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MASTER THESIS IN
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The liberalisation of the European Railway Market

Did the railway packages have a statistical significant effect on rail freight in the EU Member States?

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I Abstract

The European railway market is since 25 years subject to a constant transformation process. The EU's railway packages, bundles of railway specific legislation, initiate reforms in a sector that was characterised by decade long national fragmentation and a shrinking modal share. National railways used to be run by vertical integrated governmental authorities, which were unable to adjust to changes in the market and new developments like the unprecedented rise of the individual motor car after World War Two. Liberalisation (market opening) and privatisation (franchising private competitors) were the key strategies to overhaul the massive and ponderous state-owned as well as state-controlled railway sector in order to curb waste of public subsidies and worsening train service. The main objective is the creation of a single European railway market with a high degree of interoperability and competition, similarly to the Single European Sky initiative in the civil aviation.

So far three railway packages (2001, 2004 and 2007) have been adopted by the European Parliament and the Council. A fourth one is since 2013 in the making, whereby the technical pillar is closer to an agreement than the highly contested market pillar especially for high-speed long-distance passenger service. The rail freight sector was already liberalised and enjoys free market access for all competitors since 2007.

The aim of this paper is to examine the impact of the railway packages in particular on the rail freight transport in the EU Member States. How much influence has the EU legislation in a specific policy area, here transport (impact assessment). In order to answer the research question a sequential multiple regression was chosen. This method allows adding gradually suitable independent variables and dummies in a fixed order to determine their impact on the dependent variable rail freight.

The results were humble; the biggest impact on the depended variable had rail passengers with a high statistical significance. A negative impact had EU membership with low significance. All three railway packages had only a marginal impact without significance. Several problems and limitations were faced during the operationalisation and partly explain the poor output.

Keywords: European railways, railway market, railway packages, reforms, liberalisation of a public service, sequential multiple regression.

Word count: 17,680

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III Abbreviations

approx.	approximately
BEV	Bundeseisenbahnvermögen (German Federal Railway Estate)
Council	Council of the European Union, also: Council of Ministers
CTP	Common Transport Policy
D/s or Dummy/ies	Dummy variable/s
Dir.	Directive (EU legislation)
DB	since 1994: Deutsche Bahn (German Railways)
	before 1994: Deutsche Bundesbahn (former West German Railways)
DR	Deutsche Reichsbahn (former East German Railways)
DV	Dependent variable
EBA	Eisenbahnbundesamt (German Federal Railways Office)
EC	European Commission
ECJ	European Court of Justice
ETCS	European Train Control System
EMCT	European Ministers of Transport
EP	European Parliament
ERA	European Railway Agency
EU	for simplification refers to the European Union since the Maastricht Treaty of 1992 but also to the previous European Communities
EU-28	European Union of 28 Member States
EuroStat	Statistical Office of the European Union
FS	Ferrovie dello Stato (Italian Railways)
ITF	International Transport Forum of the OECD
IV/s/1/2	Independent variable/s 1 or 2
M1/2/3	Models 1, 2 or 3
MS	Member States of the European Union
NSA	National Supervisory Authorities
ÖBB	Östereichische Bundesbahn (Austrian Railways)
OECD	Organisation for Economic Co-operation and Development
OLS	ordinary least squares method
pax	passenger/s
pkm	passenger*kilometre
pub.	published
Reg.	Regulation (EU legislation)
ret.	retrieved
RFF	Réseau ferré de France (French Rail Network)
RP	Railway or reform Package(s)
SBB	Schweizer Bundesbahn (Swiss Railways)
SNCB	Société nationale des chemins de fer belges (National Society of Belgian Railways)
SNCF	Société nationale des chemins de fer français (National Society of French Railways)
T	Tolerance
TOC	Train operating company
tkm	tonne*kilometre
VIF	Variance Inflation Factor

IV List of tables and figures

1 Introduction

This section will provide an overview of the paper's content and lay out its intention. First, the aim and the research questions are explained including their academic relevance; second, a definition of the overarching theory of liberalisation is given; third, a historical outline of the European railway reform is presented; fourth, the various limitations of the study are discussed; and fifth, the disposition of the following sections is illustrated.

