministers assumed responsibility for a number of areas, including:

- setting a strategy for Scotland's railways, incorporating freight and passenger services;
- the role of franchising authority for Scottish franchise agreements. This means specifying which services are to be provided under franchise, and contracting for, managing and funding the provision of these services. The manifestation of these powers is the ScotRail and Caledonian Sleeper franchises;
- specifying and funding outputs for Network Rail in the management (including performance) and enhancement of the infrastructure on the Scottish route;
- issuing non-binding guidance to the ORR, outlining Scottish Ministers' expectations of how the regulator will carry out its duties in Scotland.

In addition to the legislative devolution of powers, there are operational changes that are relevant to the functioning of the industry in Scotland. Most notably, there has been the creation of the Network Rail Scottish operating route as part of a more regionalised approach to network management across Great Britain.

2 Economic footprint

Key findings

- The GVA impact is **£668m**[11] a year. This is made up of £462m of direct GVA from the rail sector itself and £206m of indirect GVA.
- The impact of rail on employment is approximately **12,800** employees. This comprises 9,200 direct employees and 3,600 indirect employees.
- Tax income from the railway is estimated to be **£292m**, of which £131m arises from PAYE income tax and NICs, £13m from direct and indirect corporation tax payments, and £148m in other direct and indirect tax receipts.

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 train operating companies (TOCs), the freight operating companies (FOCs) and Network Rail;
- an **indirect impact**, which measures the value of the resources in the domestic (i.e. within Scotland) 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.

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.

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 Scottish Government's Analytical IO tables.[12]

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.[13]

2.1 Impact of the rail sector

The direct impacts are estimated using industry and company accounts, consultant reports and annual accounts, data from the Scottish Government,

[11] All figures are in 2014/15 prices unless stated otherwise.
[12] See Office for National Statistics, 'Input-Output UK National Accounts', http://www.ons.gov.uk/ons/guide-method/method-quality/specific/economy/input-output--uk-national-accounts/index.html, accessed 26 June 2014.
[13] These tables were published in 2013.

Transport Scotland and the Office for National Statistics (ONS). More detail for each of the indicators is provided in the following sub-sections.

2.2 GVA

GVA indicates the value of outputs created by the industry, less the costs of inputs purchased.[14] 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.

The direct contribution of the rail sector, in terms of its GVA, is recorded in the national accounts produced by the Scottish Government. For the purposes of this assessment, the rail sector is defined as comprising the Standard Industrial Classification (SIC) class 'Rail transport services' (SIC 49.1-2).

Based on discussions with the ONS, Oxera understands that part of the class 'Warehousing and support services for transportation' (SIC 52) contains the activities of Network Rail.

This second SIC class represents the activities of Network Rail that feed directly into the rail sector as well as other activities. It is important that the outputs from these two SIC codes are not simply added together. Doing so would lead to significant double counting, since the majority of Network Rail's output would be sold directly into the rail industry, meaning it would be counted as both direct and indirect rail sector output.

Instead, we estimate Network Rail's contribution to the rail industry. This is estimated as being worth £142m of direct GVA based on the split of Network Rail's activities.[15] We allocate this to direct GVA for the rail sector.

The total (direct plus indirect) GVA for the rail sector is calculated based on the IO modelling described above. Direct GVA is taken directly from the Scottish National Accounts with the adjustment for Network Rail described above. Indirect GVA is total GVA less direct GVA.

Oxera has calculated rail sector GVA as **£668m** a year, in 2014 prices. This is made up of £462m of direct GVA and £206m of indirect GVA.

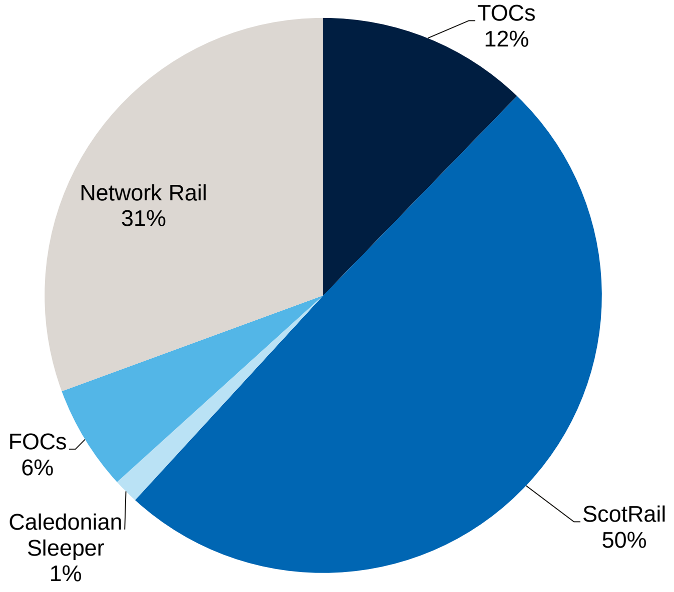
2.3 Employment

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.

Data from Transport Scotland and RDG suggests that there are around 9,200 direct FTE employees in the Scottish rail sector. The majority of the employment is accounted for by the ScotRail TOC and Network Rail, accounting for 50% and 31% of direct employment, respectively.

[14] GVA plus taxes on products minus subsidies on products equals gross domestic product (GDP).
[15] Network Rail is included in SIC class 52 among other non-rail activities. We have 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. Based on the Network Rail regulatory accounts, we have assumed that 89% of its contribution is direct GVA (£142m). A similar approach to incorporating SIC 52 is used in other calculations in this section.

Figure 2.1 Breakdown of direct employment in the Scottish rail sector in 2015



Note: TOCs include TransPennine Express, Virgin Trains East Coast, Virgin Trains West Coast and CrossCountry Trains. FOCs include Great Britain Rail Freight, Direct Rail Services, Deutsche Bahn Schenker Rail and Freightliner.

Source: Transport Scotland and RDG.

To estimate the total employment of the rail supply chain, it is aggregated into groups for which employment data for Scotland is available from the ONS's Business and Employment Register dataset. The level of total employment is then calculated based on average labour productivity across Scotland for each sector.

Direct employment has been sourced from data provided by Transport Scotland and RDG. 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 **12,800** employees. This is composed of 9,200 direct employees and 3,600 indirect employees.

2.4 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. We estimate the contributions from three of the largest tax bases: PAYE income tax, corporation tax, and a high-level estimate of other tax receipts.

2.4.1 PAYE income tax

PAYE income tax receipts from the Scottish rail sector are estimated using the share of Compensation of Employees (COE) in the rail industry supply chain. COE is a component of GVA[16] which relates to wages, salaries and pension contributions. Given that PAYE income tax and NICs are based on returns to labour, it is reasonable to assume that these tax receipts should be closely correlated. We estimate COE by sector across the whole economy from the I-O

[16] Under the income approach to measuring GVA.

modelling. We then estimate the total amount of COE for the rail supply chain on the basis of its share of GVA in each sector. Finally, we assume that the share of PAYE income tax and NICs is proportionate to COE.

The results suggest that the Scottish rail sector and its supply chain contribute **£131m** annually in PAYE income tax and NICs, in 2014 prices.

2.4.2 Corporation tax

It is also possible to use the share of gross operating surplus (GOS)[17] to estimate the corporation tax paid by the Scottish Rail sector. Like COE, GOS is part of the GVA income received by owners of capital and includes profits earned by companies. As a result, we would expect the amount of GOS to be closely linked to corporation tax.

The results suggest that the Scottish rail sector and its supply chain contribute **£13m** in direct and indirect corporation tax payments.

