

THE ECONOMIC FOOTPRINT OF RAILWAY TRANSPORT IN EUROPE

Client: Community of European Railway and Infrastructure Companies (CER)



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Final report

Client: **Community of European Railway and Infrastructure Companies (CER)**
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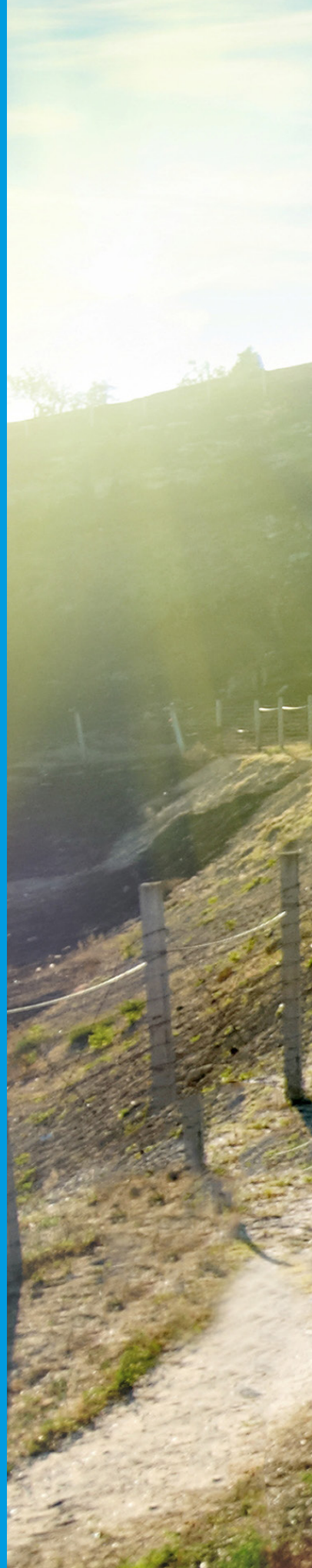




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DISCLAIMER

The opinions expressed in this document are the sole responsibility of the author and do not necessarily represent the official position of the Community of European Railway and Infrastructure Companies (CER).

OVERVIEW: THE ECONOMIC FOOTPRINT OF RAILWAY TRANSPORT IN EUROPE

1. RAILWAYS ARE AN ESSENTIAL MEANS OF TRANSPORT

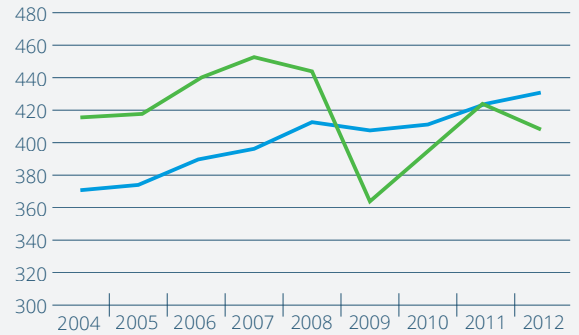
9 BILLION
passenger trips in the EU in 2012

Total length of railway tracks
>220,000 km

over 405 billion tonne-kilometres

and over 420 billion passenger-kilometres per year

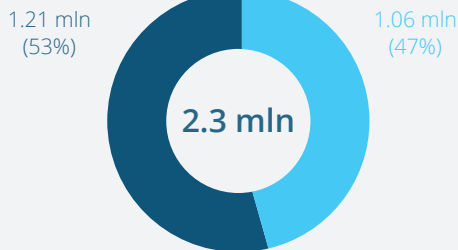
DEVELOPMENT OF PASSENGER/TONNE KILOMETRES IN THE EU



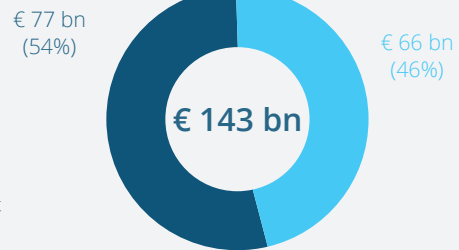
■ Billion passenger-kilometre ■ Billion tonne-kilometre

2. CREATING NUMEROUS JOBS AND VALUE ADDED

NUMBER OF PERSONS EMPLOYED (EMPL)



GROSS VALUE ADDED (GVA)



■ Direct ■ Indirect

ONE  job in railway transport creates

more than **ONE**  other job in for example:

- Manufacturing
- Accounting
- Market research
- Advertising
- Financial services
- Food services
- Wholesale trade
- Building services
- etc.

Rail transport creates more value added than air or water transport

COMPARISON OF SIZE OF THE DIRECT GROSS VALUE ADDED OF DIFFERENT TRANSPORT MODES IN 2011



Air transport: passenger and freight transport by air, including operation of airports

Water transport: maritime and inland waterway transport of passenger and freight, including operation of ports

3. HELPING COMMUTERS, BUSINESSES AND INDUSTRY

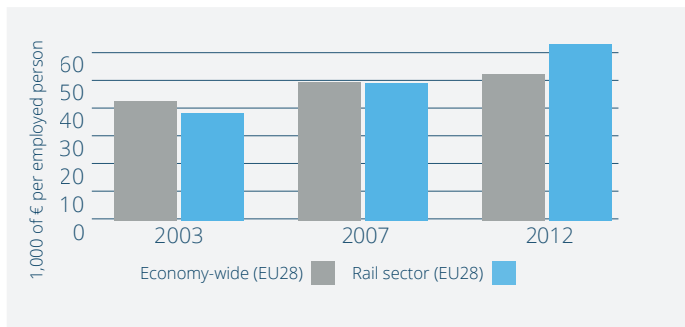
Rail infrastructure projects create wider economic impacts as a result of improved travel times and increased capacity

Rail infrastructure projects:

- Increase the size of the available labour market to companies
- Provide for indispensable transport facilities for certain industries

- Create more work opportunities for employees
- Enhance the productivity of companies
- Offer additional clustering benefits
- Increase the attractiveness of city centres

4. RAIL'S LABOUR PRODUCTIVITY HAS OVERTAKEN THE ECONOMY-WIDE AVERAGE



5. SUPPORTING THE GLOBAL LEADERSHIP OF THE EU'S RAILWAY SUPPLY INDUSTRY

The railway supply industry:

- Largest in the world
 - output of € 27 bn in 2009
 - 20% share in global trade
- High R&D intensity: 4-10% of industry turnover

6. CONNECTING EUROPE'S CITIZENS



Railway transport is:

- essential in linking regions throughout Europe
- a backbone of urban transport systems
- indispensable for commuters to get to work
- offering travel for all, including those without a car, elderly or disabled

7. INCREASED HIRING & JOB STABILITY

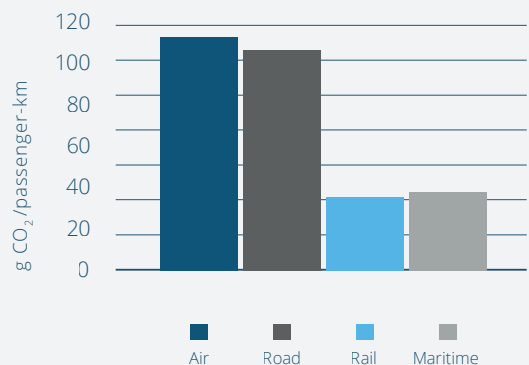
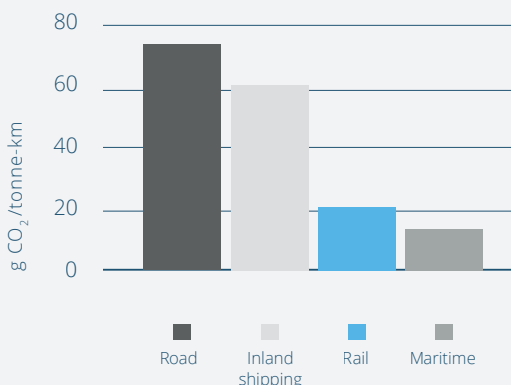
- A sector that provides long-term job stability as well as rising hiring patterns
- A sector with comprehensive training programmes for a large number of apprentices contributing to youth employment

Increase in number of persons hired (2012 vs 2003)



8. CONTRIBUTING TO A MORE SUSTAINABLE TRANSPORT SYSTEM

CO₂ EMISSIONS BY TRANSPORT MODE IN 2011



INTRODUCTION

BACKGROUND

Rail transport has a crucial role in shaping Europe's future. A well-developed network of rail connections, including a dedicated high-speed rail network, caters to a demand of over 1.1 billion passenger-kilometres daily and over 1 billion tonne-kilometres of freight rail transport.¹ The key role of rail transport is recognized in the European Commission's 2011 'Roadmap to a Single European Transport Area' ("White Paper").² Rail transport will be a significant contributor to achieving the "Europe 2020" strategic ambitions of smart, sustainable and inclusive growth.

Against this background, this report analyses *"the economic footprint of railway transport in the European Union."* For the purpose of the report, the term 'economic footprint' is defined as the economic impact in terms of gross value added, employment, exports and other key economic variables. The facts and figures and analytical results presented in this report cover the entire EU and span the time period 2003 – 2012. The 'economic footprint' includes direct, indirect and wider economic effects, which are assessed in the context of the wider relevance of rail transport to Europe's society and citizens. The report summarizes the findings by building on three pillars: economic, social & employment, and environmental.

¹ Averages per day based on annual transport performance figures for EU27 in 2010. Source: European Commission (2012): EU Transport in Figures 2012

² COM(2011): 144 final : White Paper, Roadmap to a Single European Transport Area – Towards a competitive and resource efficient transport system

Economic pillar

The analysis of the economic pillar forms the core of the study. We begin with an introduction to the general position of railways in the European Union, before diving into a more complete assessment of the full economic contribution of railway transport. Having delineated the sector, estimates are made of its direct and indirect contributions to gross value added and employment. In addition, the report explores induced effects, describing their theoretical background and providing real life examples of the wider economic benefits resulting from rail infrastructure projects. To conclude the analysis of the economic pillar, the competitive position of railway transport is assessed, together with the underlying drivers influencing this position, and the effects on innovation in the railway supply industry.

Social & employment pillar

The social and employment pillar looks into the social aspects of rail transport, including employment patterns within member companies of CER and specific themes such as 'social inclusion' and 'mobility for all'. The analysis of the internal demographics of rail transport and employment trends, including rail transport's role in offering new job opportunities to today's youth, incorporates findings from a 'flash survey' of CER members conducted specifically to support the research underlying this report.

Environmental pillar

The potential contribution of rail transport to the creation of a more sustainable transport system is widely recognised. Faced with growing demand for freight and passenger transport, ensuring sustainable mobility calls for a shift towards less polluting and more energy efficient modes of transport, especially for long distance and urban travel. The analysis under this pillar presents information on some of the environmental advantages of railway transport in comparison to alternative transport modes.

I. THE ECONOMIC PILLAR

The economic pillar begins by delineating the European rail transport sector in terms of its overall economic characteristics. Next, it quantifies the size of the direct, indirect, induced and wider economic impacts of rail transport in the European Union.

This pillar consists of three chapters:

- The size of the railway transport sector;
- Wider economic benefits of infrastructure projects;
- Impact of railway transport on competitiveness and innovation.



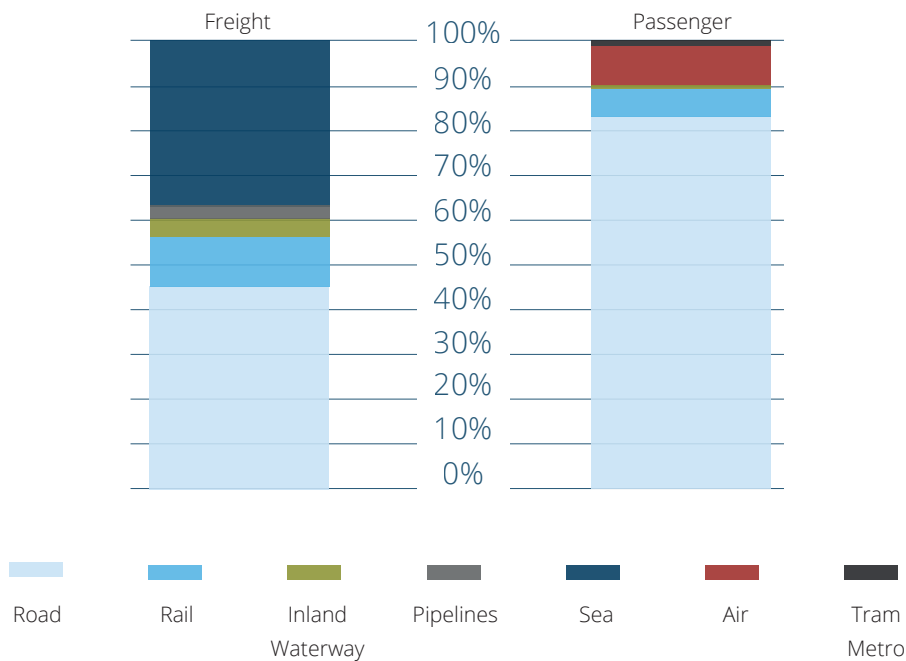


INTRODUCTION

Railway transport occupies a core position in Europe’s overall transport sector. More than 800 operators³ operate about 60,000 locomotives and rail cars⁴ on a relatively dense railway network covering 200,000 kilometres of tracks in the European Union. On a daily basis, EU railway transport meets demand for 1.1 billion passenger-kilometres and over 1 billion tonne-kilometres of freight.⁵ In 2012, around 9 billion passenger trips were made by railway.

In terms of modal share, rail transport supplied 11.0 % of freight and 6.3 % of passenger transport in 2011; excluding maritime transport, rail transport’s share of ‘inland’ freight transport rises to 18.5 %.

Figure 1 Modal split in the EU in 2011 in passenger and freight transport



Source: Ecorys based on Eurostat Transport Statistics

Although road remains the most used mode of transport, the demand for passenger rail transport grew by 17 % between 2000 and 2012, partially driven by the expansion of the European high-speed rail (HSR) network. Consequently, the modal share of rail passenger transport has improved.

As a result of the economic and financial crisis, rail freight volumes dropped considerably during the period from 2007 to 2009 but subsequently recovered between 2009 and 2011. By contrast, passenger

³ Eurostat SBS (2014)

⁴ European Commission (2012): EU Transport in figures 2012

⁵ Averages per day based on annual transport performance figures for EU27 in 2010. Source: European Commission (2012): EU Transport in Figures 2012

transport remained more stable throughout the crisis period. At a national level, the largest increases in rail transport's passenger modal share can be observed in Germany, Denmark and Austria with, respectively, increases of 4.6, 6.1 and 11.2 percentage points between 2003 and 2011.

The importance of railway transport is reflected not only in infrastructure numbers and passenger and freight volumes but, also, in a variety of types of economic effects that can be categorised as follows:

- **Direct effects** created by operations within railway transport. These include, for example, employment resulting directly from the transport of persons and freight from A to B and the associated infrastructure management, together with the value added created by these activities.
- **Indirect effects** created through upstream supplier relations. This covers, for example, the jobs and value added that depend on supply relationships with railway transport operations (e.g. manufacture of locomotives, maintenance, accounting etc.). In addition, indirect effects are generated through the jobs and value added created through railway infrastructure investments (e.g. laying tracks or building tunnels).
- **Induced effects**, also often called "income effects", reflect the jobs and value-added created as a result of spending by those workers who, directly or indirectly, earn incomes from railway transport.
- **Wider effects** cover broader economic outcomes linked to rail transport activities and infrastructure. These include labour and product market effects caused by lower transport times and/or costs, as well as agglomeration effects (spatial concentration effects) e.g. local business development, local real estates markets.

These different effects are explored in the following chapters. We begin by delineating the sector and providing estimates of the magnitude of direct and indirect economic effects. This is followed by some insights into induced effects. The wider economic effects of rail infrastructure projects are explored through a number of case studies. Finally, the impact of railway transport on competitiveness and innovation is assessed.

1 THE SIZE OF THE RAILWAY TRANSPORT SECTOR

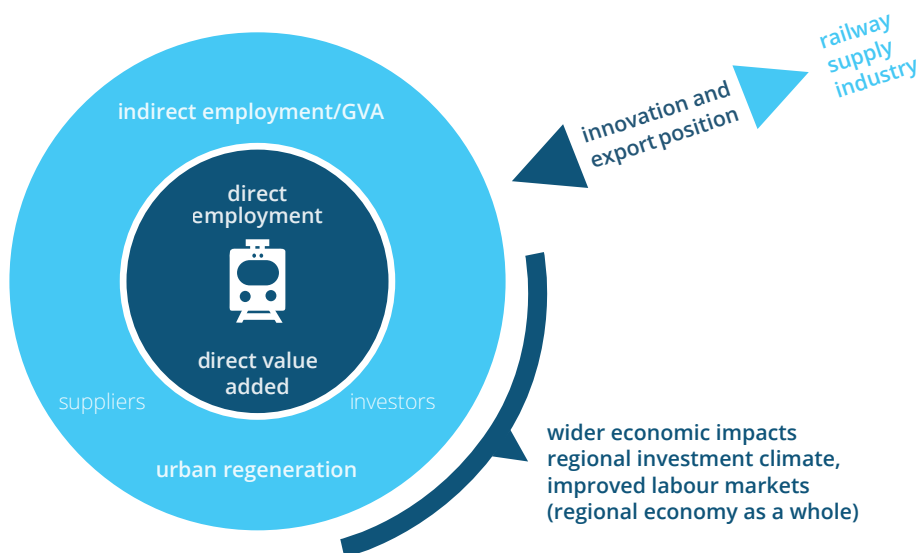
The economic footprint of the railway transport sector can be measured in various ways. This chapter focuses on quantifying direct and indirect economic effects and also offers a brief discussion on induced effects. Wider economic benefits as well as impacts on competitiveness and innovation are described in the following chapters.

1.1 Delineating and measuring the sector

Railway transport is more than just driving trains. The core economic activity, which results in what we call direct effects, covers the operation of trains. Direct rail transport enterprises are rail operators that transport passengers or goods between cities and towns (= interurban). Under the NACE 2 industry classification this is covered by the codes 49.10 Passenger rail transport, interurban and 49.20 Freight rail transport cover the core rail transport sector.

Linkages between railway transport and related sectors

Railway transport is the operation of trains. Operating trains requires specific inputs, including physical equipment and services. Rail operators need vehicles as well as access to tracks, stations, or terminals. Moreover railway transport may involve the purchase of services from external providers such as catering, cleaning, accounting, IT, or travel agency services.