The negotiations for a 4th Railway Package (RP) between the Council of Ministers and the European Parliament continue in the first half of 2015. Furthermore so-called *trialogues*[1] meetings are held for contested issues like the opening of the long-distance passenger transport for market competition. The result will be the latest milestone in a succession of reform packages over the past 25 years in order to revamp the formerly ailing European railway sector. It is the conviction of the Member States (MS) that the old model of a state-run railway is outdated by modern developments and that liberalisation was the adequate answer.

This research paper looks into this long-lasting transformation of the railway sector in detail and tries to find a statistical relevant impact of these reform packages on the domestic rail freight (cargo) figures in selected Member States since 1988.

1.1 Aim, research question Q and hypotheses H

Out of the need to reform a public service like the railway transport the RPs guide the transformation through rules that apply in every Member State and thus to each national railway. These legal acts, initiated by the European Commission and then negotiated between the Council and Parliament, form the basis and the reference for the national authorities supervising their respective national railway.

Fundamentally this study tries to examine the impact of EU legislation concerning the rail freight in the Member States.

> Q1: Did the railway packages have a statistical effect on the railway freight in the Member States? And if yes, was it positive or negative and how strong was the effect?

The following hypotheses stem from the research question. They are set within the framework of liberalisation and structural reform of the European railway market as described in the next section 1.2.

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1 Describes in EU inter-institutional politics an informal tripartite meeting with the aim of solving political blockades attended by representatives of the European Parliament, the Council of the European Union, and the European Commission.

H0[2]: The EU railway packages had no significant effect on rail freight in the Member States.

H1: By opening the European railway market and enabling competition the volume of railway goods in the member states increased.

1.2 Liberalisation, privatisation and marketisation of the railway sector

When talking about the applied theory of liberalisation and marketisation the following section will give an explanation of these concepts.

The term *liberalisation* in an economic sense refers to a relaxation (removing or reducing) of legal restrictions and/or provisions imposed by the state on public services like post, telecommunications and transport. Often the ownership of public assets (services, organisations, land, buildings, equipment, information and intellectual knowledge) are sold or transferred to the private or voluntary sector.[3] In the case of European railway the old regulations provided that the state railways were the all-encompassing monopolist of train service and infrastructure provider in each Member State. That is why liberalisation and deregulation often coincidence in terms of opening a market for private companies access thus enabling competition.

The provision of transport by a foreign or international private competitor within the domestic market is called cabotage. Because of its high initial infrastructure investments (large sunken cost) rail transport is considered a natural monopoly for the owner of tracks and stations. Therefore a precondition for liberalisation of the railways is the separation of infrastructure management (rail network and stations) from transport operation (trains). This can be implemented in different degrees (from least to most): single vertically integrated company => accounting (bookkeeping) separation => organisational separation (separated units within the same organisation) => institutional separation (disconnected organisations).[4] Thus eliminating the monopoly power and enabling competition in transport. On the contrary, competition in rail infrastructure would mean building costly parallel tracks between two destinations owned by different companies, amounting to high financial market barriers for new competitors. Competition in rail infrastructure would produce not only redundant infrastructure but also cause unnecessary investment. Therefore only competition in transport is rational and viable in an economic sense. The degree of competition can also vary (from least to most): single vertically integrated

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2 In inferential statistics the null hypothesis usually refers to a general statement that there is no relationship between two measured phenomena.
3 Whitfield (2006), p.4.
4 Nash and Rivera-Trujillo (2004), p.15.

company (monopoly) => yardstick => franchising => open access.[5] Please see table 3 in the appendix for rail sector restructuring.

Yardstick competition refers to markets where agents (railway companies) have low incentives for promoting productive efficiency thus competition is weak or absent. In this case the principal or regulator of the market (state authorities) reimburses agents according to their relative performance compared with other agents that offer a similar scope of business. This reward mechanism induces a process of competition among the agents. Up to the 1970s, the term yardstick competition was used for the situation in which a state-owned firm competed with privately owned firms. The state-owned firm would serve as the benchmark or yardstick.[6]

Railway franchising, well practised in the UK since the mid 1990s, refers to the process of contracting out the operation of passenger or freight rail service by the state (the franchisor), as owner of the assets (this can involve both infrastructure and rolling stock, depending on the arrangement), through a system of awarding operating licences (privilege) based on a contract, after a competitive public tendering, to private companies (the franchisees).[7]

Similar developments like in the railway industry can be found in the civil aviation with an established owner and operator for airports (infrastructure) separated from the open competition among airlines (transport). As this sector was liberalised earlier in the EU, through the so-called the Single European Sky initiative[8], it can be seen in some aspects as a precursor to the liberalisation of the European railways.