2.4.3 Other taxes

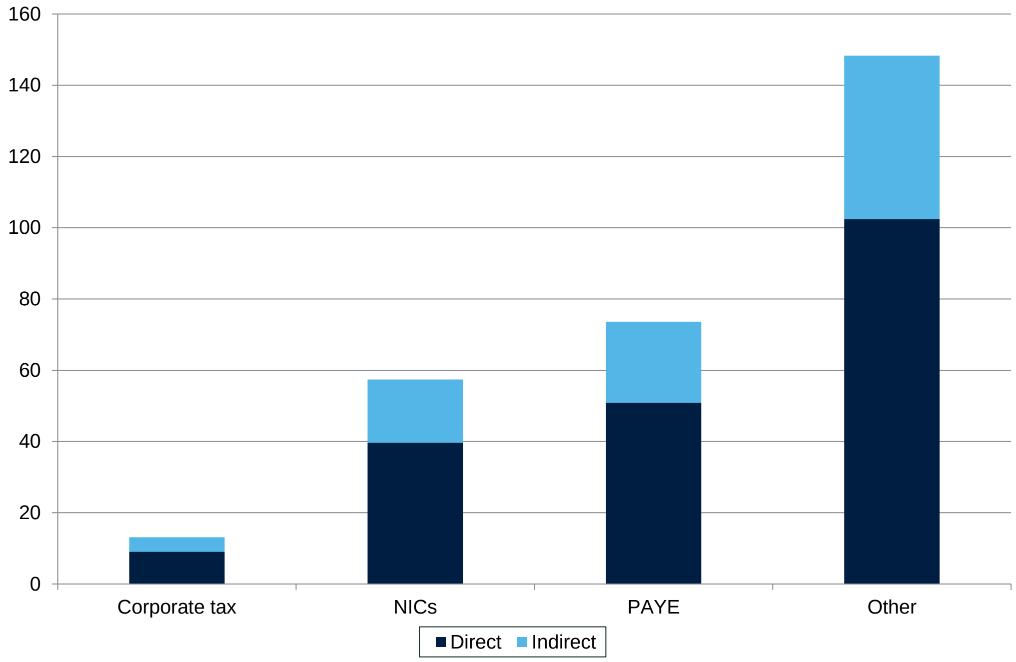
The rail industry also makes significant contributions to other tax receipts, including VAT, national non-domestic rates (business rates) and excise duties. As many of these other taxes are levied on transactions or specific assets, it is difficult to provide a robust estimate of receipts based on data in the sector accounts. Using data from the Government Expenditure and Revenue Statistics (GERS) for Scotland,[18] we estimate that these other receipts for Scotland total £25bn. Assuming that the rail industry and its supply chain contribute to other taxes and duties in line with its contribution to overall Scottish GVA, this would add another £148m in direct and indirect tax receipts.

This gives a total estimated tax contribution of the Scottish rail sector and its supply chain of **£292m**.[19]

Oxera's estimates for the direct and indirect tax receipts from the rail sector are shown in the figure below.

[17] GOS is the portion of income derived from production that is earned by the capital factor.
[18] The Scottish Government (2014), 'Government Expenditure and Revenue Scotland', http://www.gov.scot/Topics/Statistics/Browse/Economy/GERS/GERS2014xls, accessed 4 December 2015.
[19] This is total tax collected by all UK tax-collecting agencies.

Figure 2.2 Direct and indirect tax contribution from rail (£m, 2014)



Source: Oxera.

2.5 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 indication of the importance of the sector. The table below shows the results of the analysis presented in this section.

Table 2.1 Economic footprint results

Impact	Total	Direct	Indirect
Employees	12,798	9,240	3,558
GVA (£m)	667.9	461.5	206.4
Tax (£m)	292.4	202.1	90.4

3 User benefits

Key findings

- Total user benefits per year are between **£101m** and **£1,014m**, of which 94% is passenger benefit and 6% is benefit to freight users.
- 47% of the benefits to passengers (between **£95m** and **£949m**) accrue to commuters, 27% to business passengers, and 26% to leisure travellers.[20]
- The Scottish rail sector contributes between **£6m** and **£65m** in freight benefits.

Section 2 outlined the economic footprint of the rail sector on the Scottish economy. However, as also explained above, 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 impact of that sector on the productivity of other sectors of the economy (see section 4).[21]

3.1 Determining an appropriate counterfactual

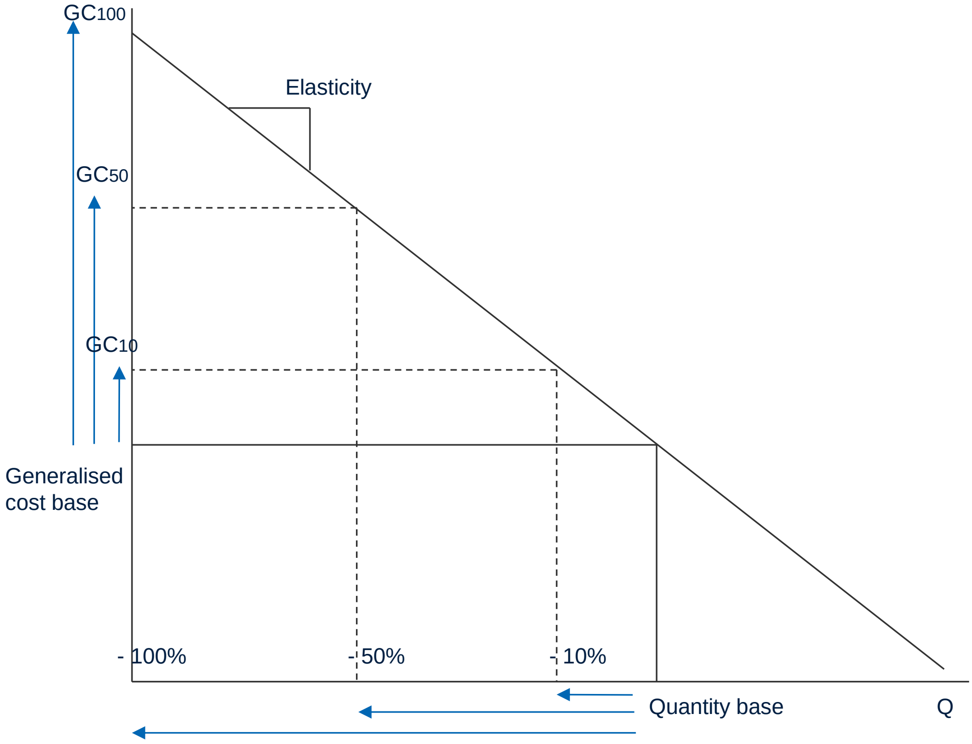
In order to quantify the user benefits, and the wider benefits in the following section, it is necessary to specify a counterfactual. In standard economic appraisal, one would typically consider a counterfactual where an entity does not exist in order to calculate the economic impact. However, while 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 would be removed.[22] 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 rail is currently providing in Scotland. Figure 3.1 below shows the demand curve, which illustrates the relationship between costs and demand.

[20] The user benefits have been apportioned out between commuters, business passengers and leisure passengers, using data on the relative proportions of these three groups in Scotland from the National Rail Travel Survey. Department for Transport in association with Transport Scotland (2010), 'National Rail Travel Survey: Overview Report', December, Table 4. https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/73094/national-rail-travel-survey-overview-report.pdf.
[21] This is similar to the approach adopted by the DfT in its appraisal guidance—WebTAG—and to the Scottish appraisal guide—STAG.
[22] Even if there were no rail, there is a possibility that there would be a comparable alternative that would produce comparable user benefits.

The figure demonstrates how increases in costs are associated with decreases in demand.

Figure 3.1 Demand function and cost increase



Source: Oxera.

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)[23] 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.[24] We used a financial cost increase for the freight traffic calculations, as a relevant GC elasticity for freight traffic could not be obtained.