This definition excludes, for example, passenger transport by urban and suburban transit systems (e.g. tube, inner city trains).⁶ Furthermore, rail infrastructure management, a crucial part of operating trains is not captured under this definition.

⁶ Eurostat (2008): NACE Rev. 2 Statistical classification of economic activities in the European Community, p. 235, see: http://epp.eurostat.ec.europa.eu/cache/ITY_OFFPUB/KS-RA-07-015/EN/KS-RA-07-015-EN.PDF and Correspondence table NACE Rev. 1.1 – NACE Rev. 2

The case of infrastructure management

The EU reports the break-down of economic activity by industry according to the 'NACE' classification (Nomenclature statistique des activités économiques dans la Communauté européenne). Under NACE Revision 1.1, railway transport operations were reported under a single code, namely 60.1 (other codes being used for the other transport modes). The operation of rail freight terminals, railway stations, and railway infrastructure management were reported under a different code, namely 63.21, together with non-rail infrastructure activities such as bus stations. Since the introduction of NACE Revision 2.0 from 2008, rail transport operations are reported under codes 49.1 (passenger rail) and

49.2 (rail freight), while railway infrastructure management is grouped together with road infrastructure activities under code 52.21. This is a problem because industry data from Eurostat's Structural Business Statistics (SBS) is not available at a lower level of aggregation. Furthermore, a closer look at the time series from SBS suggests that railway infrastructure management activities were reported together with railway transport activities for some countries and/or in earlier years but not for other countries and/or in more recent years. For the purposes of this report it was therefore necessary to carry out consistency checks using additional data sources in order to arrive at plausible estimates of gross value added for railway transport including railway infrastructure management.

Consequently our definition of the direct sector consists of NACE 2 code 49.10 Passenger rail transport, interurban and code 49.20 Freight rail transport (plus a correction for management of rail infrastructure where necessary). The indirect sector consists basically of all activities that supply goods or services to the railway operators. This means, for example, that if a railway operator buys catering services for its trains from an external provider then these persons are considered to be indirectly employed by the rail transport sector. Further examples of indirect activities are the manufacture of locomotives for the railway transport sector and, also, investments in the construction and electrification of rail tracks that are subsequently used by rail operators.

All of the above mentioned activities generate incomes for employees, whether directly or indirectly part of the railway sector, that result in further spending on goods and services. The additional economic effects from the employment and value added created through this spending is referred to as **induced effects**. On top of this, the existence of railway infrastructure has **wider economic impacts** both for the user of rail transport and all other economic actors whose activities are affected by development of the infrastructure. Such impacts, for example, be in the form of enhanced business cooperation due to short travel time or the clustering of business activities around railway; these wider economic impacts are described in **Chapter 2**).

The following quantitative measurement of the direct and indirect economic contribution of the railway transport sector is based on data from Eurostat, national statistical agencies and, where necessary, other supplementary sources. In some cases it has been necessary to make estimations to overcome remaining data gaps. A detailed description of the methods used is provided in the **Annex** of this report. Induced effects are not quantified as part of this study, but we present and assess findings of other studies. Wider economic benefits are demonstrated through case studies that are described in **Chapter 2**.

1.2 Direct economic effects

The EU railway transport sector (operation of trains between cities and rail infrastructure management) employed **1.06 million people** in 2012 and generated a value added of **€ 66 billion**. This corresponds to **0.5 % of EU GDP**.



Variables explained – Gross Value Added (GVA) versus Gross Domestic Product (GDP)

Gross value added (GVA) is an economic measure of the value of goods and services produced. It represents the value that is added to the products and services which are bought by a company, i.e. GVA equals total revenue minus the cost of intermediate goods and services. The sum of all GVA of all companies in an economy reflects the Gross Domestic Product (GDP) of the economy.

Railway transport creates substantially more value added within the EU economy than either air or water transport.

COMPARISON OF SIZE OF THE DIRECT TRANSPORT MODES IN 2011 (IN GVA)



Source: Ecorys based on Eurostat

Definition:

Air transport: all passengers or freight transport by air and operation of airports

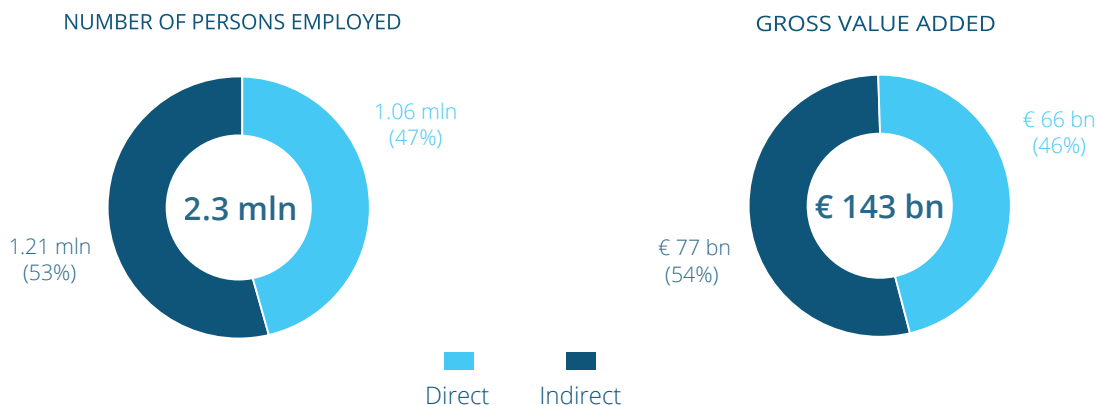
Water transport: all passenger/freight transport over water and operation of ports

At a level of € 66 billion in 2012, rail transport created about 25 % more value added than air transport and above twice as much as water transport.

1.3 Including indirect economic effects



In addition to direct effects, more than **1.2 million persons are indirectly employed** by the railway transport sector which, in turn, generates an additional **€ 77 billion of indirect GVA**. These numbers reflect the backward supply relations from railway transport to sectors such as the manufacture of locomotives, financial services, catering etc. including, also, indirect employment and GVA created as a result of investments in railway infrastructure such as tracks, electrification, tunnels etc.

Figure 2 The size of the railway transport sector in 2012 in persons employed and GVA



Source: Ecorys based on various sources

These numbers indicate that despite some outsourcing trends (mainly in cleaning, IT and legal services) almost half of the persons whose employment relies on the rail transport sector are still directly employed in the core function of railway transport of passengers and freight. They also indicate that one direct job in railway transport creates slightly more than one additional job in indirectly dependent economic activities. The indirect effects can be further divided into indirect effects coming about through supplier relations and indirect effects resulting through investments.

ONE  job in railway transport creates more than ONE  other job in

- Manufacturing
- Accounting
- Market research
- Advertising
- Financial services
- Food services
- Building services
- etc.

1.3.1 Indirect effects through supplier relations

Indirect effects generated through upstream supplier relations are estimated to amount to about **660,000 jobs** and about **€ 42 billion value added**. These estimates, which reflect the jobs and value added created through the supply of goods and services (e.g. financial services, accounting etc.) to direct railway transport operation, are derived from an analysis of input-output tables for four EU countries (for a further elaboration of this approach [see Annex](#)).

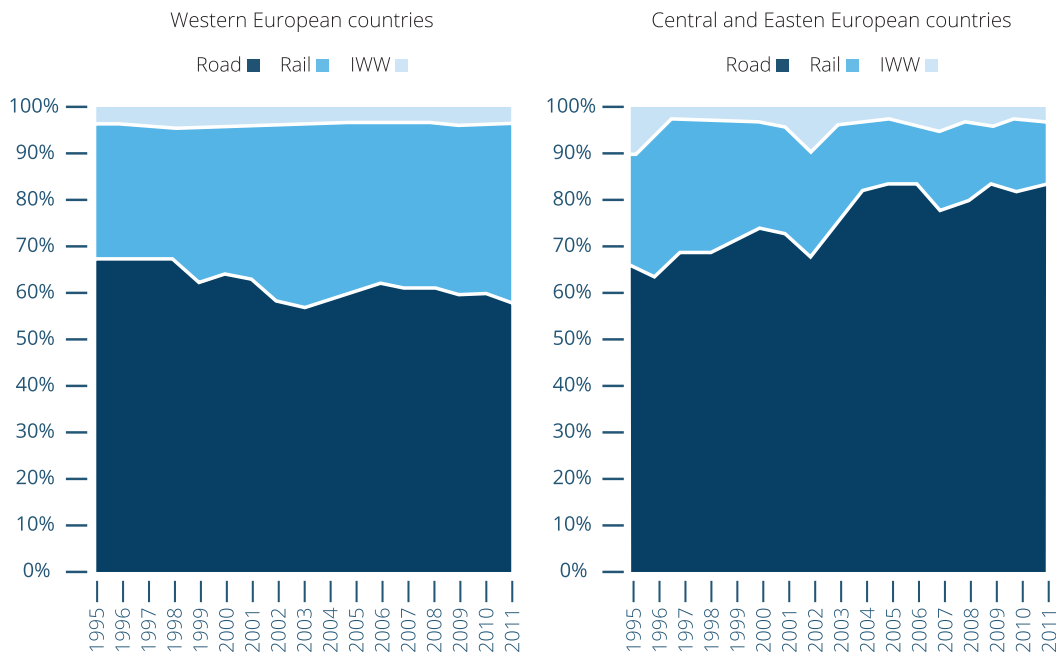
1.3.2 Indirect effects through investments

Not all indirect effects are captured by available input-output tables. On the one hand, this is due to the fact that input-output tables simply do not provide sufficient data on investments in capital stock (e.g. purchase of locomotives). On the other hand, it reflects the fact that in most cases investments in infrastructure (e.g. tunnels, tracks etc.) is undertaken by a third party, namely the State.

Investments in railway infrastructure

Railway infrastructure investments (such as tracks, tunnels, stations etc.) generate further jobs and value added creation. According to OECD data, about **€ 40 billion of investments in rail infrastructure** was made in the EU in 2011. Overall, more than 60 % of transport infrastructure investments go to road transport. In Western Europe, however, the share of investments in rail infrastructure is increasing. While, by contrast, in Central and Eastern Europe an opposite trend can be observed, which might lead to a decreasing share of rail transport in the modal split in these countries.

Figure 3 Share of investments by transport mode (inland water ways (IWW), rail, and road)



Source: International Transport Forum (2013): Spending on Transport Infrastructure 1995-2011

National studies find that transport infrastructure investments have a major impact on the economy of their respective countries. In Austria for example, a recent study⁷ finds that a total investment of € 13.6 billion for the period of 2013 – 2020 will result in an additional annual contribution of € 1.7 billion to Austrian GDP (0.6 %). Furthermore, this will create about 24,000 full time jobs for each year of the construction phase. This implies that, on an annual basis, roughly one annual full term job is created for each € 70,000 invested.

Extrapolating the above results to the EU level suggests that the economic effects of railway infrastructure investments could be estimated at about **550,000 persons employed** and **€ 34 billion of GVA**.

Investments in rolling stock

Available input-output tables do not provide sufficient information to identify capital investments such as acquisitions of rolling stock (e.g. locomotives) [see Annex](#). In order to integrate indirect economic effects resulting from purchases by the railway transport sector of capital equipment coming from the railway supply industry data covering NACE Rev. 2 code 30.2 Manufacture of railway locomotives and rolling stock has been used. According to Eurostat data, about 100,000 jobs and € 5.5 billion of GVA are generated in the EU through the manufacture of railway locomotives and rolling stock.

1.4 Further induced economic effects

The concept of induced economic effects, which are often called “income effects”, is not precisely defined and can differ across studies, sometimes overlapping with wider effects and/or indirect effects. In general, however, it refers to the economic effects created by the consumer spending by persons employed in a sector that results in further value added and employment generation elsewhere in the economy. Four relevant studies have attempted to estimate induced effects for the railway sector in European countries. A study for the Verband Deutscher Verkehrsunternehmen (VDV)⁸ estimates induced effects to be 0.5 times the direct and indirect effects of the sector. A Swiss study for VÖV UTP⁹ estimates induced effects to be more than two times higher than the sum of direct and indirect effects, while another Swiss study for the SBB¹⁰ estimated them to be at about 1.5 times of direct plus indirect effects. In comparison an Austrian study¹¹ (measuring only rail infrastructure investments) estimates a ratio of 0.1 for induced effects. The following table provides an overview of findings.

7 Industriellen Vereinigung/ÖBB (2013): Der Ökonomische Fußabdruck des Systems Bahn

8 Eduard Pestel Institut Hannover (2008): Wertschöpfungs- und Beschäftigungswirkungen des Schienengüterverkehrs und des Schienenpersonenfernverkehrs

9 Peter et al. (2004): Volkswirtschaftliche Bedeutung des öffentlichen Verkehrs in der Schweiz

10 SBB (2010): Die SBB – Motor für die Schweiz

11 IV (2013): Der Ökonomische Fussabdruck des Systems Bahn

Table 1 Comparing estimates of induced effects multipliers across studies

| | Germany, 2008 | Switzerland, 2004 | Switzerland, 2010 | Austria, multiple years* |
|-----------------------------------|---------------|-------------------|-------------------|--------------------------|
| Ratio induced / (direct+indirect) | 0.5 | 2.1 | 1.5 | 0.1 |

* covering not an individual year but a time period from 1995 – 2029 and only infrastructure investments

The estimate of 0.1 for infrastructure investments in Austria appears to be rather low while the Swiss estimate of 2.1 appears to be very high. The higher Swiss estimates are, in part, due to inclusion of investments in capital stock and infrastructure in the definition of induced rather than indirect effects. Given these divergent values, our approach is to estimate induced effects using a multiplier range from 0.25 to 0.75 of combined direct and indirect effects. This approach yields a value of **induced effects** in terms of additional GVA that lies between **€ 35.5 – 106.5 billion**. Applying the same multipliers to the employment estimates gives additional employment resulting from induced effects in the range of **575,000 – 1,725,000 persons**.

1.5 Putting the figures in the EU context

From the above analysis, we can see that a substantial number of EU citizens are working directly or indirectly for the railway transport sector and that induced effects provide a further significant amount of value added and employment to the EU economy. We have also seen that, in terms of direct gross value added, the railway transport sector in the EU is economically more important than either air or water transport.

1.5.1 Comparison with the EU economy

To place the railway transport sector in a broader context, in 2012 the European Union had a **gross domestic product (GDP) of € 13 trillion**. Based on an estimated (direct + indirect) value added of **€ 142 billion**, this means that the railway transport sector accounted for **1.1 % of the European Union's economy**. On its own, the direct contribution of the railway transport sector amounted to 0.5 % of European Union GDP, with indirect effects contributing a further 0.6 %.

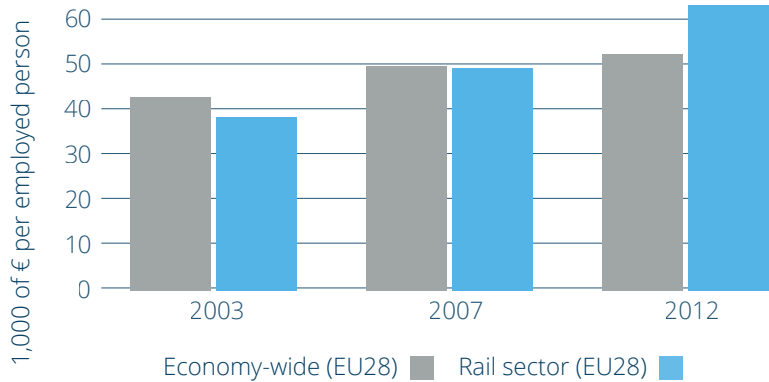
Under a theoretical scenario, and allowing for the further inclusion of induced effects, if all the economic effects attributable to the rail transport sector were removed without being replaced by other economic activities, the economy could **lose more than 2 % of GDP**. Such a value is comparable to the impact of a major economic recession.

1.5.2 Labour productivity

The railway transport sector has increased its productivity over the last decade. During this period, the labour productivity of the railway sector (measured by gross value added per employed person) caught up with and then overtook the economy-wide average labour productivity in the EU. This is a remarkable

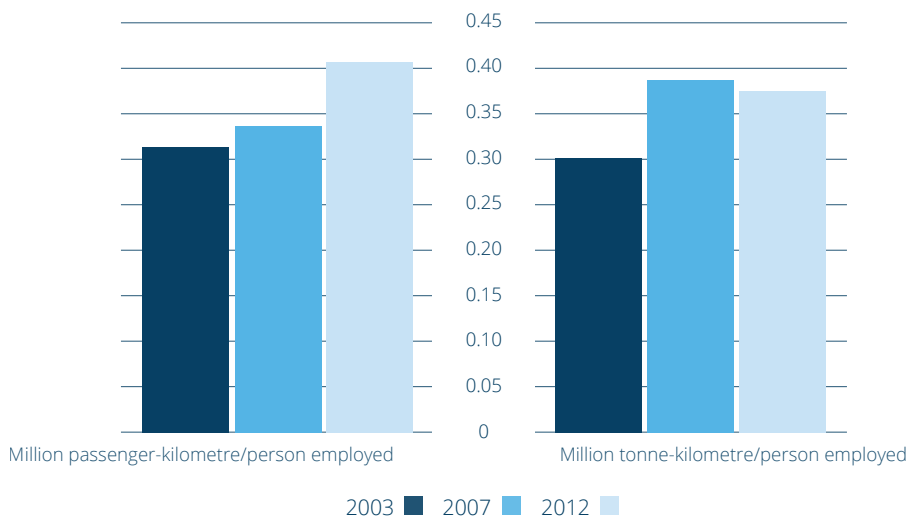
development. Productivity measures based on physical units tell a consistent story: traffic volume per employed person increased significantly for both passenger and freight.