Another dimension of the overarching liberalisation theme is privatisation, which denotes the process of transferring ownership of an entity from the public sector (state) to the private sector (company). Even though privatisation and liberalisation often go hand in hand both are two distinct concepts. For example the liberalisation of the railway market led to access of private competitors to the former state monopoly railway network. The former state railways were transformed into (holding) companies managed under private law but remain partially or completely in government ownership, depending on the Member State. It is this discrepancy between genuine 100% private companies and governmental holding companies that distort the market to unequal competition of today's European railways.

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5 Nash and Rivera-Trujillo (2004), p.15.
6 Canoy et.al. (2000), p.15-16.
7 ECMT report: Competitive Tendering of Rail Services (2007), p.9-10, 204.
8 http://ec.europa.eu/transport/modes/air/single_european_sky/index_en.htm (ret. 14 Jul 2015).

Marketisation is understood as the restructuring process by which market forces are imposed on public services, whereas these have traditionally been planned, delivered and financed by the state (preference of competition over administration). This enables state enterprises to operate as market-oriented firms by changing the legal environment of the affected sector. Key elements of this process are the commodification of services and infrastructure, the restructuring of the sector for competition and market mechanisms, the reorganisation of work as well as jobs to maximise productivity and enabling transfer to another employer.[9] In the case of railways this has meant the introduction of tendering of train operations in a market of competitors.

1.3 A historical outline of the European railways

The reform of the European railway market was the answer to decades of fragmentation and a shrinking share of total transport services. National railways used to be run by vertical integrated governmental authorities, which were unable to adjust to changes in the market and new developments like the unprecedented rise of the individual motor car after World War Two. Liberalisation (market opening) and privatisation (franchising private competitors) were the key strategies to overhaul a massive and ponderous state-owned and controlled railway sector in order to curb waste of public subsidies and worsening train service.

1.3.1 From the early beginnings to the mid-20th century

The history of European railways is one of constant change and development. First connections between European cities were established in the 1820s and 1830s in England, the motherland of the Industrial Revolution, by private companies. This trend spread all over the European continent in the following decades of the 19th century and step by step a network of railways came into existence. Many small railway lines merged or were bought by competitors over time to create bigger and more efficient companies. During the 20th century most countries in Europe nationalised their various private railway companies and formed a single national railway authority.[10] These were vertical integrated and provided all services from one source: infrastructure, operation, maintenance, information, authorisation and inspection. The governments had realised the potential of the railways for military and economic purposes. From then on European rail networks have been conceived, managed and regulated only at the national level.[11] Those isolated national applications led to a patchwork of poorly interoperable networks, existing side by side.

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9 Whitfield (2006), p.4.
10 For example: British Railways created in 1948; French SNCF in 1938; Deutsche Reichsbahn created through merger of individual German state railways in 1920; and Spanish RENFE in1941.
11 Laperrouza and Finger (2009), p.2.

Hence rail gauge, electrification, signalling, train regulation, operational charges, traffic mix and density differed widely among European countries even if they were neighbours.[12] As consequence of two World Wars and especially during the Cold War only little attention was paid to cross-border transport. The limited international traffic that existed was expensive because of technical hurdles and administrative burdens. Each crossing had to be based on a bilateral agreement as there was no supranational railway entity.