In the calculation for passenger benefits, we also distinguished between passengers, broken down by journey purpose between commuter, business and leisure.[25] 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

[23] Generalised cost is the sum of the monetary and non-monetary costs of a journey.
[24] For example, a GC elasticity of -0.8 implies that a 10% increase in the GC would lead to an 8% reduction in demand.
[25] The average commuter, business and leisure fare was estimated using results from the National Rail Travel Survey: Department for Transport in association with Transport Scotland (2010), 'National Rail Travel Survey: Overview Report', December, https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/73094/national-rail-travel-survey-overview-report.pdf.

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 and Scottish Transport Statistics reflecting current guidance on value of time.[26] Using GC elasticities, which are based on fare and journey time elasticities from the Passenger Demand Forecasting Handbook (PDFH),[27] we calculate that GC would need to increase by approximately 9.62% to reduce passenger rail journeys by 10%.[28,29] The GC 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.

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 paying. The consumer therefore benefits from paying less than they were actually willing to pay. In 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:

- 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.[30]

Based on the GC changes discussed above, the loss in passenger user benefits, for those who continue to travel using rail, would be £90m a year in the 10% scenario.

The loss in consumer surplus for passengers who no longer travel by rail is £5m 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.

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 Scottish

[26] Average fares were calculated using Scottish data on fares per journey, UK data and passenger revenues by ticket type from the ORR, to calculate the fares for commuting, business and leisure.
[27] Association of Train Operating Companies (2013), 'Passenger Demand Forecasting Handbook, v5.1', April.
[28] We assume that passenger journeys in each category (business, leisure, and commuting) reduce proportionally.
[29] There are a number of knock-on effects that such a reduction could have (e.g. on crowding and punctuality of trains). This analysis does not consider these dynamics for reasons of simplicity.
[30] 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.

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.

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 **£95m** 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 £474m in the 50% scenario and £949m 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.

Table 3.1 gives the user benefits of rail for different passenger types and the different scenarios.

Table 3.1 Passenger user benefits (£m)

	Scenario		
	10%	**50%**	**100%**
Commuting	44	222	444
Business	26	128	257
Leisure	25	124	248
Total	**95**	**474**	**949**

Note: Numbers may not sum due to rounding. The user benefits have been apportioned out between commuters (59%), business passengers (11%) and leisure passengers (30%), using data specific to Scotland from the National Rail Travel Survey. Oxera used a generalised cost elasticity, which was based on fare and generalised journey time elasticities from the Passenger Demand Forecasting Handbook. The generalised cost elasticity is equal to -1.04, which indicates that a 10% increase in the generalised cost leads to a 10.4% reduction in demand. An increase in the generalised cost may occur due to a combination of fare rises and/or longer generalised journey times.

Source: Oxera analysis.

3.2.1 Freight user benefits

Oxera has used a similar methodology as described above 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 -1.3 was applied to determine the increase in cost necessary to price 10% of freight away from rail, which showed that a cost increase of 7.69% was needed.[31]

Based on these assumptions, the loss in consumer surplus for freight users who continue to transport goods by rail would be £6m a year in the 10% scenario and £61m in the 100% scenario. The loss in consumer surplus from not continuing

[31] MDS Transmodal (2012), 'Impact of changes in track access charges on rail freight traffic', February.

on rail is £0.3m in the 10% scenario. As in the passenger calculations, the welfare gain from switching from rail under the alternative choice is not clear, and has not been quantified.

Therefore, the total annual loss of consumer surplus for freight users is approximately **£6m** in the 10% scenario, **£32m** in the 50% scenario, and **£65m** in the 100% scenario.

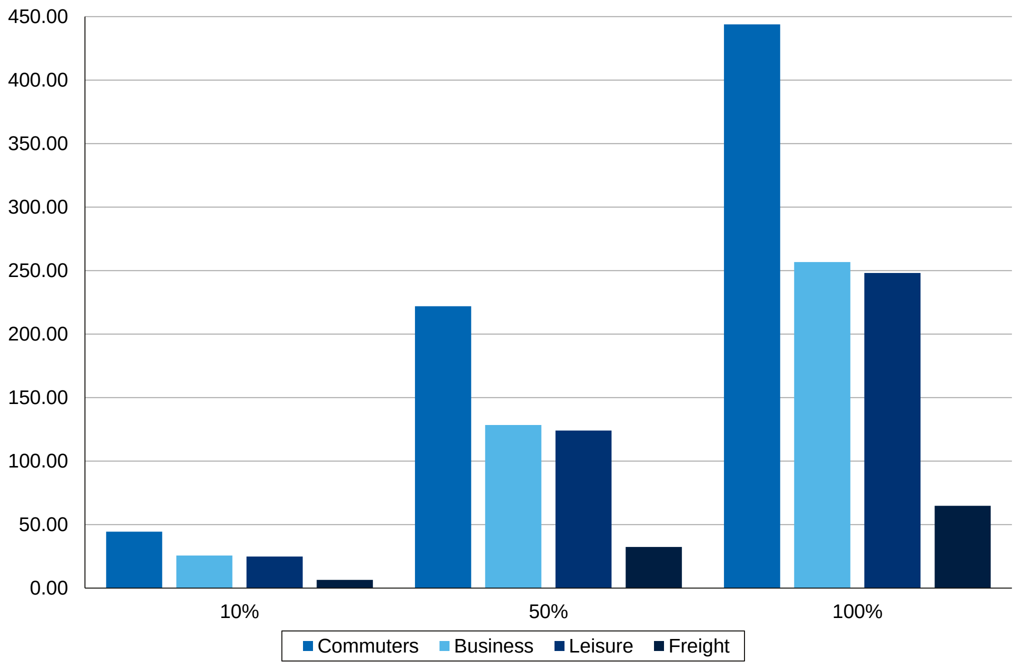
3.3 Summary

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

Oxera has estimated the benefits of rail travel to users against a range of counterfactual scenarios. The results suggest that:

- the total user benefits per year are between **£101m** and **£1,014m**. 94% of this figure is comprised of benefits to passengers, while the remainder is comprised of benefits to freight users;
- the benefits to passengers can be split between different types of users, with 47% accruing to commuters, 27% accruing to business passengers, and 26% to leisure travellers;
- the Scottish rail sector contributes between **£6m** and **£65m** in freight benefits.

Figure 3.2 User benefits per scenario (£m)



Source: Oxera analysis.

Table 3.2 Total user benefits (£m)

	Scenario		
	10%	**50%**	**100%**
Commuting	44	222	444
Business	26	128	257
Leisure	25	124	248
Freight	6	32	65
Total	**101**	**507**	**1,014**

Note: Numbers may not sum due to rounding.

Source: Oxera analysis.

4 Wider economic impacts

Key findings

- The total wider economic impacts of rail in Scotland are between **£32m** and **£331m**, comprising:
  - reduced congestion on the road, which has a monetary benefit of between £23m and £241m;
  - the agglomeration effect, i.e. the productivity increase because of a decreased travel time to work, which is between £6m and £64m;
  - the increased output benefit, which is equal to between £3m and £26m.
- Total impacts include the business passenger benefits and the freight user benefits, which amount to a **total impact on the economy** of between **£64m** and **£652m**.

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

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. 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 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 both urban and rural areas that would result from a reduction in 10%, 50% and 100% of passengers on the rail network.[32] 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. These percentages apply to urban areas.[33] 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.[34] It is assumed that all freight diverted off the rail network would be transported by lorry on the road network.[35]

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 Transport Scotland's national and regional transport models.[36] 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 Scottish economy.

This indicates that the total value of lost time would be **£23m** with a 10% reduction in annual volumes on the network, **£118m** with a 50% reduction, and **£241m** with a 100% reduction. The majority of these costs are incurred in urban areas, where the rail network is denser. 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.