Figure 4 Labour productivity in the rail sector compared to the economy-wide average



Source: Ecorys based on Eurostat

Figure 5 Passenger-kilometre/person employed and million tonne-kilometre/person employed



Source: Ecorys based on various sources

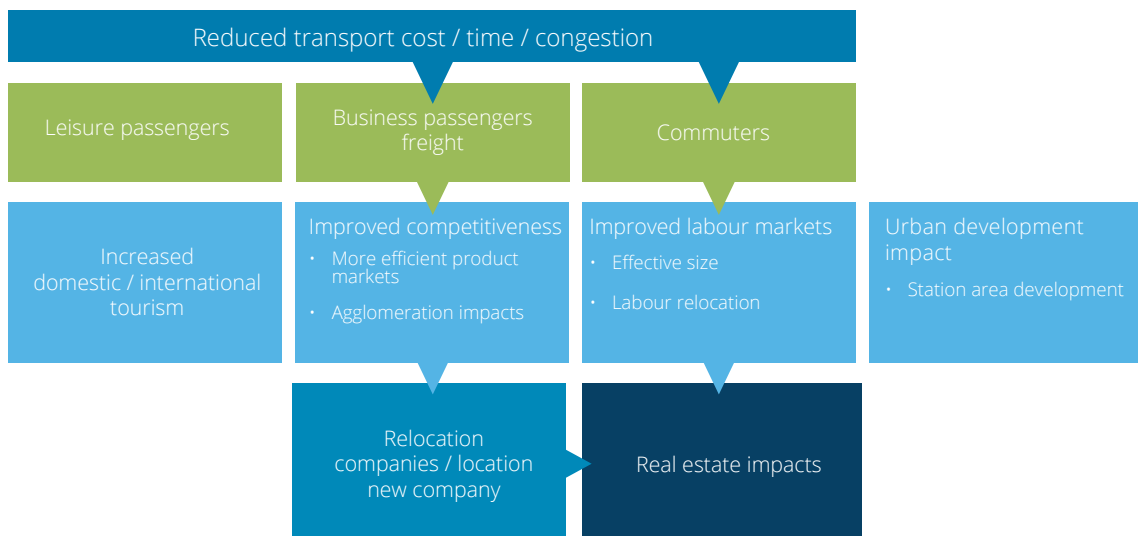
The figures presented in this chapter have highlighted the significant contribution of the railway transport sector to employment and value added creation in the EU. However, this is only a partial picture as it does not include the economic effects resulting from railway infrastructure projects. The additional economic benefits of rail infrastructure projects are considered in the next chapter.

2 WIDER ECONOMIC BENEFITS OF SELECTED INFRASTRUCTURE PROJECTS

The previous chapter quantified the size of the railway transport sector in terms of direct and indirect effects on GVA and employment, along with a description of potential induced effects. Infrastructure projects related to the development of the railway transport sector are a further source of wider economic benefits. However, despite common acknowledgement of their existence, it is much harder to quantify the effects of infrastructure projects on the economy as a whole. In particular, economic effects of infrastructure projects are often strongly dependent on the exact project and its geographical location. Accordingly, rather than offering quantitative estimates, this chapter uses selected case studies to provide indications of the importance of the wider economic benefits of infrastructure projects. The chapter starts, however, with a short presentation of the theoretical basis underpinning the assessment of these wider economic benefits.

2.1 The theoretical basis

Currently available literature supports the general conclusion that actual **effects of infrastructure are highly context-specific**. One-size-fits-all answers to questions concerning these effects do not exist. In particular, methods for determining the impact of new railway infrastructure on real estate prices (or, even better, on land rents) remains something of a 'holy grail' for experimental studies in this area.



Within the macro-econometric tradition, early contributions to the literature on the economic impacts of infrastructure investment build on the work by Aschauer (1989)¹² who estimated the effect of public expenditure on economic growth. However that strand of literature is fraught with problems. These problems arise not least because the direction of causality is not clear. General equilibrium approaches

12 Aschauer, D.A. (1989): Is public expenditure productive?, *Journal of Monetary Economics*, 23(2), pp. 177-200

have also been developed by, amongst others, Sue Wing et al. (2007¹³, 2009¹⁴, 2011¹⁵, 2013¹⁶, 2014¹⁷). Although appealing at first sight, these approaches and others such as that used in Barro (1990) still rely on standard assumptions of constant returns to scale and perfect competition, in a way defining away the potential relevance of wider benefits which rely on increasing returns to scale processes. This makes them less relevant for this study.

In line with more recent literature, potentially of greater relevance are studies exploring infrastructure investments from the **perspective of agglomeration effects** (e.g. in terms of improved accessibility, aggregated markets, increased supply and demand) and urban economics. The fundamental question addressed by these studies is how (effective) density affects the performance of firms (e.g., Fujita and Mori, 1997, Mori, 1997, and many studies that followed¹⁸). The basic idea is that **transport improvements help cities grow and diversify**, thus making 'learning, matching and sharing' easier for firms and households.¹⁹ These are the three fundamental microeconomic mechanisms driving agglomeration effects: *Learning* can be increased through knowledge spillovers within clusters. *Sharing* means that clusters can share certain input sources and therefore save costs. *Matching* means that a higher density of suppliers and demand reduces search costs. To give an example, transport improvements make **more workers willing to commute**, which leads to a better matching in the labour market between workers and jobs and thereby raises productivity.²⁰ Furthermore, companies may benefit from knowledge spillovers accrued from the sharing of new technologies, or increased innovation capabilities due to networking and face-to-face contacts. Intuitively, an advanced public transport system makes it easier for workers to share knowledge through social activities, such as casual interactions with fellow employees and acquaintances when travelling by public transport.²¹

Complementary literature emphasizes the growth-enhancing effects of **scale, diversity and competition** within urban environments. This literature builds on the seminal work by Glaeser et al. (1992) and was surveyed in a meta-analysis by De Groot et al. (2008).²² Transport infrastructure, both internal as well as external, can play an important role in **enhancing effective diversity, scale and competition**.

13 Sue Wing, I. (2007): The Regional Impacts of U.S. Climate Change Policy: A General Equilibrium Analysis

14 Sue Wing, I. (2009): Computable General Equilibrium Models for the Analysis of Energy and Climate Policies, in J. Evans and L.C. Hunt (eds.), *International Handbook On The Economics Of Energy*, Cheltenham: Edward Elgar, 332-366

15 Sue Wing, I. (2011): Computable General Equilibrium Models for the Analysis of Economy-Environment Interactions, in A. Batabyal and P. Nijkamp (eds.) *Research Tools in Natural Resource and Environmental Economics*, Hackensack: World Scientific, 255-305

16 Lanzi, E. et al. (2013): Capital Malleability, Emission Leakage and the Cost of Partial Climate Policies: General Equilibrium Analysis of the European Union Emission Trading System, *Environmental and Resource Economics* 55: 257-289

17 Sue Wing, I. and E.J. Balistreri (2014): Computable General Equilibrium Models for Economic Policy Evaluation and Economic Consequence Analysis, *Oxford University Press Handbook on Computational Economics and Finance*, forthcoming

18 Fujita, M., Mori, T. (1997): Structural stability and evolution of urban systems, *Regional Science and Urban Economics*, 27(4-5), pp. 399-442; Mori, T. (1997): A Modelling of Megalopolis Formation: The Maturing of City Systems, *Journal of Urban Economics*, 42(1), pp. 133-157

19 Chatman, D.G., Noland.R.B. (2011): Do public transport improvements increase agglomeration economies? A review of literature and an agenda for research. *Transport Reviews*, 31(6), pp. 725-742

20 Venables, A.J. (2007): Evaluating urban transport improvements: cost-benefit analysis in the presence of agglomeration and income taxation. *Journal of Transport Economics and Policy*, pp. 173-188

21 Murphy, L. (2001): Exploring social interactions of backpackers, *Annals of Tourism Research*, 28(1), pp. 50-67; Daniels, R., Mulley, C. (2011): Exploring the role of public transport in agglomeration economies and centres

22 Glaeser, E.L. et al. (1992): Growth in Cities. *Journal of Political Economy*, 100(6), 1126-1152. De Groot, H.L.F. et al. (2009): Agglomeration, Innovation and Regional Development: Theoretical Perspectives and Meta-Analysis, in: R. Capello, Nijkamp, P.: *Handbook of Regional Growth and Development Theories*, Edward Elgar, Cheltenham, pp. 256-281.

Following from the literature mentioned above, the role of transport infrastructure in urban agglomeration effects plays out through intra- and inter-region connectivity, which determines firms' market potential, and through intra-region interaction among economic agents that impact on the spatial scale of urban areas and the realization of external economies of scales. When transport quality in terms of inter-regional connectivity is taken into account, then agglomeration effects occur not just at a localized level but may also spread across multiple regions. It has indeed been shown empirically that **small cities can 'borrow the size' of large cities** nearby through proper infrastructure, allowing them to benefit from agglomeration effects generated by large and nearby cities (e.g., Alonso, 1973; Phelps et al., 2001; Phelps and Ozawa, 2003; Shearmur and Polese, 2005²³).

Many empirical studies have been carried out to estimate the changes in **firm productivity resulting from increases in urbanization**. They have been neatly summarized in a meta-analysis by Melo et al. (2009)²⁴ who find that the elasticity estimates vary substantially across time and space. Building on the existing empirical literature, they put forward the hypothesis that the real effective size of urban agglomerations is influenced by the overall quality of transport infrastructure system.

Vickerman and Ulled (2009)²⁵ focused on high-speed lines in Europe and found that wider economic effects vary significantly. A study on the CrossRail project in London suggests that **local benefits increase by about 20 %** when agglomeration effects are taken into account.²⁶ This estimate falls well inside the range of 0-30 % that is typically thought to be a reasonable range within which such effects should lie.

Koster et al. (2013) and Debrezion et al. (2006)²⁷ present two experimental studies on the effects on house prices. Whereas the first study reaches the conclusion that there is no effect of rail infrastructure projects on house prices, the second one finds that there is an **optimal distance to a railway station** of around 250 metres, at which point the negative effects of noise and congestion are balanced by the **positive effects of accessibility** (depending on conditioning factors such as frequency of train trips, etc.). These two studies, however, indicate that the literature in this area remains under-developed; something which should improve with increased availability of micro-data.

Building on the findings from available literature, four case studies that illustrate the wider economic benefits of railway infrastructure investments are described; the case studies are as follows:

- High-speed rail Paris-Lyon-Marseille;
- High-speed rail Rome-Milan;
- Manchester Piccadilly station;
- Rail shuttle system in the hinterland of the Port of Gothenburg.

23 Alonso, W. (1973): Urban zero population growth, *Daedalus*, pp. 191-206; Phelps, N.A. et al. (2001): Small Firms, Borrowed Size and the Urban-Rural Shift, *Regional Studies*, 35(7), pp. 613-624; Phelps, N. Ozawa, T. (2003): Contrasts in agglomeration: proto-industrial, industrial and post-industrial forms compared, *Progress in Human Geography*, 27(5), pp. 583-604; Shearmur, R. and M. Polese (2005). Diversity and employment growth in Canada, 1971-2001: can diversification policies succeed? *The Canadian Geographer*, 49(3), pp. 272-290.

24 Melo, P.C. et al. (2009): A meta-analysis of estimates of urban agglomeration economies, *Regional Science and Urban Economics*, 39(3), pp. 332-342.

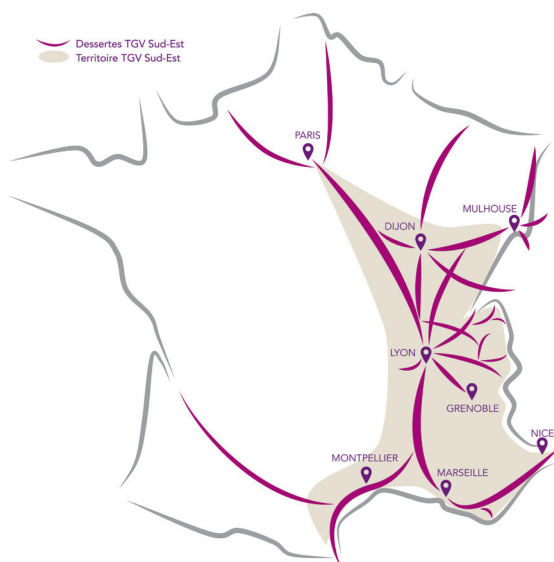
25 Vickerman, R., Ulled, A. (2009): Indirect and Wider Economic Impacts on High-Speed Rail, in: *G. de Rus (ed.) Economic Analysis of High Speed Rail in Europe*, Fundacion BBVA, Bilbao, pp. 89-118.

26 CrossRail(2012): Property Impact Study

27 Debrezion, G. (2006): Railway Impacts on Real Estate Prices, PhD Thesis Tinbergen Institute; Koster, H. (2013). The Internal Structure of Cities: The Economics of Agglomeration, Amenities and Accessibility, PhD Thesis Tinbergen Institute.

2.2 Case study 1: High-speed rail Paris-Lyon-Marseille

More than 100 million passengers travel on the TGV network in France every year. The first TGV line between Paris and Lyon (TGV Sud-Est) was inaugurated in 1981 and subsequently expanded to serve Marseille (TGV Méditerranée) in 2001. TGV Sud-Est was fully amortised in just 12 years and is estimated to have provided a social rate of return of 30 % and a financial rate of return of 15 % over the 1981-1997 period. The latter result exceeded expectations: a financial rate of return of 12% had been initially expected for that time horizon. Due to its much more recent construction, the long-term effects of TGV Méditerranée between Lyon and Marseille are only starting to show and research results are still quite limited.



As it is naturally attractive to business day-commuters, Paris-Lyon is seen as one of the most ideal routes for high-speed services. The passenger volumes carried on the service increased²⁸ immediately after inauguration (1981). Comparing the year 1980 (one year before inauguration) with 1992 showed an increase from 12.5 million to 22.9 million passengers. Since then passenger numbers have remained relatively stable. In the meantime, air travel between Paris and Lyon halved between 1980 and 1984, while flights between Paris and Geneva fell by 20 %.²⁹ Today rail has market shares of over 90 % on the route Lyon-Paris.³⁰

Automobile traffic on the parallel motorway was also affected, growing by only a third of the national average growth rate for the same period.³¹ Furthermore, despite low-cost airline competition on the route Paris-Marseilles, rail market shares are estimated to remain higher than 60 % until 2016.³²

28 Berlioz, C., Leboeuf, M. (1986): Les résultats du TGV Paris – Sud-Est: Bilan a posteriori du TGV Sud-Est, *Revue Générale des Chemins de Fer*, No. 105

29 Vickerman, Roger (1997): High-speed rail in Europe – experience and issues for future development, *The Annals of Regional Science*, Vol. 31, p.21-38

30 Maria Börjesson – KTH (2012): Forecasting Demand for High Speed Rail

31 Vickerman, R. (1997): “High-speed rail in Europe: experience and issues for future development”, *Annals of Regional Science*, 31 (1), 21-38

32 European Commission, DG TREN (2006): Air and Rail Competition and Complementarity

Furthermore, in the two years prior to introduction and especially in the two years following introduction, **real estate values increased around HSR train stations**. The increases were especially strong within a perimeter of 15 minutes walking distance of rail stations.³³ In the case of Lyon, the restructuring of Lyon-Part-Dieu had the most pronounced effect on real estate prices, and helped rejuvenate the neighbourhood into a vibrant business hub. Businesses that moved closer to the station benefitted from better access for business travellers and customers and, as corporate buildings are clearly visible from the TGV line, also increased their visibility.³⁴ Bonnafous (1987) showed that HSR access is a “bonus” when choosing business locations.³⁵ Furthermore, he identified that regionally expanding businesses have especially benefitted from the TGV connection as a result of better access to the Parisian market.³⁶ Some examples include the advertising industry, for which Paris represents over 70 % of the market. Small towns on the TGV line also managed to profit from access to the system. Le Creusot, for example, managed to attract four firms because of the new high-speed link, which created 150 jobs.³⁷

Even though **employment** growth in cities that are on the TGV line does not generally appear to have been above the national average, a TGV connection can favour the retention of existing companies.³⁸ The centralisation of additional employment creation in close proximity to TGV stations can have a **clustering effect** that enables closer collaboration between business and industries. Furthermore, the introduction of the **TGV also reinforced employment in existing sectors**, which tend to provide white collar jobs in the field of business services. The research sector and consulting services are two sectors that appear to be positively affected by easy access to HSR. HSR helps to reinforce the opening-up of local markets and the subsequent arrival of highly specialised Parisian firms.³⁹ Moreover, the construction of the track created 85,000 temporary jobs, but also 19,000 permanent jobs.⁴⁰

Sales of typical regional products in the new locations served by the TGV benefitted from the introduction of HSR; as did sales of luxury products due to the increased attractiveness of shopping trips to Paris and Lyon.⁴¹ Business owners have observed similar effects on the TGV Sud-Est line.⁴²

The **number of business travellers** increased substantially after the introduction of the TGV.⁴³ This increase in traffic has been most visible on medium distances of 200-600 kilometres. There was, however, a substantial divergence between passenger growths in each direction of the line. Journeys from Lyon to Paris increased by 144 %, while the opposite direction experienced an increase of 54 % in the same timeframe.

33 Albalade, D., Germa, B. (2012): The Economics and Politics of High-Speed Rail – *Lessons from Experiences Abroad*, Lexington Books, Plymouth, UK

34 Sands, B. D. (1993): The Development of High-Speed Rail Stations and Implications for California, *California High Speed Rail Series*, University of California Berkeley

35 Bonnafous, A. (1987): The regional impact of the TGV, *Transportation*, Vol. 14, p. 127-137

36 Bonnafous, A. (1987): The regional impact of the TGV, *Transportation*, Vol. 14, p. 127-137

37 Marti Hennenberg, J. (2000): Un balance del tren de alta velocidad en Francia. *Enseñanzas para el caso español*, *Eria*, Vol. 52, p. 131-143

38 Bazin S. et al. (2006): L'arrivée de la LGV en Champagne-Ardenne et la nécessaire réorganisation des rapports de proximité, *les Cahiers Scientifiques des transports*, n° 49, p. 51-76

39 Mannone, V. (1995): L'impact régional du TGV Sud-Est, PhD Thesis, Université de Provence, Aix-en-Provence

40 Réseau Ferré de France (2007): Bilan LOTI de la LGV Méditerranée

41 Bazin S. et al. (2006): L'arrivée de la LGV en Champagne-Ardenne et la nécessaire réorganisation des rapports de proximité, *les Cahiers Scientifiques des transports*, n° 49, p. 51-76

42 Vickerman, Roger (1997): High-speed rail in Europe – experience and issues for future development, *The Annals of Regional Science*, Vol. 31, p.21-38

43 Bonnafous, A. (1987): The regional impact of the TGV, *Transportation*, Vol. 14, p. 127-137

The increased economic interaction between the major nodes of the network also led to an increase in the number of regional offices of Paris-based businesses in Lyon, helping to increase the popularity of the latter as a business location. The increased centralisation of businesses further promoted intra-organisational business trips. Business trips increased by 21 % overall, with trips with Paris as a destination increasing by 156 %.⁴⁴ These numbers are expected to have further increased with the opening of the HSR station at Charles de Gaulle Airport in Paris and the Paris rail bypass that directly connects the airport to Lyon.⁴⁵

In addition, the arrival of the TGV between Paris and Marseille in 2001 constituted a substantial shift in rail market share, which rose from 50 % to nearly 70 % until 2004 on the line Paris Marseille.⁴⁶ Moreover, the TGV Méditerranée is used by 14 million tourists annually to travel to the South of France for holidays.⁴⁷ The Provence thereby constitutes the second largest tourism location after the Paris Region. In the case of Dijon, from the late 1970s until the mid-1980s the number tripled, and reached 85,000 in 1985. Even though it declined again afterwards until 1994 to 31,470 tourists, it remained still higher than before.⁴⁸

Conclusions

- Shift from air travel to rail transport:
 - air travel between Paris and Lyon halved between 1980 and 1984;
 - and fell by 20 % between Paris and Geneva;
- Passenger volume:
 - increased between Paris and Lyon from 12.5 million in 1980 to 22.9 million in 1992;
- Increased business and leisure travel:
 - journeys from Lyon to Paris increased by 144 %, while the inverse direction experienced an increase of 54 % in the same timeframe;
 - 14 million tourists per year use the TGV Méditerranée to travel to the South of France;
- Real estate prices:
 - increased around HSR train stations two years prior and especially two years after introduction of HSR;
 - especially strong within a perimeter of 15 minutes walking distance;
 - Lyon Part Dieu had the most pronounced effect on real estate prices;
- Overall gain for the public:
 - after 20 years of operation for the Rhône-Alpes regions it is estimated to be € 1.02 billion (in 2003 prices) which means a social rate of return of 15.4 %;
 - socio-economic benefit for the TGV Méditerranée is estimated to be 12.2 %.