During this time the most common structure of the railway sector in many European countries was a single public authority, in charge of managing both the rail infrastructure and the train operation, an all-embracing state monopoly.[13] As such they were often used for political objectives (e.g. investment and employment). Even if certain passenger services became unprofitable they had to be maintained for political reasons and decisions (e.g. public service obligations). The authorities were inflexible and often too cumbersome to adapt in reasonable time to changes in passenger demand. This all resulted in an indebtedness of the national railways over the curse of decades. For example, the two former national railways of West Germany (Deutsche Bundesbahn) and East Germany (Deutsche Reichsbahn) accumulated together in about €35bn of debt by 1993, which would have increased to staggering €190bn in 2003 without any reform being implemented.[14] High debt levels relative to the national public budget were attained in most European states at the end of the 1980s. Frequent political interference conserved this situation with low ambitions for necessary reforms.[15]

Even though most neighbouring systems were to some extent interconnected (mostly historic junctions), the whole European network remained highly inefficient and especially un-coordinated above the national level. It needed to overcome the national level of organisation as barrier of further integration. First attempts were made in the 1950s by the European Conference of Ministers of Transport (ECMT) which led to the introduction of a Common Transport Policy (CTP) in the Treaty of Rome of 1957.[16] The CTP was considered as a core competence of the newly established European Economic Community. First measures were to modernise the existing rail infrastructure, to stimulate cross-border traffic and to improve the financial situation of the state railways. But failing to achieve these objectives for decades made the dissatisfied EP to involve the European Court of Justice (ECJ), which led in 1985 to the so-called 'inactivity verdict'.[17] This initial event was followed by the Single European Act (1986) which laid down the basis for the

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12 Presentation by Stephen Perkins in October 2010, International Transport Forum, p.5.
13 Laperrouza and Finger (2009), p.3.
14 Große Anfrage Die Linke (Nov 2014), p.6: DM70bn in 1993 and DM380bn in 2003 (prediction).
15 Laperrouza and Finger (2009), p.4.
16 Laperrouza and Finger (2009), p.4.
17 Schipper (2009), p.12.

establishment of the Single Market, including transport services. Furthermore the Maastricht Treaty of 1992 reinforced the political, institutional and budgetary foundations of the CTP.[18]

1.3.2 The gradual liberalisation from the mid-20th century

As described above for much of the 20th century European railways have suffered from financial losses (due to unprofitable services), inefficient management (cumbersome authorities) and insufficient commercial outlook (relying mostly on state subsidies to stay viable, accumulation of debts).[19] This poor testimony has given incentive to EU Member States (MS) to reform their national rail sector in the past two and a half decades guided by the European Commission's railway packages. The reforms had several overarching goals:

- reducing the need for state subsidies and removing corporate debt (sustainable finances),
- enhancing productivity as well as efficiency of the railway system by assurance of third-party access to the infrastructure (opening the market for competition),[20]
- increasing the competitiveness by separation of infrastructure management from transport operations (end of natural monopoly of state railways),[21]
- introduction of independent national railway oversight and regulation authorities for capacity allocation and access to essential facilities,[22]
- foundation of a European Railway Agency (ERA) promoting interoperability and mutual recognition of technical as well as safety standards.[23]
- the integration of the national railway networks into a single European railway area

However, the pressure to reform and liberalise the railway sector did not only came from its own poor state. Rail traffic was losing ground significantly to road traffic because of the domination of the car in daily life (increased degree of individual motorisation), the expansion of the road network, the poor international railway cooperation, changing demands from the market, and technical incompatibilities at border crossings. From 1970 to 1995 the modal split for rail passenger services and rail freight services within the EU-15 declined by more than 40 percent and almost 58 percent, respectively, compared to other transportation modes, like road, air or sea transport.[24]

One of the basic principles of the liberalisation was the separation of infrastructure, which included the railway tracks, signals, overhead wires, tunnels, bridges, level crossings and mostly the stations, from operations, that is the passenger or commercial freight rolling

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18 European Commission: Evaluation of the CTP of the EU (August 2009, Brussels), p.7.
19 Eisenkopf (2006), p.292.
20 Nash (2008), p.61.
21 Wetzel (2008), p.4.
22 Presentation by Stephen Perkins in October 2010, International Transport Forum, p.4.
23 Laperrouza and Finger (2009), p.4.
24 European Commission, Directorate-General for Energy and Transport, 2003, 2007.