[32] 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.
[33] The diversion ratios in the guidance published by TRL only show (complete) diversion rates from other modes of transport to rail. We have therefore assumed that diversion rates from rail to other modes are equivalent in both directions. For rural areas, the diversion ratios in the literature differ slightly: 80% of passengers divert to road, 6% to air and 14% no longer travel. These diversion ratios are based on results from TRL (2004), 'The demand for public transport: a practical guide', TRL593, Table 9.9 and Table 9.10.
[34] We have assumed that extra road journeys are of equal length to rail journeys, which is likely to be a conservative assumption.
[35] This is consistent with KPMG's assumption in its 2014 report: KPMG (2014), 'Keeping the lights on and the traffic moving: Sustaining the benefits of rail freight for the UK economy'.
[36] This uses average vehicle miles and vehicle speeds across all traffic from Transport Scotland's national and regional transport models to obtain an elasticity of speed with respect to miles.

Table 4.1 Congestion costs, 2014 (£m)

	Scenario		
Sector	**10%**	**50%**	**100%**
Urban	17	89	182
Rural	6	29	59
Total	**23**	**118**	**241**

Note: Numbers may not sum due to rounding.

Source: Oxera analysis.

4.2.2 Agglomeration

Agglomeration describes productivity improvements from firms being located close to one another. The extent of the benefits will depend on the effective density of economic activity—that is, the economic size of a location depends on the number amount of activity in a location and neighbouring areas.[37]

Agglomeration benefits could arise from various sources.[38]

- **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.

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.

Oxera has estimated the agglomeration effect for urban areas, which include all journeys within Scotland, as follows.[39] 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.[40] Commuters who divert to

[37] 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.
[38] Department for Transport (2005), 'Transport, wider economic benefits, and impacts on GDP', discussion paper, July.
[39] The calculation does not include journeys to and from Scotland.
[40] 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.

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 Scotland, to provide an estimate of the reduction in the density of workers, which is equal to a reduction in approximately 2,880 commuters in the 10% scenario. 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 4% increase in productivity.[41]

It is estimated that the cost to Scottish annual GDP of a 10% reduction in passenger traffic as a result of agglomeration effects is **£6m** (in 2014 prices). 50% and 100% reductions in passenger traffic would lead to lost benefits of **£32m and £64m**, respectively, to Scotland's economy (in 2014 prices).

4.2.3 Increased output

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

In most markets, prices are normally higher than marginal costs.[42] 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 that this impact be estimated using a simplified approach, calculating it as a 10% uplift to business user benefits.[43]

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,[44] 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 **£3m** and **£26m** a year using the range of counterfactual scenarios.

4.3 Summary

We have estimated a range of wider economic impacts of the rail sector, as presented in Table 4.2. These benefits take the form of increased clustering of businesses, reduced congestion on the road network and increased output. We estimate that these would be worth between £32m and £331m to the economy.

[41] Calculated using a weighted average of UK agglomeration elasticities by industrial sector. See Department for Transport (2014), 'TAG Unit A2.1: Wider Impacts', January, section 5.3.1, Table 1, https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/427091/webtag-tag-unit-a2-1-wider-impacts.pdf.
[42] 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.
[43] Department for Transport (2014), 'TAG Unit A2.1: Wider Impacts', January, para. 4.1.9.
[44] Department for Transport (2005), 'Transport, wider economic benefits, and impacts on GDP', discussion paper, July, para. 100.

These impacts would all be realised as monetary benefits.

Some of the user benefits considered in section 3 are also realised as monetary benefits; specifically business user benefits and freight benefits. Other benefits of the rail sector estimated in this report have an economic value that can be expressed in monetary terms but would not necessarily be realised as a monetary effect (e.g. individuals saving travel time for leisure journeys). Table 4.2 shows the benefits of the rail sector that would be realised in monetary terms.

Table 4.2 Monetary impacts of the rail sector (£m per year)

	10%	50%	100%
Wider economic benefits			
Reduced congestion (business passengers and freight)	23	118	241
Agglomeration	6	32	64
Increased output	3	13	26
Total wider economic benefits	32	163	331
Other monetary impacts			
User benefits (business passengers only)	26	128	257
Freight benefits	6	32	65
Total monetary impact	**64**	**323**	**652**

Note: Numbers may not sum due to rounding.
Source: Oxera.

5 Environmental and social impacts

Key findings

- Rail saves between **52,434** and **524,337 tonnes** of CO_2 emissions a year. This is valued at between **£3m** and **£30m** a year.
- By removing traffic from roads, the rail sector prevents up to 89 serious or fatal accidents a year.

The previous sections have adopted different approaches to determining the economic impacts 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.

5.1 Environmental impacts

Rail, and the transport sector more generally, has a number of environmental impacts, including on noise, air quality, biodiversity, carbon emissions, and flood risk. Of these various impacts, this section focuses on greenhouse gas emissions.

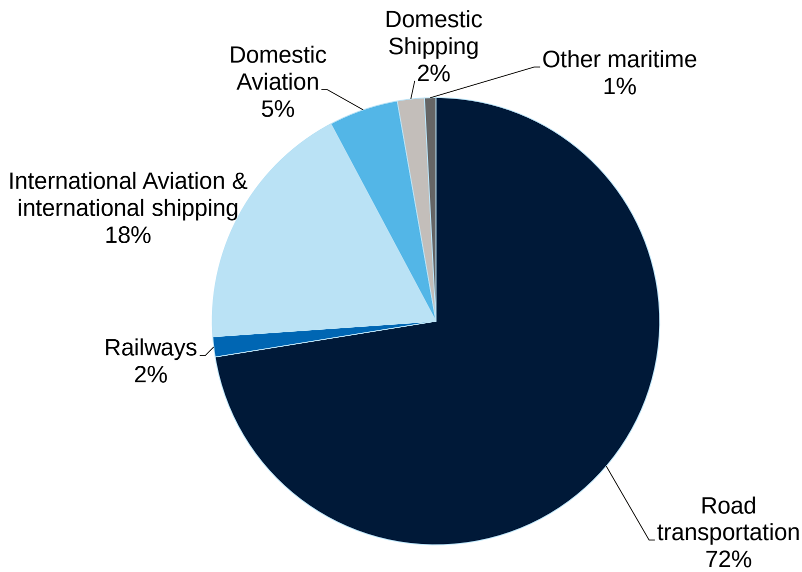
5.1.1 Greenhouse gas emissions

Transport accounted for about 24% of greenhouse gas emissions in Scotland in 2012.[45] The main greenhouse gas, CO_2, accounted for 81% of total transport greenhouse gas emissions in Scotland in 2012.[46]

Although rail has a market share estimated at approximately 7% for freight and 1.4% for passenger traffic,[47] it contributes less than 1.45% of the emissions from the transport sector (i.e. 0.36% of total emissions).[48] This compares favourably with road, which contributes 72% of the emissions from the transport sector and 18% of Scotland's total emissions.[49] A comparison of emissions contributed by rail, road and other modes of transport is illustrated in Figure 5.1 below.