44 Albalade, D., Germa, B. (2012): *The Economics and Politics of High-Speed Rail – Lessons from Experiences Abroad*, Lexington Books, Plymouth, UK

45 Chen, Chia-Lin (2010): Written evidence from PhD Candidate Chia-Lin Chen and Professor Sir Peter Hall, University College London

46 Steer Davies Gleave (2006): Air and rail competition and complementarity, for European Commission, DG TREN, London.

47 See Comité Régional du Tourisme Provence-Alpes-Côte d'Azur, http://www.chiffres-tourisme-paca.fr/PageEditosUK.asp?ID-PAGE=43&sX_Menu_selectedID=m9_67F703B9

48 Mannone, V. (1995): *L'impact régional du TGV Sud-Est*, PhD Thesis, Université de Provence, Aix-en-Provence

2.3 Case study 2: High-speed rail Rome – Milan

HSR Rome-Milan connects the two economic centres of the peninsula, each with about 4 million inhabitants in their urban area. While Rome is the political capital of Italy, metropolitan Milan produced 9 % of Italy's GDP in 2010, while the larger Lombardy region accounted for 20 %.⁴⁹ Milan hosts the most important stock exchange of the country and is the main player in key sectors such as banking, automotive, the luxury industry, and services. The transport link is the second largest intra-European connection (all modes of transport combined).⁵⁰



Other important cities on the line are Bologna and Florence. Although Florence is also an important player in the fashion world, it is mainly known as a popular tourist destination.

The time savings between city pairs due to HSR are in a range of 20-40 %. The total time reduction from Rome to Milan was from 4.5 hours to less than 3 hours. Further savings have been achieved through the underground bypass station in Bologna in 2013 and will be in a similar form in Florence. The introduction of a new train model in 2015, the Frecciarossa1000 with a maximum speed of 360km/h, will further cut travel times.⁵¹

In just two years following the introduction of the new HSR line, more than 40 million travellers have chosen to use high-speed rail services.⁵² According to calculations by a group of Italian researchers, the demand on the Italian high-speed network increased by 39.1 % from 2009 to 2011.⁵³



The Italian HSR, known as Alta Velocità/Alta Capacità (AV/AC) in Italian, connects all major cities of the peninsula. It is of more recent origin than the French TGV (conceived in the 1990s) and differs in that the network nodes are much closer to each other. Initially, Pendolino trains were introduced that used regular

49 Lombard Industry Association (2012): Nominal GDP of Italian regions, 2000-2010

50 Eurostat (2012), cited in Mancuso, Paolo (2014): An analysis of the competition that impinges on the Milan-Rome intercity passenger transport link, *Transport Policy*, Vol. 32, p. 42-52

51 Cascetta, E. et al. (2013): High-Speed RAIL Demand – Before-and-After Evidence from the Italian Market, *disP – The Planning Review*

52 Presentation by Stivali Franco (2012): The role of externalities in the Cost Benefit Analysis of Rome Milan HS line, Ferrovie dello Stato Italiane

53 Cascetta, E. et al. (2013): High-Speed RAIL Demand – Before-and-After Evidence from the Italian Market, *disP – The Planning Review*

tracks but could move at higher speeds than classic trains due to tilting technology. Since the mid-2000s, high-speed tracks running parallel to classic rail lines have been inaugurated to serve the area from Turin in the north to Salerno in the south. The new network has multiple interconnections with the regular train network and allows new high-speed trains to travel at up to 300km/h. The Italian HSR network is equipped with the ERTMS Level 2 signalling system. In 2000, Italy had only 248 kilometres of HSR line, which was substantially less than comparable networks in Germany, Spain and France. Since then, substantial investments have been made such that in 2013 a total dedicated track network of 932 kilometres was operating HSR service.⁵⁴

The Italian HSR network provides a high-speed backbone for domestic travels in Italy. Moreover, as a result of a national decision which anticipated EU law, the whole Italian rail network is fully subject to direct *open-access* competition. In April 2012, the private railway undertaking NTV started to operate high-speed services on the entire HSR system in direct competition with the incumbent operator Trenitalia. This is the first ever experience of a HSR market with two competing operators providing services along the same routes. Despite the severe economic recession which impacted Italy, total passenger numbers are increasing, which suggests that competition brought in not only a new operator but also attracted more passengers.

As a result of the construction of the high-speed line a major shift from air to rail has taken place.⁵⁵ Air traffic decreased by 1.3 million passengers per year on city pairs linked by the HSR network. This occurred at a time when the national trend showed a 5.3 % increase in air traffic between 2007 and 2010.⁵⁶ Between Rome and Milan however, the main carrier Alitalia reduced the shuttle flights offered. Between 2008 and 2012 the modal share of rail for the Rome - Milan route grew from 36 % to 66 %.⁵⁷ At the same time, the shift of passenger transport to the new parallel HSR network allowed for substantial efficiency gains by freeing up capacity on the traditional network for freight transport and regional passenger train services.

In a survey conducted in 2012, 26 % of interviewed travellers indicated that the availability of HSR had a positive impact on their travel choice. Moreover, 12 % stated that the presence of HSR influenced their travel choice to go to additional cities within the proximity of Rome.⁵⁸

As the nodes on the Italian rail network are relatively close to each other, a further integrating effect between urban centres is achieved. This has led to an increased economic reach for individuals in those cities close to each other, and in some cases creates a virtually “joint city”.⁵⁹ In addition, the HSR network in Italy is much more integrated with conventional rail than most other countries’ HSR networks.

54 Deplace, Marie et al. (2014): Does High Speed Rail services influence tourists’ choice? Some concerns from Paris and Roma and other linked cities, *ERSA conference papers*, No. ersa13p13

55 Mancuso, Paolo (2014): An analysis of the competition that impinges on the Milan-Rome intercity passenger transport link, *Transport Policy*, Vol. 32, p. 42-52

56 Beria, P. et al. (2011): An Early Evaluation of Italian High Speed Projects, *Trimestrale del Laboratorio Territorio Mobilità e Ambiente...*

57 European Commission (2014): Fourth report on monitoring development in the rail market, SWD(2014) 186 final, page 9.

58 Deplace, Marie et al. (2014): Does High Speed Rail services influence tourists’ choice? Some concerns from Paris and Roma and other linked cities, *ERSA conference papers*, No. ersa13p13

59 Romano Fistola (2008): Alta velocità, nuova contiguità urbana temporale e nascita di sistemi macrofunzionali connessi, *Journal of Land Use, Mobility and Environment*, Vol.1 No.1

Conclusions

- Shift from air travel to rail transport:
 - air travel decreased by 1.3 million passengers a year on city pairs served by the HSR;
 - modal share of Rome - Milan by rail has grown from 36 % to 66 % from 2008 to 2012;
- Increased passenger volume:
 - more than 40 million travelers used the HSR in the first two years;
 - demand increased by 39.1 % from 2009 to 2011;
- Increased business and leisure travel:
 - improved linkage between the economic centres of Italy;
 - 26 % of interviewed travelers indicated that the availability of HSR had a positive impact on their travel choice.

2.4 Case study 3: Manchester Piccadilly Station

The shift in the structure of developed economies away from manufacturing and towards service-based activities has boosted city-centre employment as well as retail and leisure activity. Between 2001 and 2008, rail passenger numbers for major UK cities increased by more than 60 %. This trend is expected to continue in the coming years.

Stations can act as enablers to economic growth. In particular, railway stations:

- I act as a connecting link between urban transport and the national rail network;
- II offer capacity to accommodate passenger demand, which has a direct impact on residential and employment growth potential of cities;
- III when provided with adequate capacity and connectivity, can assist sustainable development by accommodating increasing transport demand;
- IV can improve the image of a location to travellers by offering an attractive gateway;
- V provide development opportunities to the surrounding areas through the creation of accessibility advantages that raise commercial potential;
- VI provide a catalyst for regeneration of underdeveloped areas in the vicinity;
- VII take up the **role of commercial centres** offering a range of commercial facilities.

Over the period from 2009 to 2014, € 4 billion⁶⁰ were invested in stations on the UK railway network. One good example is Manchester, the birthplace of passenger rail transport with the Liverpool and Manchester Railway opening operations there in 1830. Manchester's stations have been renovated and improved in recent years, particularly since 1996. Out of the five large terminal stations that were built in the Victorian period, two are still in use for passengers: Manchester Piccadilly and Manchester Victoria. Serving more than 22 million passengers per year, the Manchester Piccadilly station is currently the busiest station in the Greater Manchester area and also one of the busiest stations in the UK outside of London.⁶¹



Manchester Piccadilly station dates back to 1840 when Manchester and Birmingham Railway (M&BR) initiated a line to Stockport. Known earlier as London Road station, in 1960 the station was renamed Manchester Piccadilly after it reopened following a renovation to accommodate electric train services. In the following years, the station also underwent improvements to enable the introduction of light rail services. Further reconstruction and extension of the island platforms was made in 1988 with the opening of the Windsor link.

More recently, in the late 1990s, € 34 million was spent on replacing the station's glass roof over the

⁶⁰ An exchange rate of GBP 1 = EUR 1.26 was applied throughout this section

⁶¹ Estimates of station usage, Office of Rail Regulation. 2012-13, retrieved 28-03-2014

platforms and restoring train sheds, platform surfaces and signage. Additionally, a separate station improvement project was stimulated by the 2002 Commonwealth Games. Within this project, € 78 million was invested to improve visibility, road and tram access and increase the concourse to accommodate increasing passenger volumes.⁶²



Prior to the last round of investment, the area around Manchester Piccadilly station was perceived as extremely rundown, neglected and unattractive for investments. The station regeneration has been linked to a host of positive impacts, among which are:

- generation of € 12.26 million in rental income through the creation of 60,000 m² of new office space;
- an increase of about 33 % in the value of properties around the station, resulting in € 163.8 million in inward investments and € 8.3 million in gross value added;
- generation of approximately 3,000 jobs in the area immediately around the train station;
- the creation of 2,000 m² of retail space, a pub and a restaurant along the station concourses.

After the conclusion of the station regeneration project, the area around Manchester Piccadilly has been able to improve its image with the attraction of high-value office and hotel activities, while the station itself acts as a commercial hub for retail, food and entertainment activities. Moreover, as a result of the increased rate of development around Piccadilly compared to other peripheral locations in the vicinity of the city centre, the redevelopment of the station has helped to shift the city centre southwards.⁶³ Overall, the station redevelopment project has acted as a catalyst for the development of the Piccadilly Basin and a change in perception of the area.⁶⁴ The currently debated 'Core Strategy Proposed Option' put forward by Manchester City Council⁶⁵ considers Piccadilly Gateway as one of the locations with the greatest potential for high-density development and expects considerable employment and residential growth in the future. Additionally, Piccadilly Station is identified as a key generator of activities in the wider Manchester area.

Plans for further development of the Manchester Piccadilly station are linked to strategic plans for future rail network development. In particular, development of the station is strongly connected to the Northern Hub and High-Speed 2 plans. The realisation of these plans will further reinforce the importance of the Piccadilly station as a transport hub for the Greater Manchester area and, more broadly, North England.

The Northern Hub is a series of projects targeting bottlenecks for the hub function of Manchester, which would allow for the creation of additional capacity for freight and passenger transport. Overall the investment in the Northern Hub series of projects is estimated to return a benefit of € 5 for every € 1.26 of public expenditure.⁶⁶ Impacts on the urban environment have been the driving factor for the choice of the preferred construction alternatives for station infrastructure. The final choice of platform alignment at Manchester Piccadilly was made on the basis of minimising the negative impact on local enterprises in

62 <https://www.networkrail.co.uk/manchester-piccadilly-station/history/>

63 Steer Davies Gleave (2011): The value of station investment; research on regenerative impacts

64 Downing et al. (2012): Victoria Station, City Link Victoria Regeneration Project

65 Manchester City Council, Manchester Core Strategy Proposed Option: http://www.manchester.gov.uk/downloads/download/3626/core_strategy_proposed_option_consultation

66 Network Rail(2013): The Northern Hub factsheet

the station area, as well as minimising visual pollution and providing the best potential for further urban redevelopment.⁶⁷

As part of the HS2 scheme, further northern expansion of the high-speed rail network of the UK is planned with the western branch reaching Manchester. The unfolding of the HS2 scheme (including station investment) is expected to have a significant impact on the Greater Manchester area in terms of job creation, additional GDP, and new housing units.^{68 69}

Conclusions

- Real estate value:
 - increased in the vicinity of the station by about 33 % after station improvements;
 - 60,000 m² of new office space created;
 - generation of a € 12.6 million of rental income;
- Increased investments and value added:
 - € 163.8 million of inward investments;
 - € 8.3 million of additional gross value added (GVA);
- Generation of jobs:
 - approximately 3,000 new jobs in the area;
- Improved business and leisure environment:
 - 2,000 m² of retail space, plus a pub and restaurant along the concourses.

67 Steer Davies Gleave (2011): The value of station investment – research on regenerative impacts

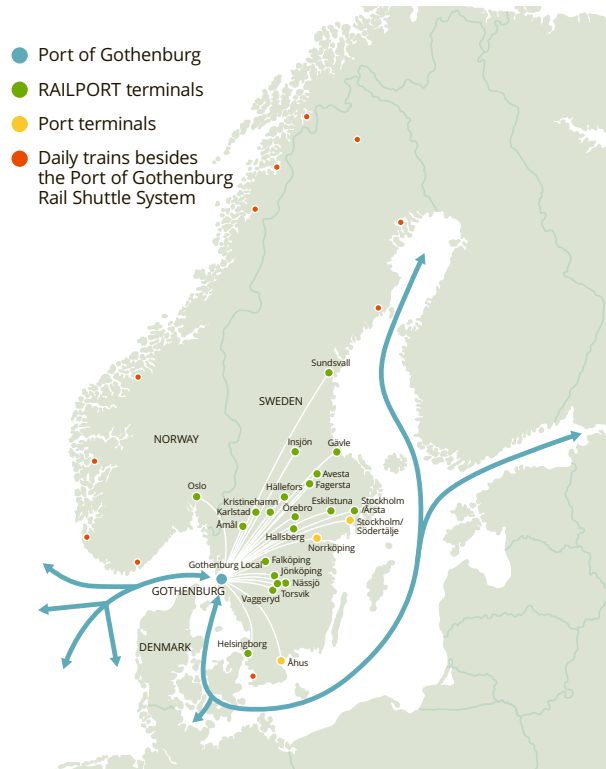
68 ATKINS (2014): Maximising the growth & regeneration benefits of HS2; final report

69 Temple-ERM (2013): High Speed Rail: Consultation on the route from West Midlands to Manchester, Leeds and beyond; Sustainability Statement; Non-technical summary; A report for HS2 Ltd

2.5 Case study 4: Rail shuttle system in the hinterland of the Port of Gothenburg

The Port of Gothenburg is Scandinavia's largest port. The port handles 65 % of Sweden's container traffic, amounting to almost 900,000 TEU⁷⁰, and over 500,000 roll-on/roll-off units annually. It is the main port for refining, storing and transshipment of over 20 million tonnes of oil per year and handles close to 40 million tonnes of freight. It is also one of Scandinavia's largest car ports, handling over 200,000 cars every year, combined with 1.5 million passengers travelling internationally.⁷¹

For a little over ten years, the Port of Gothenburg has been intensively increasing the use of rail shuttles to and from hinterland intermodal cargo terminals. In the late 1990s a general trend in the transportation of goods became visible: the use of intermodal inland terminals to enlarge the hinterland of seaports and cut costs across the transport chain.⁷² This meant that the role of seaports changed in that they became a dynamic interlink providing one of several systems in the logistical chain. Ports are now required to drive rather than react to developments in both their hinterland and foreland.



The Port of Gothenburg has been actively seeking cooperation with inland terminals so as to develop an extensive network of rail shuttle connections. Currently (spring 2014), there are 28 daily rail shuttles between the Port of Gothenburg and 22 towns and cities throughout Sweden and Norway. These connections cover a broad range of distances: from less than 10 kilometres to up to 500 kilometres. By replacing (mainly) road transportation, the shuttle network allows large volumes of goods to reach the port's customers quickly and efficiently, whilst also decreasing the environmental impact of the transport chain.

Next to its hinterland railway connections, the Port of Gothenburg has a highly efficient on-dock rail terminal for rapid transshipping for intermodal transportation, alongside customer-adapted whole train systems. These efforts have enabled a steady growth in the transshipment of containers via train: in 2012 close to half of all containers coming through the Port of Gothenburg were transported to hinterland connections by train.

The increasing number of containers being transported by train has a positive effect on overall transport

⁷⁰ Twenty-foot equivalent unit (TEU): Standard unit for describing a ship's cargo carrying capacity, or a shipping terminal's cargo handling capacity. A standard forty-foot (40x8x8 feet) container equals two TEUs (each 20x8x8 feet).

⁷¹ Figures taken from the Port of Gothenburg Rail services fact sheet published in June 2013.

⁷² McCalla R.J.(1999): Global change, local pain: intermodal seaport terminals and their service areas, *Journal of Transport Geography* 7(4)

costs of the port, which are estimated to have decreased by 10 %. This means that the current rail shuttle system generates annual business cost savings of about € 6 million.⁷³ This figure is based on the fact that the rail system, which handles over 40 % of all containers to and from the Port of Gothenburg, is more cost efficient than conventional handling by lorry.