stock (i.e. trains and wagons). It is specified in the first Railway Package (e.g. Dir. 2001/12/EC) that both need separate profit and loss accounts as well as separate balance sheets. A transfer of public funds between the two is not allowed. Furthermore, if both remain within the undertaking then as distinct divisions, otherwise each of them needs to be managed by a separate entity.[25] The separation is meant to facilitate competition for train service on an independently maintained track network. This progressive market opening for new operators was assisted by rules regarding the fair allocation of time slots and the pricing of infrastructure use, administered by an independent regulator (e.g. Dir. 2001/14/EC).[26]

The new operators also include former state monopolists conducting service in a neighbouring MS, for example SNCF in Germany. A new regulatory structure was introduced called national supervisory authorities (NSA), which were often just outsourced from the former state monopoly. These NSA were later constrained in their area of activity due to the new European Railway Agency (ERA) established in 2004 by the second railway package (Reg. 881/2004/EC).

The ERA is one of the many agencies of the European Union and its headquarters is located in Valenciennes, France. Its mandate is the creation of a competitive European railway area, by increasing the interoperability of national railway systems through mutual recognition and harmonisation of technical standards. At the same time the ERA ensures the required level of technical and working safety.[27] The ERA is responsible for drafting of the Technical Standards on Interoperability (TSIs) for the whole EU market.

The EC's new regulatory regime creating and supporting an open access railway market was implemented through five important steps over time (please see an overview in table 18 in the appendix). Previous EU/EC legislation concerned railways only in a wider sense as part of (public) services,[28] for instance that governments should refrain from interference in market mechanisms by providing subsidies except under specific conditions.[29]

The first step was the so-called 'mother' Directive 91/440/EEC from 1991 which pooled after long negotiations several earlier legal proposals to reform the European railways. The intention was to lay down the foundations for the creation of a single European railway

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25 Council Directive No 91/440/EEC, Section 3, Article 6 (1 + 2).
26 Laperrouza and Finger (2009), p.5.
27 European Railway Agency (ERA) Annual Activity Report 2013, p.7.
28 Three important regulations: 1191/69 on Public Service Obligations, 1192/69 on Normalisation of Accounts, 1107/70 on Aids to Transport.
29 Nash and Rivera-Trujillo (2004), p.1.

area.[30] It required MS to break-up their vertically integrated national (state) railway monopolies (accounting separation of infrastructure and operation). Additionally railway companies from all MS were allowed to run services on any other MSs rail infrastructure, both for passengers and goods. This first directive was followed up by two additional directives in 1995: Dir. 95/18/EC set out a framework and guidelines for the way in which MS provide licenses to operate railway companies on their network (requiring appropriate financial capacity, professional qualifications, insurance and safety certification); and Dir. 95/19/EC set out the framework for the installation of state supervisory bodies that control and regulate the allocation of line possessions to that said railway companies, and the charges for using the track (based on non-discriminatory rules like train kilometres, speed, time, axle weight, etc.).[31] In 2001 the EC published a White Paper[32] on the future of transport in Europe. The ambition was to revitalise the ailing transport sector by calling for clearer separation of infrastructure from operations, at least separate divisions (organisational separation), for a gradual extension of access rights and for transparent as well as non-discriminatory infrastructure charges. The schedule then intended the full liberalisation of cross-border freight service by 2007 followed by (domestic) passenger service in 2012.[33]

The second step was the first so-called 'railway package[34]' adopted in 2001 with the objective to further promote market opening and to create a single European railway area. It was deemed necessary by the Commission because of the unsatisfactory implementation of its previous directives. The package consisted of three Directives ensuring non-discriminatory infrastructure access (2001/12/EC on the development of European railways amending Directive 91/440/EEC, 2001/13/EC on railway licensing amending Directive 95/18/EC and Directive 2001/14/EC on capacity allocation, railway infrastructure charging and safety certification); and the directive 2001/16/EC on the interoperability of rail systems through implementation of common technical specifications.[35]

The third step was the 'second package' of measures adopted in April 2004. It provided instructions on rail safety, an amendment of the interoperability Directives 96/46/EC and 2001/16/EC in order to gradually extend the scope of interoperability to cover the entire rail network and the setting up of a European Railway Agency (ERA). The ERA is supposed to provide technical support for the work on interoperability and safety of the

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30 CER Annual Report 2013-2014, p.73.
31 Nash and Rivera-Trujillo (2004), p.5.
32 White papers are official EU policy documents containing an official set of proposals in specific policy areas and calling for community action.
33 EC White Paper on Transport (2001).
34 Package, because it was a bundle of directives and not a single one like in 1991.
35 Eisenkopf (2006), p.292.