[45] Carbon Account for Transport, from *Greenhouse Gas Inventories for England, Scotland, Wales and Northern Ireland.* See Transport Scotland (2015), 'Chapter 13 – Environment', February, Tables T13.2–13.4, accessed via http://www.transportscotland.gov.uk/statistics/scottish-transport-statistics-no-33-datasets-6495.
[46] Carbon Account for Transport, from *Greenhouse Gas Inventories for England, Scotland, Wales and Northern Ireland.* See Transport Scotland (2015), 'Chapter 13 – Environment', February, Tables T13.2–13.4, accessed via http://www.transportscotland.gov.uk/statistics/scottish-transport-statistics-no-33-datasets-6495.
[47] Freight: by million tonne-km for 2010. See Transport Scotland (2013), 'Scottish Transport Statistics', A National Statistics Publication for Scotland, No 32, 2013 Edition, Figure 3.4, http://www.transportscotland.gov.uk/statistics/j285663-06.htm. Passenger traffic: 2010, see Transport Scotland (2015), 'Summary Chapter – Interactive tables and charts', February, Table S3 SHS, accessed via http://www.transportscotland.gov.uk/statistics/scottish-transport-statistics-no-33-datasets-6495.
[48] Carbon Account for Transport, from *Greenhouse Gas Inventories for England, Scotland, Wales and Northern Ireland.* See Transport Scotland (2015), 'Chapter 13 – Environment', February, Tables T13.2–13.4, accessed via http://www.transportscotland.gov.uk/statistics/scottish-transport-statistics-no-33-datasets-6495.
[49] Carbon Account for Transport, from *Greenhouse Gas Inventories for England, Scotland, Wales and Northern Ireland.* See Transport Scotland (2015), 'Chapter 13 – Environment', February, Tables T13.2–13.4, accessed via http://www.transportscotland.gov.uk/statistics/scottish-transport-statistics-no-33-datasets-6495.

Figure 5.1 UK domestic transport greenhouse gas emissions



Note: Based on 2012 data.

Source: Carbon Account for Transport via Scottish Transport Statistics.

While Figure 5.1 presents the greenhouse gas emissions of the different transport modes, these figures 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 Inverness to Edinburgh by rail, air and road. The CO_2 emitted from rail is 14.6kg, compared with 25.5kg for car and 93.5kg for air.[50] Based on a sample of routes using the EcoPassenger tool,[51] on average a given passenger journey by car will lead to twice the CO_2 emitted by rail, while the same journey by air will lead to nearly three times the amount. Therefore, a shift of traffic from rail to other transport modes, such as road or air, would be likely to lead to an increase in greenhouse gas emissions.

Oxera has quantified the effect of diverting rail traffic to other forms of transport using the same counterfactual scenarios outlined in the previous section. Information on the number of additional car, bus, lorry and plane miles required as a result of 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. This was combined with Scottish Transport Statistics figures of total CO_2 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 of Energy & Climate Change.

The cost of additional carbon emissions is estimated to be **£3m** if rail traffic reduces by 10%, **£15m** if rail traffic reduces by 50%, and **£30m** if rail traffic

[50] 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.
[51] EcoPassenger tool, available at http://www.ecopassenger.org/. An online tool that compares the energy consumption, CO_2 emissions and other environmental impacts for planes, cars and trains in passenger transport.

reduces by 100%. This cost is associated with **increased** CO_2 emissions of between **52,434** and **524,337 tonnes**. Table 5.1 summarises these results.

Table 5.1 Impact of additional carbon emissions

	10% reduction in rail traffic	50% reduction in rail traffic	100% reduction in rail traffic
Increase in carbon emissions ('000 tCO_2)	52.4	262.2	524.3
Increase in environmental costs (£m)	**3**	**15**	**30**

Source: Oxera.

This calculation does not include an estimate of the increased emissions across the road network that would result from additional congestion; nor does it include the associated health benefits of a reduction in carbon emissions. Therefore, the result is likely to be an underestimate of the true cost.

5.2 Social impact

In addition to the economic and environmental impacts of rail reviewed in the previous sections, 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 by increasing opportunities for activities such as education and employment.

In particular, the core social benefit that is considered in this report is a reduction in accidents.[52]

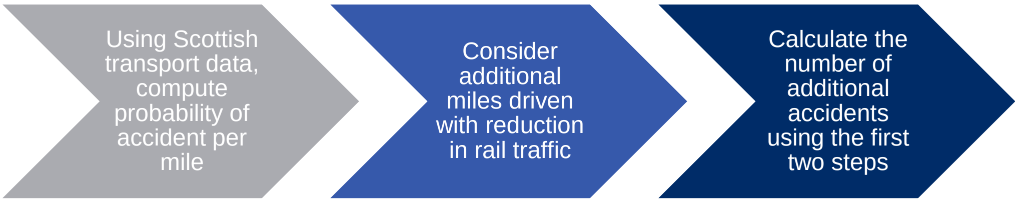
5.2.1 Reduction in accidents

One of the main benefits that rail delivers is a much lower accident rate 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 kms were killed, seriously injured or slightly injured on rail. This compares with 241 individuals per 1bn passengers for cars, 151 for buses/coaches, 62 for vans and 4,415 for motorcycles. The only form of transport (including walking and cycling) with a lower accident rate than rail is air travel.[53]

To estimate the impact of a reduction in rail travel on the number of 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 below sets out the approach for quantifying the impact. The calculation should be interpreted as an order of magnitude rather than a precise quantification.

[52] The DfT also considers other social impacts in its guidance, including journey quality, option value, greater accessibility, physical activity, security, severance, and personal affordability, but these are not considered to be significant in this context and are not discussed further.
[53] 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 the latter ceased operating in January 2014.

Figure 5.2 Approach to accidents quantification



Source: Oxera.

Oxera has used the approach set out in Figure 5.2 to provide an estimate of the benefit of rail in terms of the number of accidents prevented on the road. If the number of journeys made on the rail network were 10% smaller, we estimate that there would be an increase of one fatal accident, eight serious accidents and 41 slight accidents on the road. In total, there would be up to a further 89 fatal and serious accidents on the road in the 100% scenario.[54]

These increases in road accidents would be partly offset by a small decline in rail accidents. If 10% fewer rail journeys were made, there would be approximately three fewer accidents. On the basis of the accident rate for rail traffic, we estimate that a 100% reduction in rail traffic would lead to 32 fewer accidents. However, there is no available accident rate data with a breakdown by severity; therefore, we cannot estimate the net reduction in accidents by severity of accident.

The table below presents the additional accidents on the road for the three scenarios—10%, 50% and 100% reduction in rail traffic—and the estimated decrease in rail accidents.

Table 5.2 Impact of additional accidents

	10% reduction in rail traffic	50% reduction in rail traffic	100% reduction in rail traffic
Additional fatal accidents on road	1	4	9
Additional serious accidents on road	8	40	80
Additional slight accidents on road	41	206	413
Total additional accidents on road	**50**	**250**	**502**
Decrease in rail accidents	**3**	**16**	**32**

Note: Numbers may not sum due to rounding.

Source: Oxera.

5.3 Summary

The environmental and social impacts of the rail sector are important components of the sector's overall impact on Scotland. 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 the road.

[54] Rail prevents up to 89 fatal and serious accidents on the road a year. The total number of accidents, including slight accidents, is 501.

6 Performance over time

Devolution of transport policy has been an ongoing process since the Scotland Act 1998, which originally established the Scottish Parliament. This section examines the overall performance of the rail sector in Scotland, focusing on the period following devolution of power.