The switch from road to rail also has a positive effect on the environmental impact of transportation services. Annually, the rail shuttles eliminate a total of some 120,000 truck journeys, saving roughly 60,000 tonnes of carbon dioxide emissions. Table 2 provides an overview of indicators on the reduction in environmental impacts resulting from the shuttle services.

Table 2 Environmental impact factor difference between train and lorry 2012

| Environmental impact factor | Annual difference between train and lorry |
|-----------------------------------|---|
| Fuel, diesel | 25,000,000 cubic metres |
| Carbon dioxide (CO ₂) | 60,700 tonnes |
| Nitric oxide (NO _x) | 530 tonnes |
| Hydrocarbons (HC) | 21 tonnes |
| Particles/dust (PM) | 12 tonnes |

Source: Swedish Environmental Institute (IVL)

Combined with an expected increase in transportation by rail, this decrease in environmental impacts means that the city of Gothenburg is well on its way towards achieving (and possibly overtaking) not only EU climate and energy targets but also voluntary agreements made in the Covenant of Mayors.⁷⁴

Furthermore, the employment created by the rail network system should not to be overlooked: this amounts to close to 400 people.

The increase in the transportation of goods via rail was initiated by a decision of the board of directors of the Port of Gothenburg that half of the growth in the container segment should enter or leave the port by rail. The growing rail shuttle system between the Port of Gothenburg and its hinterland connections has far surpassed this goal, realising an annual growth of roughly 15 % in the last decade. The

The Danish Architect Centre indicates that the rail system of the Port of Gothenburg can be replicated by other municipalities and terminals. According to the centre, the system “can be applied in new locations with sufficient freight volumes and the required interest from stakeholders. A combi-terminal provides the possibility to develop sustainable and economically-advantageous transport solutions to and from those regions where terminals are established.”

⁷³ Bergqvist, R., Woxenius, J. (2011): The Development of Hinterland Transport by Rail – The Story of Scandinavia and the Port of Gothenburg, *The Journal of Interdisciplinary Economics*, 2011, Vol. 23, pp. 161–175

⁷⁴ “The Covenant of Mayors is the mainstream European movement involving local and regional authorities, voluntarily committing to increasing energy efficiency and use of renewable energy sources on their territories. By their commitment, Covenant signatories aim to meet and exceed the European Union 20% CO2 reduction objective by 2020: http://www.eumayors.eu/index_en.html

Port of Gothenburg is currently trying to extend its extensive usage of its rail network by increasing the number of semi-trailers using the system, aiming to increase the positive impacts of the rail shuttle system in its hinterland.

In conclusion, in the Port of Gothenburg case, increased use of rail transportation has led to decreasing transportation costs, lower environmental impacts, and increased employment. In other words: all major stakeholders have benefitted from the project and the quality of life in the local area has greatly improved.

Conclusions

- Increased efficiency of the port railway system;
- Reduction of transport costs by approximately 10 %;
- Reduced environmental impact of the hinterland transport system: 60,000 tonnes of carbon dioxide emissions saved annually;
- Direct creation of employment for 400 persons;
- Increased use of rail shuttles of more than 15 % per annum over the last decade.

3 IMPACT OF RAILWAY TRANSPORT ON COMPETITIVENESS AND INNOVATION

In line with its 'Europe 2020' ambitions, the European Commission's 2011 Transport White Paper sets out a strategy to establish an EU transport system that is capable of underpinning economic progress and competitiveness. An increased role for rail transport, as part of a competitive and sustainable transport system, forms an integral part of the EU strategy.

In light of the above, this chapter assesses the underlying drivers of competitiveness for the railway sector within Europe's transport system. It also looks at how efforts to improve the competitive position of the railway transport sector triggers innovation in rail operations and rail suppliers. As a result not only the position of railway transport improves, but it also leads to a stronger global competitive position of the European rail supply industry.

3.1 The competitive position of rail transport in the transport system

In addition to the overall policy framework, which should function as an important external factor influencing the competitive position of rail transport vis-à-vis other modes of transport, a number of internal drivers can also be distinguished. The most important factors defining the competitive position are:

- rail transport costs which in turn are influenced by productivity and efficiency improvements;
- the quality of rail services.

Significant efforts have been undertaken to improve the competitive position of rail transport in relation to both these underlying drivers, leading to increased efficiency of rail operations and improvements in service quality.

3.1.1 Transport cost: productivity and efficiency improvements

Lower operating costs can be passed on to transport users in the form of lower user costs, thus increasing the attractiveness of the transport mode. Alternatively, savings in operating costs could (partially) be used to invest in rolling stock, technologies, or skills that increase the quality of supply and thereby increase the competitive position of rail.

Lowering administrative costs

Lowering administrative costs helps to lower customer costs. Transport documents, such as waybills, bills of lading and consignments notes, play several important roles in transport and logistics. These transport documents, as many other interactions in transport and logistics, are still paper-based. It is estimated that some 10 to 15 % of the final costs of transport can be attributed to the costs of paper documents and delays in transit required to complete and check them. Particularly in multimodal transportation, further inefficiencies are introduced by the need to transfer from one set of paperwork to another each time the cargo changes transport mode.

Experiences in the rail freight market in the United States have shown that the introduction of electronic/computerised systems, which allow for transactions between shippers and railway operators to be automated, has led to significant reductions in administrative costs. European rail operators and railway undertakings have also recognized the potential to improve service quality (reliability of transfer of documents) and reduce costs thanks to the harmonization of transport documents and the electronic exchange of data. The concept of e-Freight denotes the vision of a paper-free, electronic flow of information that associates the physical flow of goods to a paperless trail built on smart technologies.

The improved cost and price competitiveness of railway transport is the result of improvements in operational efficiency and productivity. The previous section of the report pointed to the increased labour productivity of railway transport. A number of other indicators also reflect developments in operational efficiency and productivity.

Operational efficiency, as expressed by the ratio of passenger-kilometres or tonne-kilometres to train-kilometres, grew between 2003 and 2012, although fluctuations did occur between years.⁷⁵ Apart from the utilisation of trains, operational efficiency can also be measured in terms of the intensity of use of infrastructure, which also shows an upward trend between 2003 and 2012.

Productivity of rolling stock, expressed as train-kilometres per unit of rolling stock also improved. Overall, the average productivity of rolling stock grew by some 14 % between 1998 and 2012.

The increase in fleet utilisation efficiency is due to a range of factors. Operators have rationalised their fleets of rolling stock, both by investing in new vehicles with higher capacities and lower maintenance needs, and by eliminating lower-productivity fleet components. Furthermore, the introduction of improved fleet management and maintenance technologies has facilitated higher levels of fleet availability. As a result of better utilisation, the (relative) size of rolling stock fleets could be reduced.

Another indicator is total-factor productivity (TFP), which captures productivity gains that are not measured using traditional labour and capital indicators. A study by Wetzel (2008)⁷⁶ provides an analysis of the development of TFP using data from 31 railway companies in 22 European countries covering the years

75 ERA (2013): Intermediate report on the development of railway safety in the European Union, 15 May 2013.

76 Wetzel, H. (2008): Productivity Growth in European Railways: Technological Progress, Efficiency Change and Scale Effects, Working Paper Series in Economics, No. 101, University of Lüneburg

1990-2005. Her study provides a breakdown of TFP into different factors: technical change, technical efficiency change, and scale effects.⁷⁷ The analysis finds that **overall productivity** has grown significantly over time, with **technological progress** being identified as the main driver of productivity growth in the European railway sector. Several other studies⁷⁸ have also found that improvements in rail technology are a key driver of productivity growth in the railway transport sector.

The analysis of Wetzel (2008) also illustrates that **(technical) efficiency** has improved in the European railway sector. While employment in rail transport decreased significantly during the past decades, transport volumes have grown on average in the EU in both the passenger and freight segments, as illustrated earlier.

3.1.2 Quality of rail transport services

The quality of transport services is usually considered to be a combination of various factors which include journey time, reliability, frequency, flexibility, and customer information. The relative weight attached to each of these factors largely depends on the motives for travelling in the case of passenger transport, or on the type of commodity and specific characteristics of the logistics chain when dealing with freight.

Punctuality is a main determinant of user satisfaction and an essential contributor to perceptions of service quality. In 2011, punctuality levels recorded by passenger rail operators showed that, on average, more than 90 % of all trains arrive within 5 minutes of their scheduled time. Using a 15 minute threshold, this proportion rises to 98 %. Data also show that punctuality improved slightly between 2010 and 2011⁷⁹, rising by 1 to 3 percentage points depending on the categories of delays and type of services. Although evidence is patchy, information from individual passenger transport operators indicates that in some countries punctuality has increased by 5 to 10 % over the past decade.

Punctuality in Austria

In Austria, infrastructure manager ÖBB Infrastruktur and the rail passenger operator ÖBB-Personenverkehr AG, have worked together to introduce a whole package of measures to improve punctuality. These include investing in high-tech switch heaters and implementing an accurate and early-warning system for weather events (snow, wind, temperature extremes) in order to be able to mobilise staff in good time. In addition, speed restrictions were removed and maintenance work was adjusted to minimise disruption.

A meticulously planned and maintained programme of activities for the last five minutes before departure from the originating station has been designed to provide a precisely timed departure countdown. Its introduction has encouraged drivers, train crews, platform staff, signalling staff and many other staff members to work even more closely together to achieve a punctual departure. As a result, between 2009 and 2011, overall punctuality improved by 6.1 %; for long distance traffic the increase was above 10 %. In 2011, 96.6 % of passenger services ran on time (5 minute punctuality threshold).

⁷⁷ Based on a stochastic frontier model for panel data that accounts for firm-specific heterogeneity (TFE model), the study estimated a translog input distance function to investigate technical efficiency and TFP change. Furthermore, it used a generalized Malmquist index approach to decompose TFP change into different components: technological progress, efficiency change, and scale effects.

⁷⁸ Cantos and Maudos (2000) analysed productivity changes between 1970-1990; Gathon and Pestieau (1995) analysed 1961-1988; and Loizides and Tsionas (2004) analysed 1969-1993.

⁷⁹ Only since EC Regulation No 1371/2007 came into force in 2009 rail operators are obliged to report on service quality indicators, including punctuality.

3.2 The importance of innovation in railways

Innovation, both process and product innovation, plays an important role in strengthening railway transport's competitiveness. Innovation can affect underlying competitiveness drivers (e.g. costs and quality) and it can also influence other factors such as environmental performance and safety. Today it is widely recognised that innovation and technological improvements, including further technical standardisation between rail systems, are key enablers for the long-term sustainability of railway transport in Europe. In this section we show how various innovations affect the quality and efficiency of the rail transport sector and introduce the SHIFT²Rail initiative as a coherent strategy for further innovation. In connection with this initiative we draw attention to the importance of rail transport for the railway supply industry.

3.2.1 Innovation affecting quality and efficiency

The deployment of technological innovations such as the European Railway Traffic Management System (ERTMS) can help to increase the quality and efficiency of rail transport services.

Furthermore, the safety of rail transport has been raised through innovations such as embedded sensors and instrumentation, which have allowed faster and more accurate surveying of the condition of infrastructure and rolling stock.

Innovative signalling and control - ERTMS

ERTMS is contracted for more than 30,000 km of railway tracks, out of which nearly 50% outside of Europe. It has therefore established itself as a global standard.

Innovative signalling and control systems can significantly contribute to optimise capacity of the rail network and increased reliability of transport services provided that they are implemented in a consistent manner, based on stable specifications. ERTMS combines two main new pieces of technology: the European Train Control System, the signalling and control-command component, and GSM-R, the radio system for communicating between track and train.

This is expected to allow a significant reduction of the minimum headway between trains enabling

more capacity on currently existing infrastructure. Furthermore ERTMS facilitates cross-border traffic movements as locomotives no longer need to be equipped with different signalling systems to be allowed to cross borders.

Benefits from ERTMS in Italy

Italy, an early investor in ERTMS, has installed ERTMS Level 2 as the only signalling equipment (without any fall-back system and without trackside signals) on the high-speed network from Turin to Naples. This allows for considerable savings in infrastructure and maintenance costs. Italian rail operators can choose from a range of different suppliers of ERTMS equipment and all high-speed trains can efficiently switch from ERTMS to the Italian signalling system used on urban nodes and stations, as well as on traditional rail tracks.

Technological innovations have also increased the possibility to avoid energy loss when braking, which contributes to making railway transport even more eco-friendly. The principle of regenerative braking is increasingly being adopted as standard in new trains.

Regenerative braking

The idea behind a regenerative braking system is to avoid losing energy by braking. The braking system of a conventional electric train uses dynamic braking where the kinetic energy of the train is lost, mainly in the form of heat. Regenerative braking means that the current in the electric motors is reversed, slowing down the train and, at the same time, generating electricity to be returned to the power distribution system. This generated electricity can then be used

to power other trains within the network or to offset electricity demand elsewhere.

Regenerative braking is a mature technology that is becoming increasingly widespread across Europe and is now relatively standard in new trains. The possibility to use the technology depends, however, on the track and cabling system.

New on-board technology installations such as Wi-Fi also increase the quality of service of rail transport.

On-board internet services for railways passengers

An increasing number of train operators offer wireless internet on board their trains. This provides passengers with increased opportunities for social networking, entertainment or spending their time productively through access to business networks and information whilst traveling. Having on-board internet access clearly contributes to the attractiveness of rail transport. Moreover, deploying broadband internet to trains can also create revenues to cover (part of) the cost of its deployment.

Accelerating innovation in smart technologies and social media, combined with the integration of these internet-based technologies in the railway industry, has opened up a whole new range of possibilities to improve passenger services. Key areas in this respect include the introduction of advanced route planning and real time travel information, as well as multi-channel distribution and sales for tickets. Increasing the ease with which passengers can buy train tickets is an important element of service

quality for passenger rail services. Also, through-ticketing systems, where appropriate, can greatly reduce the burden on passengers who are planning journeys using transport services from multiple operators.

In today's world, we can observe an increasing trend whereby people do not want to be dependent on private cars for seamless door-to-door travel. The introduction of multimodal journey planning tools and integrated ticketing systems have significantly contributed to addressing this need. Nonetheless, it is vital to offer good interchange with other forms of transport. The majority of train journeys involve another mode of transport, either at one or both ends of the trip. Fundamentally, rail stations are transport interchanges, not just places where passengers board and alight from trains. Thus, in many countries various measures

have been taken to provide better access to railway stations. Train stations are increasingly being redesigned as multimodal transport terminals; examples range from better car parking facilities and car rental services to improved cycling connections. Cycling is increasingly being recognized as a quick and efficient method of accessing train stations and investments have been made to improve bicycle access and bicycle parking facilities.

Bicycle rental at railway stations: the example of OV-Fiets

The Dutch bicycle renting scheme 'OV-fiets' is one of many bicycle renting schemes introduced by European railway companies. It is specifically designed to provide train passengers and other public transport users with a quick and easy, low cost solution for the last mile. Since 2008 the scheme has expanded into a nationwide scheme with over 250 rental locations, primarily at railway stations and transportation hubs. The number

of customers, rentals and rental locations has almost tripled in the last three years and is still expanding. The number of rented bicycles reached 1,400,000 in 2013, with 160,000 users. Moreover, the scheme is commercially viable at current levels and studies have shown that the scheme has resulted in more frequent train use, less car use, and has enhanced the parent brand of rail operator NS.⁸¹

3.2.2 SHIFT2RAIL – a major innovation initiative within Europe

Various reports⁸¹ have highlighted that innovation processes are not always straightforward. There are factors that prevent long-term R&D investment from taking place, among which: low operating margins, high up-front costs, and long product life-times; short production series with high levels of customization, i.e. high asset specificity, which further raises investment risk and decreases the scope for opportunities that cross system or organisational boundaries; as a result, conservative attitudes that favour proven technologies and lead to slow penetration of innovation.

The same reports also show that more coordinated, long-term R&D is needed if the EU is to meet changing transport needs and strengthening the competitive position of the European rail supply industry. The need for continued public R&D support has also been highlighted. These observations support the rationale behind the rail industry's proposed joint technology initiative, SHIFT²RAIL, which aims at tackling the R&D gaps in the European rail sector through a large-scale, holistic, and cross-industry approach.

The SHIFT²RAIL initiative aims to double the capacity of the European rail system, to increase its reliability and service quality by 50 %, while also halving lifecycle costs. It will be the first European rail joint technology initiative to seek focused research and innovation (R&I) and market-driven solutions by accelerating the integration of new and advanced technologies into innovative rail product solutions. It will also be the first European rail joint undertaking to support rail product solutions.

80 Association for European Transport and Contributors (2012): How 'OV-Fiets' influences customer based brand equity of Dutch Railways. A study on Customer based brand equity of a sub brands' contribution to a corporate brand

81 UK Department for Transport and Office of Rail Regulation (2011): Realising the potential of GB rail., Ecorys (2012): Competitiveness of the European Railway Supply Industry, COM(2014) 14/2: For a European Industrial Renaissance

3.2.3 Importance of innovation for the European rail supply industry

Innovation in the rail transport sector not only strengthens the competitive position of railway operators but also enhances the global competitive position of the European railway supply industry (RSI) by enabling it to retain its technologically advanced position relative to other global competitors. This in turn supports the best use of the European rail supply industry's considerable knowledge base and highly skilled, but also highly specialized, workforce.

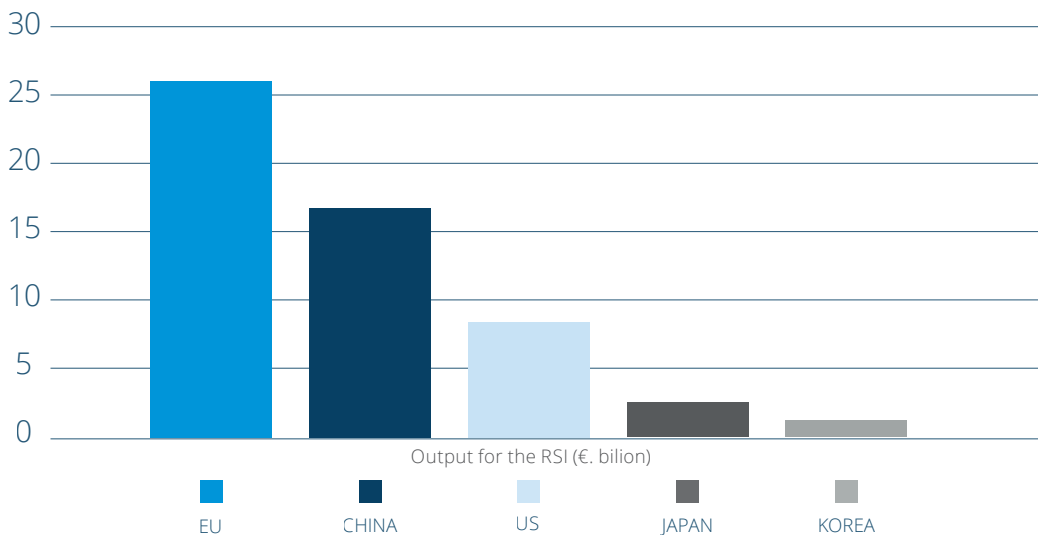
The European rail supply industry is one of the few industrial sectors in which Europe is still a global leader.⁸² The global rail supply market was estimated to have a value of € 136 billion in 2012, with a predicted annual growth of 2-2.5 % for the next few years. With a share of 21 % of global trade the EU is the leading exporter on the world market. In addition, the EU is the most important producer of railway products, accounting for 46 % of the combined output of the main international producers (EU, Japan, US, Korea, China).