European railway sector.[36] In 2007 the third 'railway package' marked the fourth step. It introduced open access rights for international transport services. At the end of 2012 the recast of the first railway package, amending its various directives, was approved by the EP together with the Council and hence published in the Official Journal of the EU.[37]

In January 2013 a 'fourth package', the fifth step, was proposed by the EC[38]. This package includes standards and authorisation for rolling stock; ensuring workforce skills; independent rail infrastructure management; cutting administrative costs for rolling stock approvals (technical pillar);[39] and the full liberalisation of commercial domestic passenger services until December 2019 (market pillar).[40] It further includes greater power to the ERA for the governance of the railway system e.g. to issue safety certificates and rolling stock authorisation in the whole of the EU instead of national agencies in order to reduce administrative costs and to make rail more environmental-friendly.[41]

So far reports have been written on measures to improve domestic rail passenger services by opening up public service contracts to more competition, giving operators fairer access to infrastructure and harmonizing safety certification to improve interoperability and get innovative new rolling stock on the rails faster. Members of the EP's transport committee approved these reports in February 2014 [42] and thereby gave the mandates to the Parliament negotiating team in foresight to start negotiations with the Council.[43] At the end of 2014 the *market pillar*, which aims to further realise the market opening (especially for international high-speed passenger service), was under heavy negotiations in the Council[44] due to outdated vested national interests; whereas the *technical pillar*, which aims to simplify and harmonise thousands of national technical and safety rules, seems to cause less disputes in the trialogue negotiations of the first half of 2015.[45]

But the EC was not the only pioneer in railway liberalisation, some MS preceded its effort from 2001 (1st railway package) and even from 1991 (1st directive on railways). Please see table 17 in the appendix for a timeline of country reforms, railway legislation and EU white papers on transport. Foremost Sweden, which was the first country in Europe to reform its railway market. The Transport Policy Act of 1988 demanded a complete

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36 Eisenkopf (2006), p.293.
37 Press release of the Council: Brussels, 19 June 2012; 11543/12; PRESSE 273.
38 Press release of Commissioner Siim Kallas: European railways at a junction (pub. 30 Jan 2013).
39 EC press release: EP adopts equivocal first reading position on 4th RP (pub. 26 Feb 2014).
40 Railway Gazette: Compliance Verification Clause unlocks the 4th RP (pub. 30 Jan 2013).
41 UNIFE: The 4th RP's Technical Pillar: a top priority for the railway sector (pub. 3 Dec 2013).
42 Euroactive: MEPs vote on changes to fourth railway package (published 27 Feb 2014).
43 Press release by the EP: 4th RP: lifting market entry barriers to improve passenger services (pub. 17 Dec '13)
44 The Parliament Magazine: Ministers discuss 4th railway package (published 10 Oct 2014).
45 EC: Simplifying procedures to achieve a Single European Railway Area (pub. 5 June 2014).

separation of infrastructure from operations, thus a gradual split-up (institutional separation) of Statens Järnvägar (Swedish State Railways), a vertically and horizontally integrated state monopoly, into separate public limited companies. The transport act of 1988 and the following amending acts resulted in: the transfer of the track network to Banverket (Swedish Rail Administration, state authority)in 1988; the liberalisation of freight operations in 1996; the transfer of the passenger transport to SJ (the government-owned train operator) in 2000; the transfer of railway stations and other buildings attached to the railway network to Jernhusen (a government enterprise) in 2001; [46] and the market opening of the passenger service in 2012.[47] Furthermore it determined the empowerment of regional authorities for ordering and funding of regional train services. All train operators in Sweden pay track access charges (based on marginal costs for maintenance) to the track authority Trafikverket (Swedish Transport Administration) since its foundation in 2010, which itself is responsible for the long-term infrastructure planning for all kinds of transport.[48]