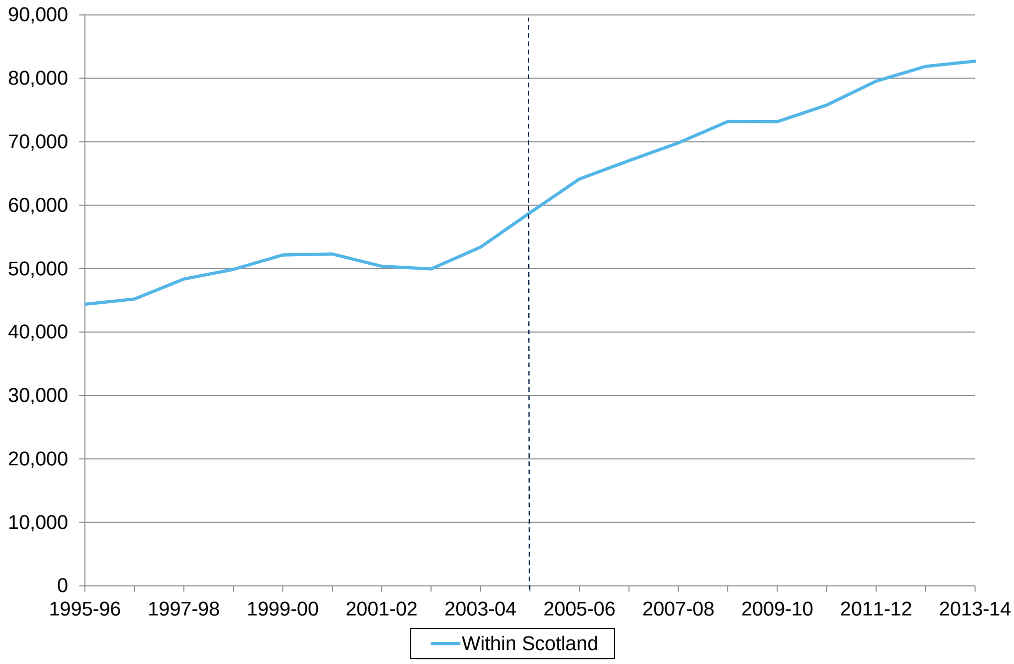
While this section describes the trends in the rail industry since devolution, we do not attempt to attribute causality to this. There are a number of factors that would also contribute to rail passenger demand and freight activity, including economic activity, incomes, fuel prices, population and car ownership.

Given the scope of devolved powers granted under the Railways Act 2005, we use 2005 as our primary reference point for devolution of powers for the purposes of this report. However, as noted in section 1, the devolution of powers has been a gradual process and, in some cases, is operational rather than legislative. As such, pinpointing a single date from which powers over the railways could be definitively labelled 'devolved' is not straightforward.

6.1 Passenger rail demand

The number of passenger journeys taking place entirely within Scotland has shown rapid growth—increasing by 63% since devolution. This also accounts for the majority of rail travel in Scotland (around ten times the number of cross-border journeys) (see Figure 6.1 below).

Figure 6.1 ScotRail passenger journeys ('000)



Source: Transport Scotland.

Figure 6.2 shows passenger journeys with origins or destinations in Scotland over time. Since devolution, the number of passengers starting or ending their journey in Scotland has increased by around 41%.

Figure 6.2 Cross-border passenger journeys (with origins or destinations in Scotland) ('000)

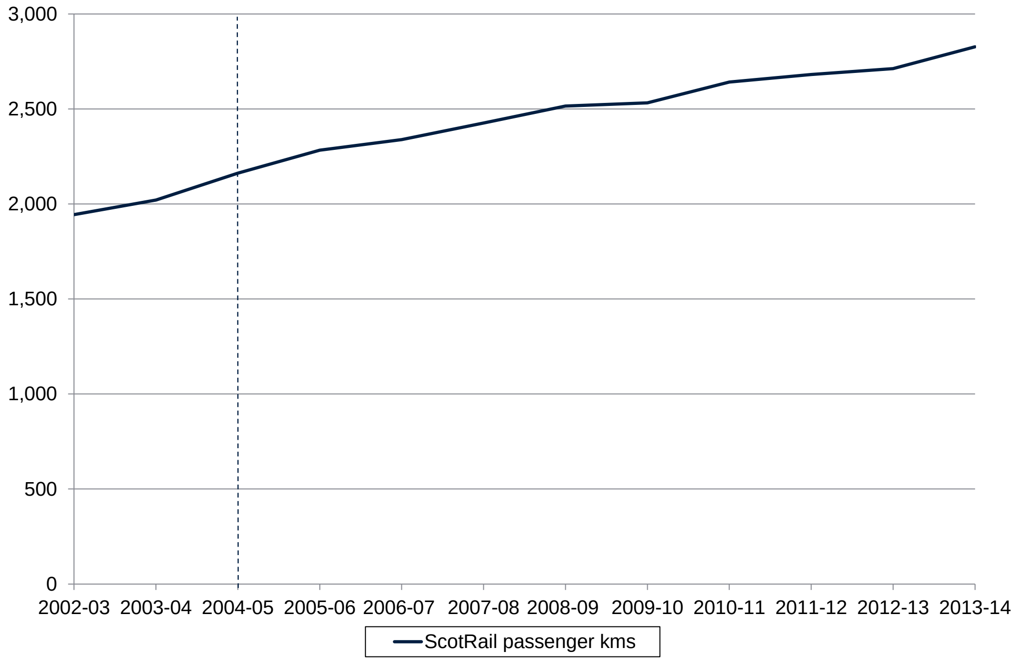
Source: Transport Scotland.

There are a number of factors that influence the demand for rail travel including incomes, the availability of substitute modes of travel (especially cars), the price of alternatives (e.g. fuel prices) and the quality of rail services. Furthermore, long-term economic trends and the distribution of economic activity will affect the overall demand for transport services. The balance of these factors, and therefore the cause of the growth observed in this data, is not straightforward to interpret. The trend for passenger growth does appear to pre-date the powers granted to the Scottish Parliament in 2005, although, as noted above, the transfer of powers has been a gradual process.

Passenger kms provide an alternative metric for measuring passenger rail activity. Unlike passenger numbers, this metric controls for the length of the journey. There is no data available covering journeys within Scotland; however, the ScotRail franchise does provide a proxy, as ScotRail operates entirely within Scotland (see Figure 6.3). By this metric, passenger rail travel has also grown since devolution, although the rate of growth has been lower than the growth in passenger journeys. Passenger kms have increased by 31% since 2004/05.[55] Given the increase in the number of passenger journeys, this suggests a decrease in the average length of journeys.

[55] The data on rail activity and financial performance is available on a financial year basis.

Figure 6.3 ScotRail franchise passenger kms (millions)



Source: Transport Scotland.

6.2 Freight

Figure 6.4 shows the volume of rail freight moved in Scotland over time. The volume of freight transported on the Scottish rail network has seen a significant amount of variation in recent years, particularly for cargoes originating in Scotland. The transport of freight is especially pro-cyclical, meaning that the 2008/09 recession is one other explanation for the decline in freight movements.

Freight performance has been more mixed, with a spike in volumes moved in 2005/06 influenced by the movement of minerals, predominantly coal. Subsequent years have seen rapidly declining volumes of coal being transported for the energy supply industry, albeit offset by growth in intermodal markets.

The data also suggests a large spike in freight lifted between 2005/06 and 2006/07 (shown in Figure 6.4), driven by an increase in exports of minerals and coal from Scotland to the rest of the UK, which itself appears to coincide with a spike in coal-mining activity.[56]

Until 2007, the movement of minerals, predominantly coal, accounted for between 75% and 80% of the total freight market in Scotland. This market share has fallen steadily to below 50% and further decline is expected. This reflects changes in the economics of power generation and environmental legislation, which have reduced the demand for coal for power generation.