A recent study⁸³ on the competitive position of the EU RSI reveals its strong international position, which is underpinned by a strong domestic market. The EU has succeeded in improving its competitive position vis-à-vis Japan and the US; although China and, to a lesser extent, Korea are gradually positioning themselves as stronger competitors. In spite of its bright performance in international markets over the past decade, it will be a major challenge for the EU RSI to stay at the cutting edge of the technology developments necessary to secure future success on global railway markets.

Competitiveness of the rail supply industry

The competitiveness of the RSI can be measured using various indicators. Data on total output clearly show the position of the EU as the industry leader.

Figure 6 RSI output, EU versus major competitors, 2009, € billion



Source: Ecorys based on Eurostat and UN COMTRADE data

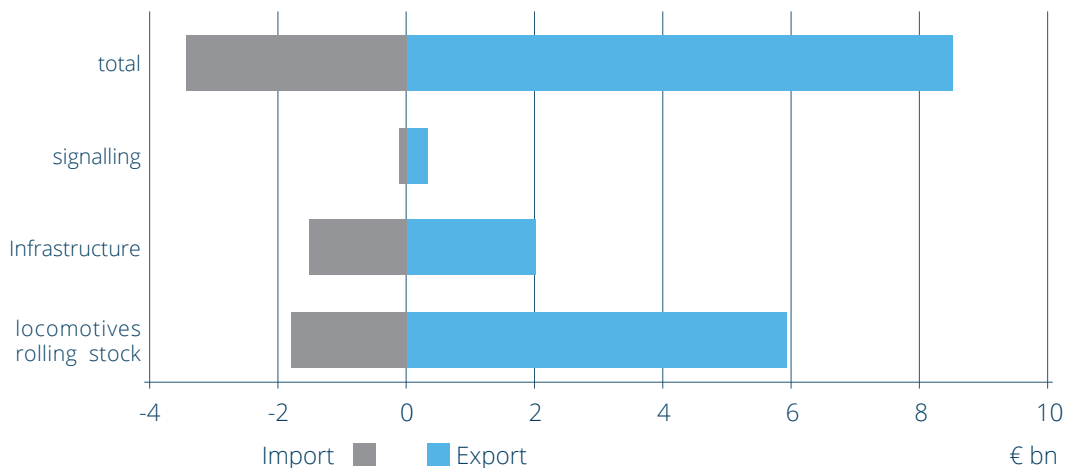
82 Cadet (2012): Competitiveness of the European Railway Industry and the Partnership Industry-Academia: a must

83 Ecorys (2012): Competitive position of the EU RSI

The EU RSI had an output of about € 27 billion in 2009, followed by China with € 18 billion. Overall, the available production data suggests that the EU accounted for as much as 50 % of global production.

The EU RSI has a significant net export position (excluding EU internal trade) with the rest of the world which is driven mainly by the locomotive and rolling stock segment.

Figure 7 EU import/export of the RSI in 2010



Source: Ecorys based on Eurostat and UN COMTRADE data

The EU RSI performs especially strongly in complex, integrated solutions (rolling stock, signalling and electrification). Furthermore, EU RSI companies invest from 4 to 10 % of their turnover into research and development activities. The EU RSI is hence a high R&D intensity sector.

SUMMARY OF THE ECONOMIC PILLAR

Railway transport is not only a core means of EU passenger and freight transport, but also has extensive impacts on the EU economy. These impacts include direct, indirect, induced and wider economic effects.

The EU **railway sector**, so including both train operation and railway infrastructure management, directly **employs 1.06 million people** and directly generates **€ 66 billion in gross value added**. Its direct contribution to EU GDP is **higher than that of air or water transport**.

Including the indirect effects generated through supplier relations and investments in rail infrastructure leads to a total of **2.3 million persons employed** and to **€ 142 billion in gross value added**. This corresponds to approximately **1.1 % of EU GDP**.

In addition, **induced effects** (“income effects”), which are based on the spending of persons directly or indirectly employed by the railway sector are estimated to contribute an additional range of **575,000 – 1,725,000 persons employed** and an additional **€ 35.5 – € 106.5 billion in gross value added**.

The EU railway sector has strongly improved its performance over the last decade. Concerning **labour productivity** it even **outperformed the overall performance of the EU economy**. Furthermore, the **competitive position** of railway transport has improved in terms of **transport costs, productivity**, and the **quality of rail transport** services.

In addition there are also **wider economic benefits** from rail infrastructure investments which are the result of reduced transport times and improved quality. Such effects **help cities to grow** and diversify their businesses, **create clusters, increase the value of real estate**, and **expand labour markets**.

The strength of railway transport in Europe also has a **strong positive impact on the European railway supply industry** which has a global leadership position.

II. THE SOCIAL & EMPLOYMENT PILLAR

This part of the report analyses social aspects of railway transport, including employment patterns. This includes internal demographic and employment trends in the sector, as well as a special focus on apprenticeship schemes which present important opportunities in times of high youth unemployment. This is preceded by a section on the social function of rail transport in enhancing social inclusion and mobility for all.

Hence this pillar consists of two chapters:

- Social inclusion and mobility for all;
- Providing jobs in times of crisis.





INTRODUCTION

There is a clear social function of railway transport in promoting social inclusion and mobility for all. Social inclusion in the area of transport may be defined as the ability of citizens to access places of employment, education, commerce, or leisure, and to access health services and public services. As such, inclusiveness is important for developing and maintaining both human and social capital and for upholding a social safety net for socially deprived persons. Furthermore the role of public transport in providing services that are both affordable and accessible, i.e. also for persons with reduced mobility, is widely recognised. Obviously, the role of rail transport is to a certain extent context-specific. A significant share of railway transport occurs in the context of public service contracts which public authorities may use as instruments of social policy, while commercial railway services may be seen as mid-market or, in some cases, as up-market mobility solutions. Ultimately railway transport aims not only to be inclusive towards vulnerable members of society but to provide mobility for all. In this respect, railway transport not only provides services to persons that do not have access to other means of transport, it also caters to those who prefer it over other forms of transport (e.g. cars) as part of broader life-style choices.

In addition, as shown under the economic pillar, railway transport is an important source of jobs for European citizens. These jobs are not just numerous, but also relatively safe in times of economic crisis. In addition, changing demographic structures within the railway transport sector mean that new job opportunities are opening up which, in turn, is reflected in large vocational and educational training programmes (VETs). In the following sections we first assess the topics of social inclusion and mobility for all, together with the sector's importance for providing jobs in times of crisis. The second section will present three examples of vocational and educational training programmes (VETs).

4 SOCIAL INCLUSION AND MOBILITY FOR ALL

The European railway transport sector plays an important role in fostering social inclusion. In addition, the sector is a crucial element in the delivery of 'mobility for all', as has been acknowledged by the European Commission. The Commission's strategies were outlined in a 2003 report⁸⁴, and in the Common Transport Policy⁸⁵, which includes the commitment to "place users at the heart of transport policy". In this regard, the Commission promotes a coherent approach, where transport planning is properly integrated into social policy.

4.1 Social inclusion in railway transport as a facilitator for equity and economic development

Fostering social inclusion contributes to achieving two transport planning goals, namely equity of transport and economic development:⁸⁶

- In terms of equity, railway transport can be considered as 'most equitable' if it provides the greatest benefit at comparable cost relative to alternative means of transportation. It is important, in this context, to keep in mind the strong positive external effects of railway transport on other transport users, especially when entering cities;
- Social inclusion contributes indirectly to economic development. Physical constraints that prevent individuals from obtaining an optimal education or employment may hamper overall economic performance. In this context, by reaching out to a wider part of society, railway transport (as opposed to car or air travel) can help to enhance the competitive positions and economic performance of underdeveloped regions and communities.

4.2 How does railway contribute to social inclusion and provide mobility for all?

Access to car transport varies strongly between men and women, as well as by age. In 2001 the group of drivers aged 65-74 (having access to cars) varied from 71 to 93 % for men and from 7 to 46 % for women across Europe. Rail transport is an important component of the overall transport package available to Europe's citizens, which improves connectivity and accessibility. Mobility is crucial in enabling people to participate in economic and social activities. Research has shown that "neighbourhoods with long-term low mobility problems contribute significantly to ingrained social exclusion."⁸⁷

Connectivity is not only affected by geographic proximity, but also by a time component. Research undertaken since the 1970s has shown that location is not the only determinant for functioning socio-

84 COM(2003)773 final

85 COM(2001) 370 final

86 Todd Litmann (2003): Social Inclusion as a transport planning issue in Canada. Contribution to the FIA Foundation G7 Comparison. Victoria Transport Policy Institute. P. 5. Adapted

87 MATISSE: a project that assessed the role of transport on social inclusion in Europe 2003, see: <http://www.fastuk.org/research/projview.php?id=1285>

economic constructs, which depends also on whether or not individuals have the time to connect to activities or each other.⁸⁸ Hence, rail services have also had a positive impact on connectivity through time savings. Furthermore, railway transport is much less congestion-sensitive than road transport, as it is able to provide high-capacity solutions for congested urban areas.

Railway providers and railway transport investments have played an important role in decreasing travel times and connecting more and more parts of Europe to each other. Many of the largest improvements to infrastructure have taken place in European regions that are still below the average in terms of connectivity, for example in Spain, Portugal, the South of Italy. Nevertheless, connectivity is still best in Germany, the Benelux countries and the North of France. This is partly due to the population density in these areas but it is also due to advanced rail networks. In the west of Germany, for example, accessibility is driven by an affordable and extensive system of regional and intercity trains.

88 See Hägerstrand, Torsten (1970): *What about People in Regional Science?*, Papers in regional science

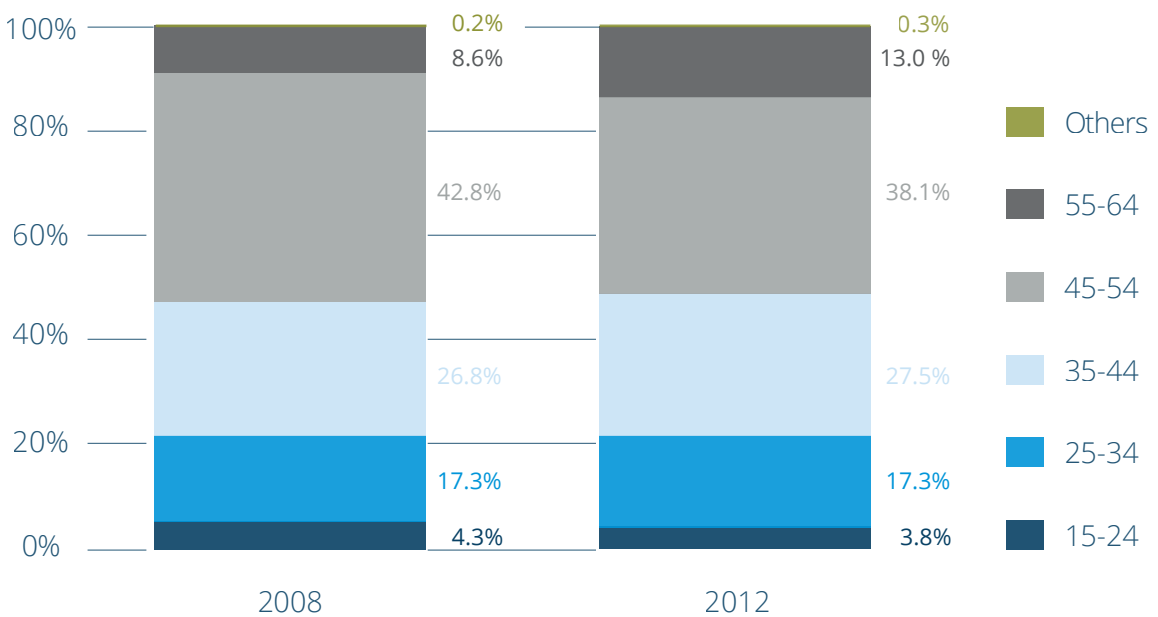
5 PROVIDING JOBS IN TIMES OF CRISIS

The railway sector and the many activities linked to the sector are an important source of employment for European citizens. In the past decade, the sector has not only continued to provide secure jobs for existing employees but has also initiated an ongoing *revitalisation process* that will offer opportunities for younger generations. This is particularly relevant at a time when the European Union is facing a significant challenge in the area of youth unemployment.

5.1 A demographic need for new people

A survey among CER member companies that collected information on the age structure of their employees revealed that more than 50 % of current employees are aged above 45 years.

Figure 8 Age distribution of employees in the railway sector (2008, 2012)



Source: Ecorys based on answers from eleven companies operating in thirteen countries

The data show that, whereas in 2008 only 8.6 % of railway company employees were close to retirement age, this number had risen to 13 % in 2012. On the one hand this demonstrates that railway transport continues to provide job security for an older generation of employees. On the other hand this reveals an emerging necessity for railway transport operators to attract and train young people. As a consequence of this demographic shift, railway transport is expected to contribute positively to the challenge of youth unemployment.

5.2 Trends in hiring and leaving

As a consequence of the changing employment demography, a substantial increase in new hiring among a number of CER member companies can already be observed. Between 2003 and 2012 the annual number of people hired by a subset of CER member companies (the respondents to a targeted survey) increased by 21 %.

Figure 9 Trends in hiring in the railway sector 2003 - 2012, head-counts



Source: CER member flash survey - Based on answers provided by ten companies

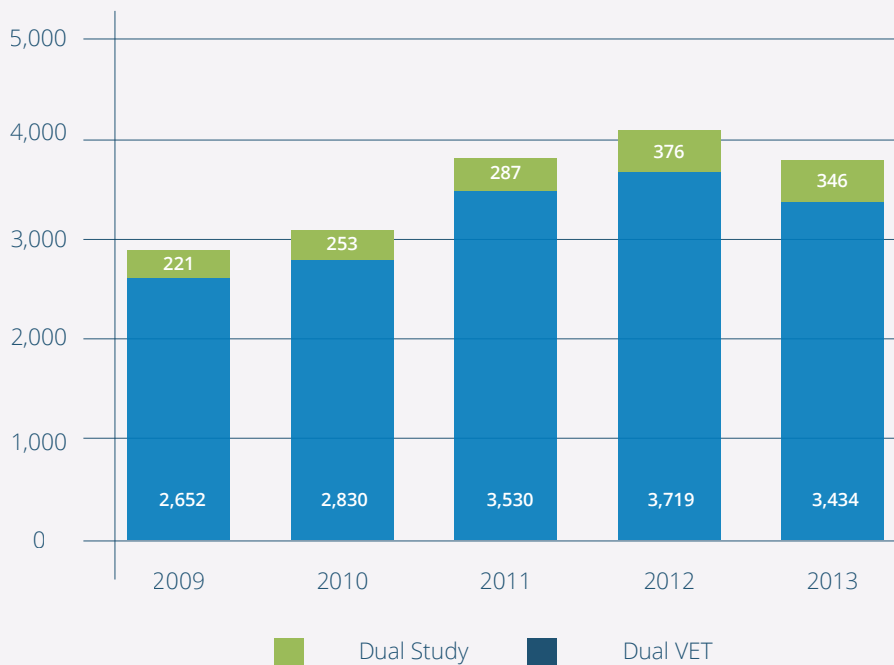
Hence, even though not every retiring employee was replaced, the railway sector was still able to create significant job opportunities for young people. Apprenticeship schemes play an important role in anticipating these needs. Three examples of existing apprenticeship schemes are described in this section.

Vocational education and training (VET) at Deutsche Bahn (DB), Germany

In Germany, vocational education and training (VET) is the main pathway into employment with about 56 % of a given age cohort taking up such training. This high ratio is seen as one of the main factors explaining the country's relatively low youth unemployment in the wake of the 2008 crisis. VET is typically delivered at upper secondary level through a dual system of in-company training and part-time education at a vocational school.

DB currently employs more than 10,000 young people in VET, making them one of the top three providers for apprenticeship schemes in Germany. 3,343 apprentices started their dual VET at the company in 2013. Additionally, 346 started in Dual Study Programmes, which combine education and in-company training at tertiary level, and 82 started as trainees after having graduated with a tertiary degree. This case study focuses on dual VET given its relative importance at DB.

Number of starters in VET and dual study at DB 2009-2013



Source: data provided by Deutsche Bahn

While DB has been offering general apprenticeships already since its beginning, since 2000 DB has been recruiting apprentices tailored to suit market need in line with company forecasts on medium-term workforce developments.

Apprentices at DB are trained in over 50 professions notably train driver (currently about 1,200 apprentices), electronic industrial engineering (1,120), mechatronics (1,000) and management assistant in traffic services (750). Apprenticeship candidates are selected independently of school type or graduation results through an online test and individual interviews.

All apprentices sign private-law contracts with DB and receive payment from DB in line with collective wage agreements. The training typically takes between 2.5 and 3.5 years depending on the chosen profession. Young people are trained at three locations: in the company, in the part-time vocational school and in DB training – the DB internal training provider.

Positive impact on youth employment beyond the national context

High quality VET provision is one of the key priorities at DB, given the need to replace around 70,000 workers in the coming ten years due to demographic change. VET is seen as the main entry point for skilled labour into the company.

One indicator for the effectiveness of the scheme is the take-up rate of apprentices after graduation. DB regularly employs over 94 - 95% of young people after graduation and has in fact agreed a guaranteed employment scheme for all successful candidates with the trade unions in 2013. Additionally, retention rates after entry are high for the German context: less than 4 % of apprentices leave the company within the first three months of entering the VET programme.