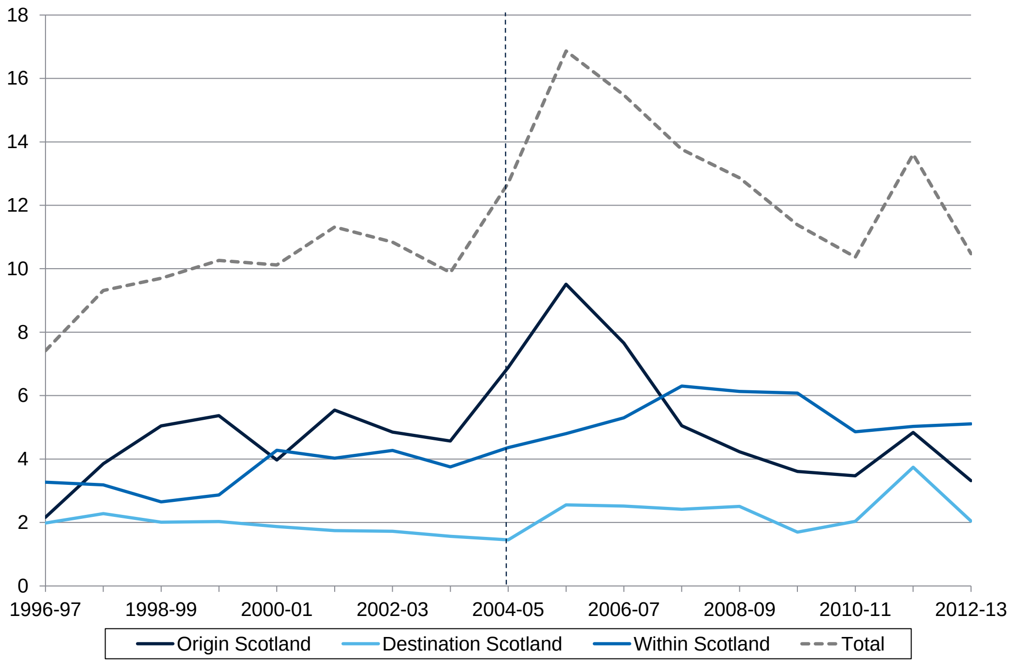
While strong growth in the intermodal market has offset this fall in coal, the net effect is a reduction in the total rail freight market in Scotland of around 40% between 2007 and 2013.

In the period since devolution in 2004/05, the data suggests that rail freight traffic into Scotland increased by 41% while movements within Scotland increased by 17%. However, the peak in freight movements leaving Scotland is also responsible for an overall decline in freight movements of 18% since 2004/05.

[56] British Geological Survey (2009), ‘United Kingdom Minerals Yearbook 2008’.

However, comparing the period before devolution with the period after, suggests an increase in freight traffic.

Figure 6.4 Rail freight moved in Scotland (million tonnes)

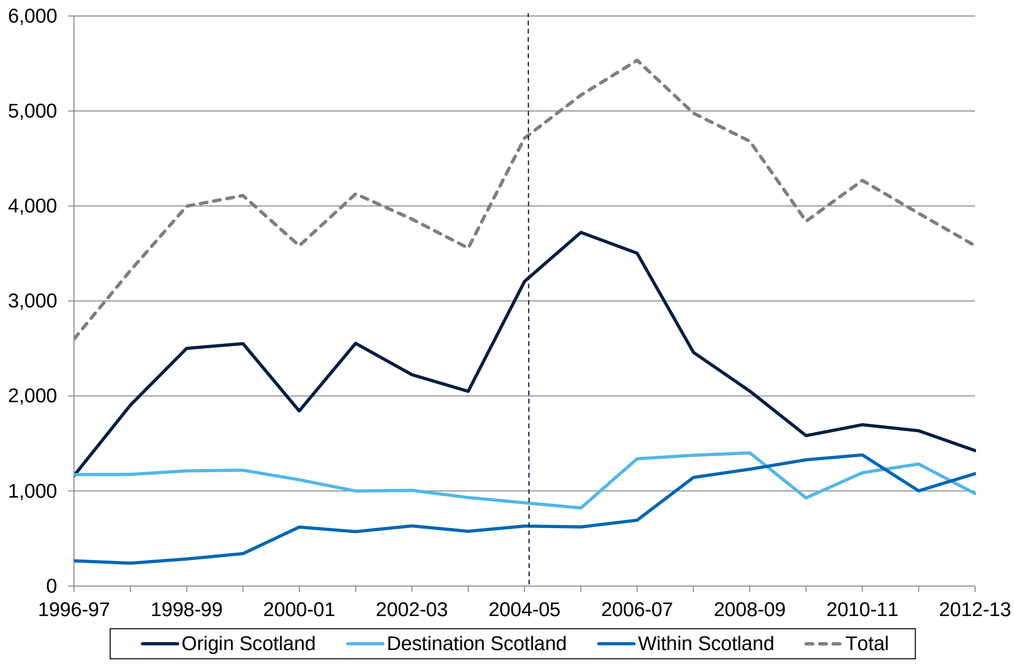


Source: Transport Scotland.

The same spike in freight is evident from the data on freight movements when expressed in tonne kms.[57] This can be seen in Figure 6.5 below. Again, this is driven by an increase in rail freight originating in Scotland and terminating elsewhere in the UK. Freight tonne kms within Scotland grew by 87% from 2004/05 while freight tonne kms originating elsewhere but terminating in Scotland grew by 11%. These increases come despite a drop in freight movements coinciding with the recession.

[57] Tonne kms is measured as the tonnes moved times the kilometres travelled.

Figure 6.5 Rail freight million tonne kms in Scotland



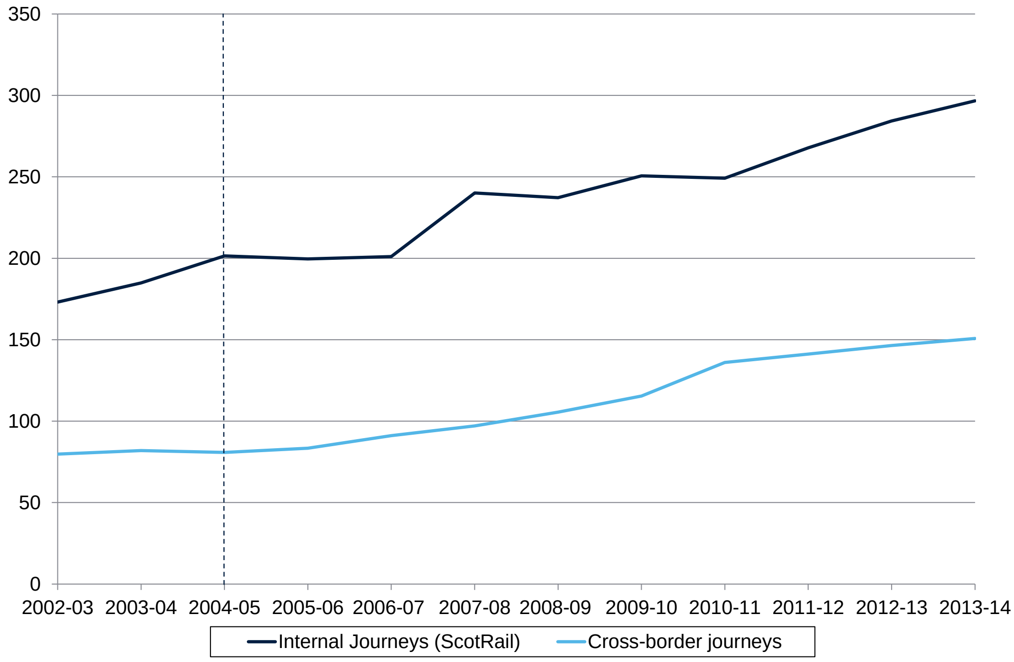
Source: Transport Scotland.

6.3 Financial performance

Passenger revenue doubled between 2004/05 and 2013/14 in nominal terms. Revenue from cross-border journeys grew most quickly, increasing by 132% in nominal terms over the period compared with 83% for internal journeys. Nevertheless, internal journeys account for a much larger share of overall passenger revenue and have therefore contributed more than cross-border journeys to the revenue increase in cash terms.

Revenue growth has been slightly more modest when adjusted for inflation, although overall growth was 59% between 2004/05 and 2013/14 in real terms. Passenger revenues have increased by £165m in total (in 2013/14 prices).