Important success factors of the scheme are:

- Embeddedness in the established, strongly quality controlled and regulated German dual VET system;
- Formalised support concept outlining which people are involved in VET, which instruments are being used (e.g. provision of feedback) and how the quality of VET can be maintained;
- High practical relevance through in-company training aimed at accustoming young people with the reality of the job (e.g. working shifts where relevant);
- Recruitment based on market need and high subsequent chance of employment with the company;
- High quality recruitment through a sophisticated online tool.

Additionally, DB has a positive impact on youth employment beyond the national context. The company provides consulting services in the area of VET to other railway operators, in particular in Southern Europe. Accordingly DB is currently in discussions with Spain and Greece.

Vocational education and training (VET) at Österreichische Bundesbahnen (ÖBB), Austria

VET is a key defining feature of the Austrian labour market. As in the German case, high VET uptake is thought to contribute to the country's relatively low youth unemployment rate. In fact, 40 % of the adult labour force has completed a vocational degree within the dual system (*Lehre*) as their highest level of education. VET is implemented through a dual system of practical in-company training (about 80 % of time spent) and part-time education at a vocational school. Apprentices typically enter VET at upper secondary level.

ÖBB's apprenticeship provision has a long history and was first set up in 1885. Today, ÖBB is the largest provider of VET in technical vocations in Austria and currently employs 1,800 young people. Every year, the company hires around 500 new apprentices, which are trained in 22 technical and commercial professions, 8 of which are specific to the railway industry.

Apprentices typically join ÖBB at the end of nine years of compulsory schooling and undergo 3 - 4 years of dual vocational training. Young people may take part in 3 to 3.5 years of training in a traditional trade (e.g. electrician) before acquiring a second specialist specialist, railway-specific training lasting half a year. Technical training is provided in training workshops in the first two years, after which apprentices apply their skills in the field. Apprentices sign a training contract directly with ÖBB and receive remuneration during their training (from around € 400/month in the 1st year to € 1,000/month in the 4th year) as defined in collective agreements.

While ÖBB receives a small public subsidy to cover part of the cost of providing the training (around € 1,000 per year), it has been estimated that training one apprentice costs ÖBB around € 80,000 overall including the costs for remuneration. While this number might seem high, there is an acknowledgement within the company that training own apprentices is crucial to be competitive by securing access to staff with specialist skills. It has also been found that apprentices have great loyalty to their training company and more often stay committed to ÖBB after their apprenticeship ends.

Positive impact on youth employment in Austria

ÖBB seeks to ensure a high level of qualification for its apprentices in order to have access to high-quality skilled workers in the future. The educational achievement of ÖBB apprentices is high; 98 % are successful in their graduation exams and 70 % graduate with distinction. After graduation between 60 and 70 % of young people are taken on by ÖBB on average, but graduates are said to also easily find employment elsewhere. Yet, staff reductions in recent years have negatively affected young graduates.

Beyond offering the traditional dual vocational route, ÖBB also offers an Integrative VET. The integrative VET aims to provide disadvantaged young people with the opportunity to obtain a vocational qualification. Each year ÖBB takes on 36 young people in such training, which is characterised by personalised support through specially trained staff (Berufsbildungsassistenten) and longer training time. The integrative VET offers these young people a real perspective of achieving a vocational training.

Overall, the most important success factors of the VET scheme at ÖBB are:

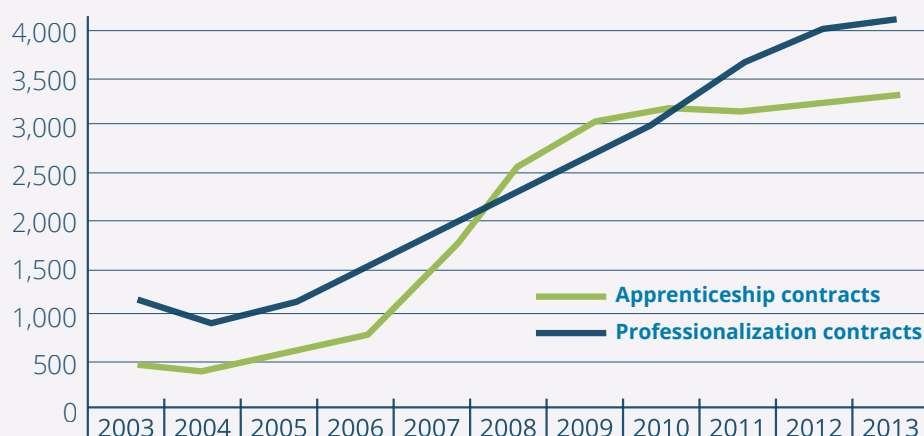
- Close cooperation with other stakeholders: government actors and social partners;
- Early intervention: ÖBB approaches 13 to 14 year-olds during “discovery days”, where young people can try out and get insights about VET at ÖBB;
- Holistic education: young people are not only trained in a profession, but also gain access to more general education. ÖBB offers a number of cultural, sports and integration projects, which aim to develop the young apprentices’ personalities beyond technical training and the role of in-company trainers has a strong socio-pedagogical component;
- Low drop-out rate: ÖBB records a drop out rate of 8-10%, which is well below the average drop-out rate of 20 % in Austria;
- Specialised provision for disadvantaged youth.

Vocational education and training (VET) at Société Nationale des Chemins de fer Français (SNCF), France

Youth unemployment has been structurally high in France even before the economic crisis, when the under-25 unemployment rate fluctuated around 20 %. Yet the situation has worsened since then. At the same time apprenticeships have become an even more popular form of qualification, with the number of apprentices having doubled over the last 20 years. Dual vocational education and training, which combines on-the-job training with part-time study at training centres is delivered in two ways:

- 1) **Apprenticeship Contract (*contrat d'apprentissage*)**, which enables young people (aged 16 to 25) to gain a recognised initial vocational qualification (273,000 youth in 2013). Required entry qualifications are generally low: In 2013, 57 % of apprentices entered this path with low or no qualifications in 2013.
- 2) **Professionalization Contract (*contrat de professionnalisation*)**, which enables young people under the age of 26 or older unemployed people to gain a vocational qualification and often serves as an entry way to train for a specific post in an enterprise (156,000 young people in 2012). Young people on professionalization contracts tend to be more qualified – 70 % of new entrants in 2012 had at least a high school diploma (*Baccalaureat*).

SNCF has a long history of apprenticeships provisions which reaches back to the first part of the 20th century. In 2013, 6,336 apprentices were enrolled at SNCF. This is above the target set by the French government, which requires companies to take on a number of apprentices equivalent to 4 % of their employees (5 % from 2015).



The number of apprenticeship places at SNCF has increased strongly over the last decade (from 1,477 in 2003 to 6,336 in 2013), mainly due to the diversification of training, which initially included only railway-specific professions. Vocational training is now provided across the eight branches of activities of SNCF (infrastructures, equipment, traction, travelling, proximity, stations and connections, circulation, transversal functions) and allows acquiring a broad range of qualifications, from high school diploma (*professional Baccalaureat*) to engineering diploma.

VET is mainly financed by the enterprise itself: apprenticeships contracts are financed through the apprenticeships tax and professionalization contracts are funded through the contribution of SNCF to professional training funds. In addition, regional authorities partly finance training centres (CFA).

Positive impact on youth employment in France

SNCF has hired 761 graduated apprentices in 2013, mainly for technical professions, yet according to SNCF graduates have an excellent employment outlook even outside SNCF itself. The 2013 annual survey to monitor the quality and relevance of VET schemes at SNCF illustrates a high level of satisfaction of young people with the scheme. 98 % stated to have acquired professional skills and 94 % of young people would recommend the scheme to other young people. Furthermore, 85 % of young people feel appropriately supported by their tutors and tutoring is mainly delivered in one-on-one relationships (78.4 %). 83 % of tutors are willing to mentor other youth in the future.

The success includes:

- Availability of training for all levels of qualifications (from technicians to engineers);
- A set of measures ensuring the relevance of training and its continuing adjustment to needs of the enterprise i.e. jointly designed diploma, monthly committee of piloting and the annual monitoring survey;
- Specific support for tutors, who also demonstrate a high level of satisfaction (see above);
- Initiatives to make apprenticeship opportunities known to the broader public, i.e. specific training sessions are run for youth with no qualifications; partnerships with NGOs exist to improve the gender balance within male-dominated fields.

At a national level, SNCF shares VET good practices with enterprises of similar size such as EDF, Orange, and through the "Club of large enterprises". SNCF has also developed an exchange programme with Deutsche Bahn.

SUMMARY OF THE SOCIAL & EMPLOYMENT PILLAR

Railway transport provides **access** to every European citizen and thereby aims to guarantee **mobility for all**. This includes providing an alternative to car travel together with providing high capacity solutions for congested areas.

The railway sector **upholds jobs security in times of crisis**. In spite of the pressures caused by the 2008 crisis, railway companies have retained existing staff members and hired new ones.

Furthermore, the demographic development within railway companies shows an upcoming need to hire young people. Especially in times of strong youth unemployment, railway operators can make a positive contribution thanks to their **large vocational and educational training programmes**.

III. THE ENVIRONMENTAL PILLAR

Positive environmental effects of rail transport are well known. Although not at the core of this economic footprint report, railway transport is clearly very important for creating a sustainable European transport system. Therefore, to provide a comprehensive overview of the role of rail transport for Europe's economy and society, this section presents a snapshot of key environmental and safety facts as a third pillar of this study.

This pillar consists of two chapters:

- Environmental effects;
- Safety.





INTRODUCTION

Rail transport is commonly recognized as a clean mode of transport that has an important role in the creation of a sustainable transport system.⁸⁹ With growing demand for freight and passenger transport, a shift towards the least polluting and most energy efficient modes of transport — especially in the case of long distance and urban travel — will contribute to more sustainable mobility. A study conducted by Austrian Federal Railways (ÖBB) in 2010⁹⁰ also shows that limited space in cities plays a crucial role in assessing the environmental benefits of railways. The study estimates that the savings in terms of congestion associated with one person switching from car to rail amount to € 3,000 per year.

Furthermore, railway transport has strong safety advantages in comparison to other modes of transport. In this section we provide first an overview on the environmental effects and then provide some key safety data.

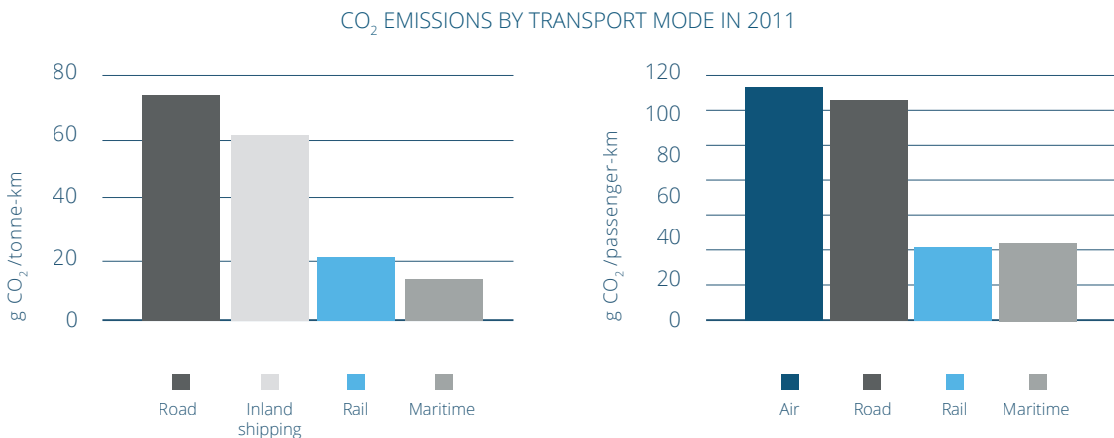
89 UIC (2011): Rail and Sustainable Development

90 Rauh (2010): Congestion – a strong argument for public transport

6 ENVIRONMENTAL EFFECTS

In comparison to other transport modes, railway transport has a broad range of environmental advantages. First of all, it emits very low amounts of CO₂.

Figure 10 Specific CO₂ emissions per passenger- kilometre (left figure) and tonne-kilometre (right figure) per mode of transport in Europe in 2011



Source: EEA (2012)

The graphs show that CO₂ emissions per passenger-kilometre and per tonne-kilometre for road transport are respectively 2.6 times and 3.6 times higher than rail transport. Comparing High-Speed Rail to air transport estimates on energy consumption (per seat mile) indicate that HSR consumption is 2.4 times lower than comparable air transport.⁹¹ If only 10 % of long-distance freight transport would shift from road to rail, an estimated reduction of 12 million tonnes of greenhouse gas emissions could be achieved.⁹² Hence the carbon footprint of rail transport is significantly lower than other modes of transport (see figures above).

Overall, over the period 1995 - 2011, specific CO₂ emissions from rail transport have decreased by about 24 % and 40 % for rail passenger and rail freight transport, respectively. This improvement is the result of technological improvements, increased load factors and operational efficiency. The ongoing electrification of railway transport is a further positive trend towards even lower CO₂ emissions. Comparing electric and diesel transport shows significantly lower emissions for electric rail.

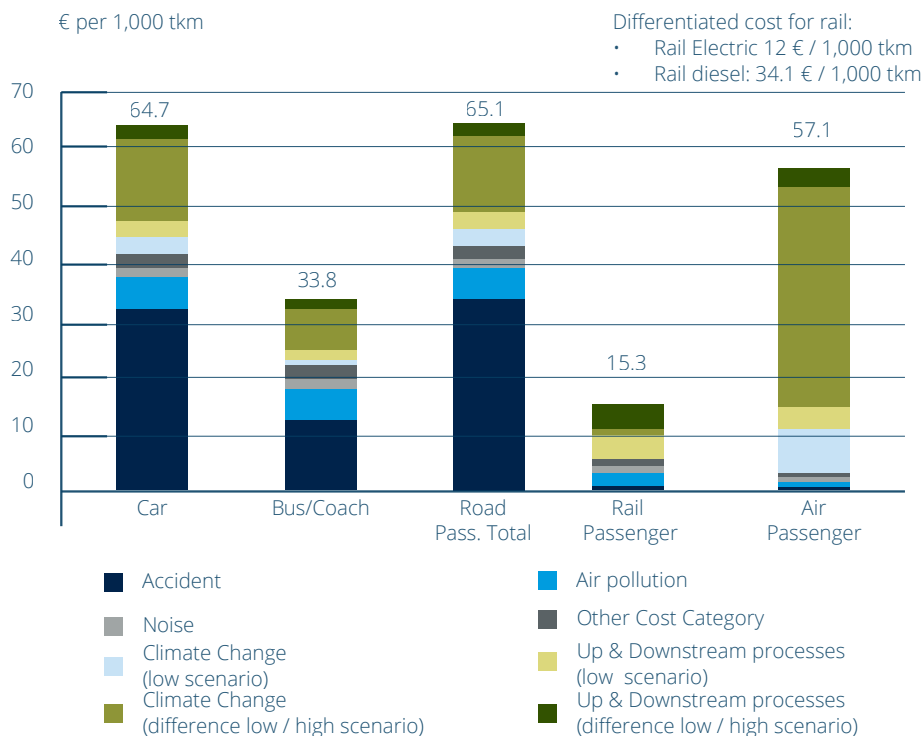
The positive environmental impacts of railway transport are not limited to greenhouse gas emissions. According to a recent study, all forms of rail transport combined are responsible for only 2 % of the estimated cost of all externalities coming from transport. In comparison, road transport is responsible for 93 %, while air transport is accountable for 4 % of external costs.⁹³

91 Van Essen et al. (2003): To shift or not to shift, that's the question. The environmental performance of the principal modes of freight and passenger transport in the policymaking process. Delft: CE Delft

92 Association of American Railroads (2010): Freight Railroads Offer a Smart, Effective Way to Reduce Greenhouse Gas Emissions

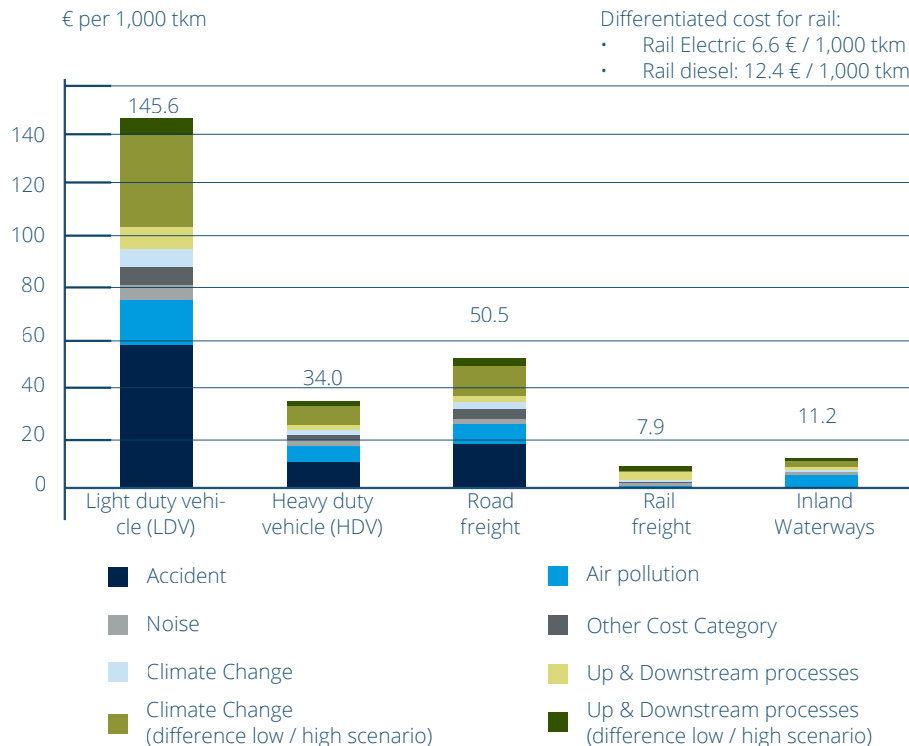
93 International Union of Railways and CER (2012): Greening Transport – Reduced External Costs

Figure 11 Average external costs 2008 for EU-27: passenger transport (excluding congestion)



Source: UIC/CER (2011): External Costs of Transport in Europe

Figure 12 Average external costs (2008) EU27: freight transport



Source: UIC/CER (2011): External Costs of Transport in Europe

7 SAFETY

Rail transport is not only a relatively clean mode of transport but it is also a safe mode of transport that creates significantly less accidents than road transport, for example. This is already shown in the figures above on the level of external costs.

Table 3 Comparison of fatalities per transport mode

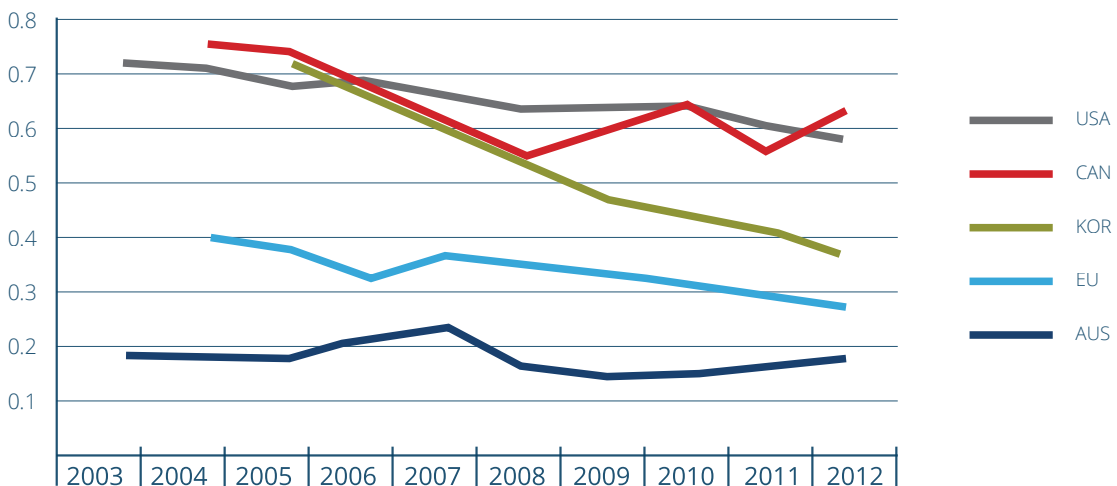
| Transport mode | Fatalities per billion passenger-kilometres |
|----------------------|---|
| Airline | 0.06 |
| Railway | 0.13 |
| Bus/coach | 0.20 |
| Car | 3.14 |
| Powered two-wheelers | 48.94 |

Source: European Railway Agency (2014): Railway Safety Performance in the European Union

Railway transport is 1.5 times safer than bus transport, 24 times safer than car transport, and 376 times safer than transport via powered two-wheelers.

Comparing different regions worldwide the EU railway transport sector is particularly safe.

Figure 13 Comparison of railway fatalities (excl. suicides) per million train-kilometres



Source: European Railway Agency (2014): Railway Safety Performance in the European Union

The EU railway sector has a significantly stronger safety record than its counterparts in the USA, Canada, or Korea. This safety record has continuously improved over the past decade.

SUMMARY OF THE ENVIRONMENTAL PILLAR

Railway transport is **one of the cleanest transport modes**. Its CO₂ emissions per transported unit are substantially lower than those of air or road transport. In passenger transport they are even lower than maritime transport.

In addition, Europe's rail sector has a **strong safety record** compared to other transport modes, as well as compared to its peers in other world regions.

IV. CONCLUSIONS & EU POLICY

Railway transport is shown to be a major pillar of the European Union economy and an important contributor to the development of a smarter, more sustainable and more competitive economy.

Including both direct and indirect effects generated through supplier relations and investments in infrastructure, the basic economic footprint of the railway sector is estimated at **2.3 million persons employed** and **€ 142 billion gross value added**. This amounts to about **1.1 % of EU GDP**.

The railway transport sector directly **contributes more to EU GDP than air or water transport**. Moreover, **labour productivity growth** within the rail transport sector has **outperformed the EU economy**.

The railway transport sector's function as connector of European people and businesses, as well as its innovative power and sustainable character are of priceless importance to European policy makers. Strong economic advantages that have led to more innovation, combined with being able to build on a strong local market and exploit well-known environmental benefits have brought the EU rail sector to a world leading position.

In conclusion, rail transport can...

- **answer key policy objectives of Europe...**

Rail transport can play an important role in the overarching Europe 2020 strategy⁹⁴: A strategy towards Smart, Sustainable and Inclusive growth. It provides answers on all three pillars: economic, environmental, social.

At the same time it fulfils a crucial role in creating a sustainable transport system in Europe as described in the European Commission's 2011 Transport White Paper.⁹⁵

- **foster economic growth and jobs....**

In recent years there has been a revitalization of rail transport. Rail transport is not just about bringing people from A to B, it also creates employment in many other areas. Furthermore, it also supports the development of a highly competitive rail supply industry able to occupy a world leadership position. Plus creating attractive cities and places to work, live and do business.

- **contribute to greening Europe's transport system, and**

Rail transport helps to reduce congestion of cities and to develop a transport system with low CO₂ emissions.

94 http://ec.europa.eu/europe2020/europe-2020-in-a-nutshell/targets/index_en.htm

95 COM(2011) 144 final: White Paper, Roadmap to a Single European Transport Area – Towards a competitive and resource-efficient transport system

- **connect Europe's citizens and regions**

Rail transport helps to unify Europe by simplifying and speeding up connectivity. Reducing travel times, including more comfort, and improving cross modal cooperation supports 'mobility for all' and helps bring people together.

The way forward

From a public policy perspective, investing in rail means investing in a broader value chain that supports employment and competitiveness for the EU economy - and provides for clean, safe, and inclusive mobility solutions for EU citizens.



ANNEXES





ANNEX MEASURING THE SIZE OF THE SECTOR – METHODOLOGICAL BACKGROUND

As described in the main report, the distinction between direct, indirect and wider economic effects is not straightforward. Accordingly, this annex briefly elaborates on how the estimation approaches behind the numbers used in this report.

Where do the data come from?

Various data sources are used to estimate the economic footprint of the railway transport sector. These include:

- **Eurostat Structural Business Statistics (SBS)**. In broad terms, the Eurostat SBS are compiled from information concerning units engaged in economic activity; the types of statistical units observed are mainly enterprises. The data are collected on the basis of Council Regulation 58/97 on structural business statistics. The company, or other units, are classified according to the European statistical classification of economic activities (NACE). Eurostat SBS data follow our preferred definition for direct employment and GVA and are, therefore, our preferred source of data. Furthermore, data is available for both employment (persons employed) and GVA (value added at factor cost).⁹⁶ Difficulties arise, however, as a result of often incomplete data that sometimes cause additional challenges when looking at time series.⁹⁷
- **Eurostat Transport Statistics**. The Eurostat Transport Statistics include data collected from so-called “principal railway enterprises”, including urban services operated by principal railway enterprises. Eurostat Transport Statistics are used to help complete the dataset for employment data. It should be noted that Eurostat Transport Statistics data may include employees who are not actually working on railway operation but are employed by a “principal railway company”. Additionally, they do not provide information on GVA.
- **Official national statistics**. National statistical agencies collect data which, in most cases, are the source of data published on Eurostat SBS. Nevertheless, in some cases, national statistical agencies publish more detailed data (e.g. France) than Eurostat.
- **AMADEUS database**. This database contains comprehensive information on around 19 million companies across Europe. It can be used to conduct research on individual companies and for companies with specific profiles. Amadeus is used as a supporting information source, mainly for the purpose of overcoming data gaps in GVA. Individual company data by country and NACE code can serve as a proxy to estimate missing data.
- **CER Member flash** survey and **bilateral contact** were individual national companies. These have been used to quality check estimations and to overcome remaining data gaps.

⁹⁶ http://epp.eurostat.ec.europa.eu/portal/page/portal/european_business/introduction

⁹⁷ National definitions may change. Also the switch from NACE 1.1 to NACE 2 changed definitions.

How did we estimate the size of the sector?

To estimate the size of the sector, nine logical steps have been followed:

1. Collection of all available information in the used data sources;
2. Compilation of a time series from 2003 – 2012 for direct employment and GVA;
3. Estimation of data for remaining gaps using the most suitable methodology (see below);
4. Correction for infrastructure management (added where not yet included in the raw data);
5. Estimation of a multiplier for indirect effects based on Input-output analysis for four Member States (UK, DK, DE, ES) using national input-output or 'supply & use' tables;
6. Application of the multiplier on the direct employment and GVA estimates (corrected for infrastructure management);
7. Addition of estimates on the economic impacts of infrastructure investments;
8. Addition of data reflecting acquisition of locomotives and rolling stock (as not included in I-O tables);
9. Calculation of final total economic value estimates.

The final estimate includes direct and indirect effects. Induced effects and wider economic effects are elaborated separately.

How to overcome data gaps?

The data compiled from Eurostat SBS and Eurostat Transport Statistics on employment was rather complete. Furthermore, employment figures usually do not have very strong fluctuations between consecutive years. Therefore, interpolation⁹⁸ and extrapolation⁹⁹ tools serve well as a means to overcome most data gaps.

By contrast, estimation of annual GVA values based on previous or following year is more risky. Financial results tend to have more rapid and stronger fluctuations than employment. Therefore, interpolation and extrapolation approaches are much less suitable. To overcome remaining gaps we used four different approaches, applying the most suitable approach on a case by case assessment.

The preferred option was to use a peer group¹⁰⁰ comparison to assess probable GVA/employment ratios. This assumes similar development trends across EU countries. A second approach is to look into individual company data provided in the AMADEUS database and to calculate aggregates by summing-up data on all relevant companies. Alternatively, in cases where AMADEUS does not provide sufficient GVA data, the trend in annual turnover growth of relevant companies in the country can be applied. Moreover, if none of the methods above led to a reliable estimate, we made use of the same GVA/employment ratio of the following or past years to get an estimate for the missing year.

The outcomes of these estimations were presented to CER Members for a quality and reliability check. The final country estimates are summed up and presented in the form of an overall EU estimate.

98 Assumption of a linear development between the year before and after the gap.

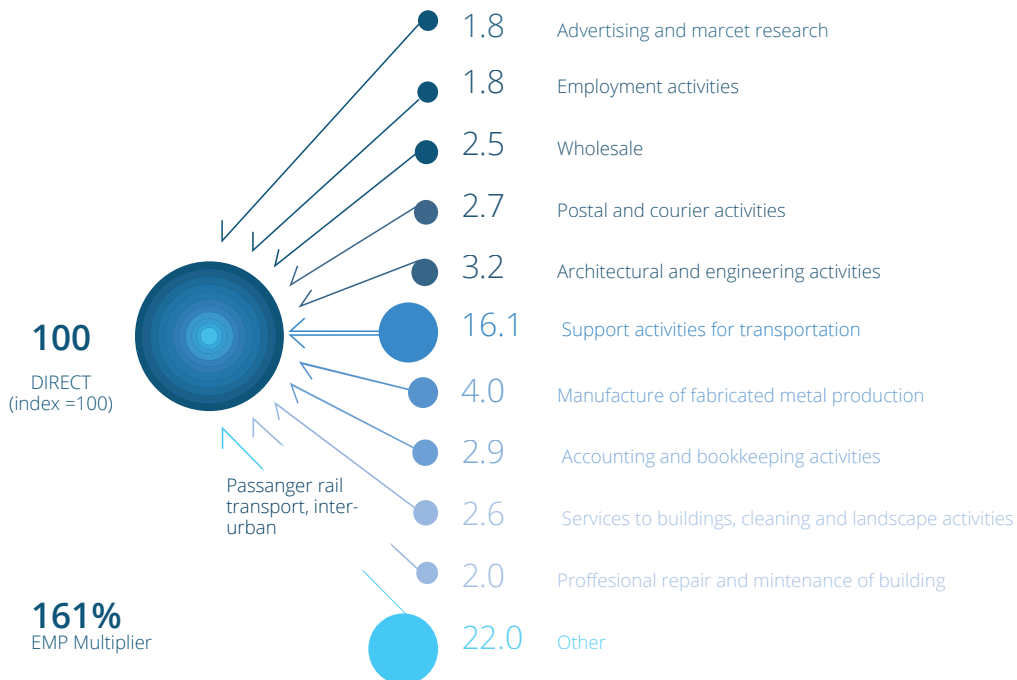
99 Follow the previous trend.

100 By "peer group" we refer to all other Member States where in the same year GVA and employment are available.

How to estimate multipliers to estimate indirect effects?

The basic approach used to develop estimates of indirect value added and employment is relatively straight forward. Input-Output data are used we obtain estimates of the rate of domestic value added (or employment) per unit of output for each industry/product identified in the Input-Output Tables. The calculated rate of GVA (or employment) is then applied to the domestic (intermediate consumption) inputs used by the industry/product being analysed (cf. rail transport services). Summing across industry product categories provides an estimate of the indirect GVA (or employment) 'embedded' in the intermediate consumption inputs used by the industry being analysed. This assessment was done for Germany and Denmark.

Figure 14 Employment multiplier for Denmark (Indexed at 100)

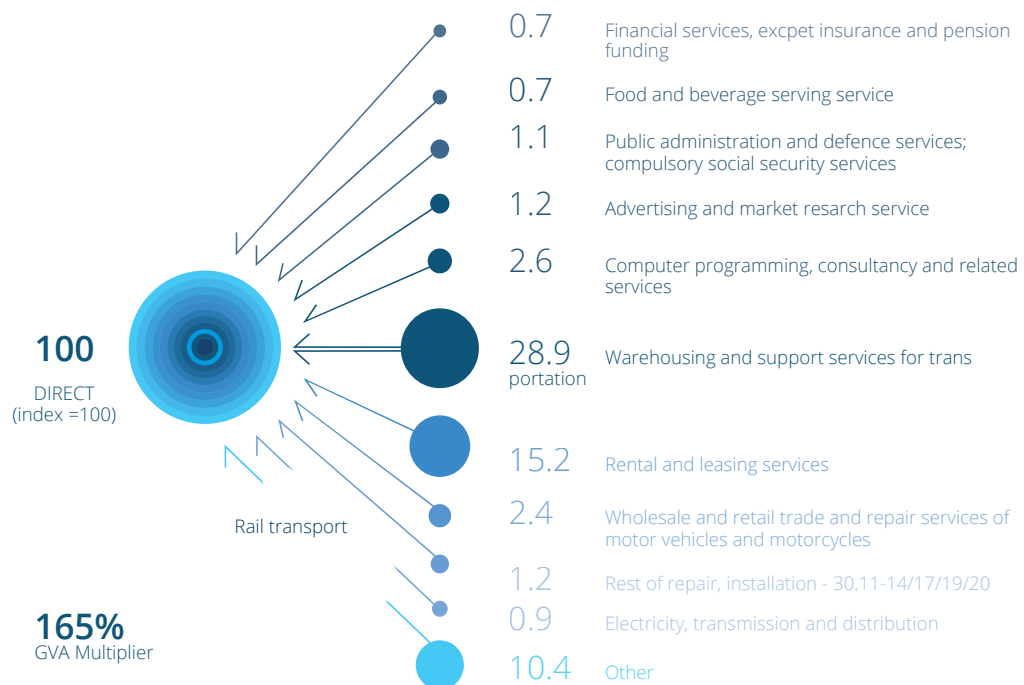


In the case of Denmark, the estimates show that for every 100 persons employed directly in the railway transport sector, there are 2.5 persons employed in wholesale, 3.2 in architectural and engineering activities, 16.1 in support activities etc. The overall estimated multiplier for employment in DK is 161 %. Therefore, to estimate the total employment we need to multiply the direct estimate by 1.61. This multiplier does not, however, include the impact of fixed capital stock investments. The reason for this is that I-O tables aim primarily to provide data on 'regular' current intermediate consumption input and output streams. Purchases of capital stock are more 'lumpy' and their inclusion would lead to strong annual fluctuations that do not reflect underlying developments in economic activity. Moreover, I-O tables cannot be used to identify investments in rail infrastructure. This is because the majority of such investments are undertaken by the States, for which I-O tables provide information of different categories of investment.

For those countries for which the underlying data is in the form of supply and use tables (cf. Spain and the UK) a modified methodology was used. The supply and use tables (SUT) provide an estimate of the gross value added generated by each branch of activity (industry). However, within the SUT framework,

each branch of activity may supply a variety of different products, both 'primary' products (i.e. products that are characteristic of the industry)¹⁰¹ and 'secondary' products (i.e. products that are characteristic of other industries). At the same time, a branch of activity may both utilise inputs of a particular product and, at the same time, be a supplier of the product. These features of the SUT framework need to be taken into account when estimating the value added embedded in the various products supplied by a branch of activity (i.e. to determine an appropriate allocation of the total GVA of an industry across the different product categories that it supplies).

Figure 15 GVA multiplier for the United Kingdom (Indexed at 100)



For both Input-Output and Supply-Use based approaches, the obtained estimates correspond to the indirect GVA (or employment) resulting from an industry's¹⁰² use of domestically supplied intermediate consumption inputs and as such they are subject to the following limitations:

- The estimates only take account of domestically supplied inputs. No account is taken of indirect 'foreign' GVA (or employment) embedded in imported inputs;
- The estimates relate only to intermediate consumption inputs. No account is taken of indirect GVA (or employment) that may be embedded in capital goods (gross fixed capital formation, GFCF) supplied to the industry/product being analysed;

101 In the case of the SUTs for Spain, the number of products (108) exceeds the number of industries (73), such that some industries may be associated to more than one 'principal' product category. For example, the industry 'Manufacture of other transport equipment' covers four principal product categories: 'Ships and boats', 'Railway locomotives and rolling stock', 'Air and spacecraft and related machinery', and 'Other transport equipment n.e.c.'.

102 In the case of product x product data, the estimates correspond to the indirect GVA (or employment) resulting from the use of domestically supplied intermediate consumption inputs in the production of the product category.

- The estimates concern only the GVA (or employment) generated in the sectors directly supplying inputs to the industry/product being analysed (i.e. first-level of backward linkages). No account is taken of the indirect GVA (or employment) that these supplying industries may generate themselves (i.e. second and subsequent higher-level backwards linkages).¹⁰³

The examples above show that the multipliers are more or less similar across countries, which supports the hypothesis that four countries are sufficient to estimate an average EU multiplier.

How to apply the multiplier?

The following steps are undertaken:

- 1) Data on direct employment, including the infrastructure management correction, provide a harmonised basis for further estimations;
- 2) Multipliers of the countries assessed (Germany, Denmark, Spain and the United Kingdom) can be directly applied for employment and GVA in these countries. As we do not have different I-O tables for each year, we assume stable multipliers over the assessed period;
- 3) For all other Member States we apply the average multiplier of the assessed countries.

What else is not included in the figures?

Induced effects, as well as wider economic benefits, are not included in the estimates on the size of the sector but are elaborated in the report.

¹⁰³ More comprehensive approaches can be developed to provide a broader estimate of indirect GVA (and employment). However, to do so means relying on complex theoretical and methodological assumptions that can weaken the intuitive understanding of presented results, which may risk reducing the approachability of the results for policy-makers and other relevant stakeholders.



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