Figure 6.6 Scottish rail passenger revenues (£m)



Source: Scottish Transport Statistics.

It is worth noting that the increase in revenues has also outstripped the growth in passenger journeys and passenger kms, meaning that there has been an increase in both revenue per passenger and revenue per passenger kms. This is show in Table 6.1.

Table 6.1 Passenger journeys and revenue

	Unit	2004/05	2013/14
Total passengers	('000)	63,689	90,669
Total passenger kms (ScotRail only)	(m)	2,162	2,828
Total passenger revenue	£m (2013/14 prices)	282	448
Revenue per passenger	£ (2013/14 prices)	4.43	4.94
Revenue per passenger kms (ScotRail only)	£ (2013/14 prices)	0.09	0.10

Source: Scottish Transport Statistics/Transport Scotland, Office for Budget Responsibility and Oxera calculations.

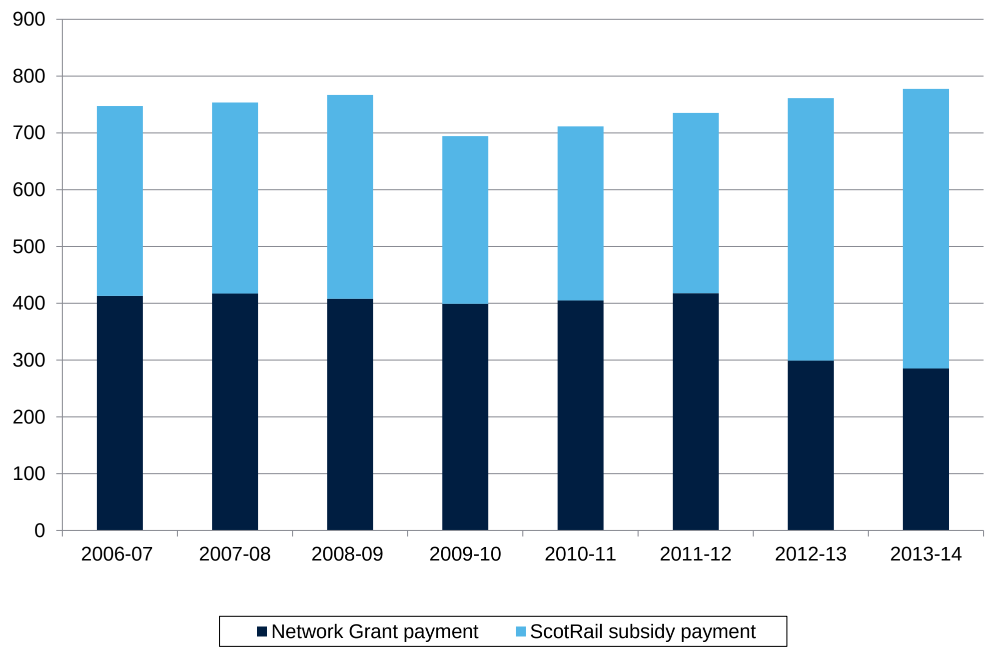
Government support to the rail sector in Scotland primarily comes from payments to franchise operators and infrastructure spending on the network.

Data on government subsidies to the Scottish rail sector is not available for the full period since devolution. However, between 2006/07 and 2013/14 (i.e. the most recent Control Period) the total level of support increased by 4% in real terms. There was a decline in the Network Grant in 2011/12, continuing to the end of Control Period 4. This was part of a wide decrease in the Network Grant at the UK level. In Scotland, the decrease in the Network Grant in this period was offset by an increase in subsidy payment to the ScotRail franchise see (Figure 6.7).

Given the growth in passenger km, this means that the total subsidy (in real terms) per passenger km has decreased by some 14% between 2006/07 and 2013/14.

It is important to note the context of government funding for the rail industry in Scotland (and for that matter in Great Britain more widely). Importantly, the public investment in railway comes during a period of increasing passenger volumes and revenues. Investment in the rail industry is also part of a conscious policy decision by the UK and Scottish Governments to improve infrastructure and services.

Figure 6.7 Scottish Network Grant and ScotRail subsidy (£m)



Note: All figures in real 2014/15 prices.

Source: Transport Scotland.

6.4 Summary

While this section describes the trends in the rail industry since devolution, we do not attempt to attribute causality to this. There are a number of factors that would also contribute to rail passenger demand and freight activity, including economic activity, incomes, fuel prices, population and car ownership.

Rail passenger demand (measured by journeys and passenger kms) has shown large increases since devolution of powers in 2005. Freight performance has been mixed, with declines following the recession as well as a spike in 2005/06 due to a large increase in mineral exports from Scotland. The subsequent decrease in mineral exports has had a substantial impact on overall levels.

Financially, the rail sector in Scotland has seen significant revenue growth since 2005, both in absolute terms and per passenger. Between 2006/07 and 2013/14 (i.e. the most recent Control Period) the total level of support increased by 4% in real terms. Given the growth in passenger km, this means that the total subsidy (in real terms) per passenger km has decreased by some 14% between 2006/07 and 2013/14.

7 Conclusions

This study has quantified the contribution of the Scottish rail industry to the economy. It has considered the economic impact of the industry from different perspectives.

The economic footprint of the Scottish rail sector is significant.

Oxera has calculated rail sector GVA as **£668m** a year, composed of £462m of direct GVA and £206m of indirect GVA.

The rail supply chain is responsible for approximately **13,000** employees. This is made up of 9,000 direct employees and 4,000 indirect employees.

We estimate that the Scottish rail sector and its supply chain contribute **£131m** in PAYE income tax and NICs, **£13m** in direct and indirect corporation tax payments, and £148m in other direct and indirect tax receipts.

This gives a total estimated tax contribution of the Scottish rail sector and its supply chain of **£292m**.

Rail users are the most direct beneficiaries of the services that the rail sector provides. Oxera has estimated the benefits of rail travel to users against a range of counterfactual scenarios. The results suggest that:

- the total user benefits per year are between **£101m** and **£1,014m**, with 94% of benefits going to passengers and 6% of benefits going to freight users;
- the benefits to passengers can be split between different types of users, with 47% accruing to commuters, 27% to business passengers, and 26% to leisure travellers;
- the Scottish rail sector contributes between **£6m** and **£65m** in freight benefits.

We have also considered a range of wider economic impacts of the rail sector. These benefits take the form of increased clustering of businesses, reduced congestion on the road network and increased output. Oxera estimates that these would be worth between **£64m** and **£652m** to the economy.

The environmental and social impacts of the rail sector are important components of the sector’s overall impact on Scotland. This report has highlighted that the rail sector makes a significant contribution to reducing greenhouse gas emissions. The reduction is worth between **£3m** and **£30m** per year. The sector also has an important role in reducing the number of accidents on roads.

While we do not attempt to attribute causality, we do observe that the rail sector in Scotland has seen significant growth in demand since devolution. This is most evident in the passenger sector, where demand (measured by journeys and passenger kms) has increased significantly. Freight performance has been mixed, with declines following a spike in 2005/06 due to a large increase in mineral exports from Scotland.

Financially, the rail sector in Scotland has seen significant revenue growth since 2005, both in absolute terms and per passenger. Government funding into the sector via the Network Grant and subsidy to the ScotRail franchise has increased in real terms.

Oxera estimates £1bn in user benefits and £331m in wider economic benefits in the context of net government funding to the Scottish rail sector of £716m in 2013/14.[58] Oxera's analysis demonstrates that the railway in Scotland provides significant benefits to users and non-users in excess of the subsidy to the rail sector.

[58] Office of Rail and Road (2015), 'GB rail industry financial information 2013-14', February.

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