This was followed by the UK in 1993 with the passing of the Railways Act[49] which led to the gradual privatisation (1994 till 1997) of the former state-owned railway company British Rail. This was implemented by franchising all passenger services to individual private operators via competitive tendering.[50] The rail infrastructure of British Rail was taken over by Railtrack (a group of private companies) until its bankruptcy in 2002 and was then transferred to the state-controlled non-profit company Network Rail,[51] following a serious accident attributed to poor infrastructure maintenance.[52]

The German railway sector was fundamentally reformed in 1994 and open access to the rail network was gradual granted to third parties. The state-owned West German national carrier Deutsche Bundesbahn was consolidated with the former East-German governmental rail undertaking Deutsche Reichsbahn, restructured and re-established as Deutsche Bahn (DB, German Railway). The DB is a government-held holding company managed under private law consisting of semi-autonomous divisions for cargo, passenger service and infrastructure. Besides the DB, which combines the train operations and rail infrastructures of the former East and West railways, the Eisenbahn-Bundesamt (EBA, Federal Railway Office) was founded, a government agency inspecting and authorising the majority of German domestic railway infrastructure and rolling stock companies. Furthermore the Bundeseisenbahnvermögen (BEV, Federal Railway Property) was

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46 Amadeus: European Rail Deregulation (pub. 5 Feb 2010).
47 Alexandersson et. al. (2013), p.308.
48 ECMT report: Competitive Tendering of Rail Services (2007), p.167 and 168.
49 "Railways Act 1993". *The Railways Archive*.
50 ECMT report: Competitive Tendering of Rail Services (2007), p.9.
51 Network Rail closer to Railtrack takeover". *BBC News*. (pub. 18 Sep 2002).
52 Nash and Rivera-Trujillo (2004), p.18.

installed, a special fund under public law for all former federal railway agents, the combined legacy debts and the non-essential railway estates.[53] Two years later, in 1996, the regional and local rail passenger market was changed, as well. The responsibility for regional rail transport organisation and funds were transferred from the federal to the state level ("regionalisation"). Public procurement, tendering and franchising (competition for the market) were introduced in the opened rail-freight market and the regional rail passenger market.[54] Long-distance service, though, remains a monopoly of DB until today with very few exceptions.

France started in 1997 to separate the rail infrastructure from its national state-owned railway company SNCF. RFF, a new state-owned company, was founded which owns and maintains the French national railway network. Despite this separation SNCF kept ownership of all French train stations in an own division 'Gares & Connexions'. Furthermore its SNCF Infra division carries out track and other infrastructure maintenance on behalf of RFF.

To sum up, one can observe that three different models for separation of infrastructure and operation have emerged in Europe: 1) complete separation (e.g. UK, SE), 2) holding company (e.g. DE) and 3) separation of key powers (e.g. FR). Please see table 5 for a visualisation.

The EC remains the driving force in reforming the sector; nowadays MS seem reluctant to lose control over their national networks. The transposition of EU legislation into domestic law is delayed in many countries. MS differ in terms of how they have interpreted requirements set by the legislation. The majority of countries only implemented the EU's minimum requirements. In order to address this non-compliance the EC repeatedly notified MS for failing to implement EU legislation.[55]

The railway packages (RP) are composed of directions with a specific policy goal, only few regulations were set up as well. That means that the MS themselves are responsible for the transposition of the directive by their national legal means in contrast to the direct effect of regulations into national legislation. But not all MS are implementing the new EU rules at the same time and to the same extent. Countries with a more liberalised market like the UK, Sweden and Germany had a stronger entry of new rail freight firms in comparison to less liberalised markets like in Spain, France and Denmark; where the incumbent rail freight operators still reach a market share of 100%. But other entry barriers like the

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53 In German: Große Anfrage der Fraktion Die Linke zu 20 Jahre Bahnreform, Nov 2014., p.2.
54 ECMT report: Competitive Tendering of Rail Services (2007), p.141.
55 Laperrouza and Finger (2009), p.6.

national right of cabotage make it hard for new freight firms. Cabotage refers to the transport of goods or passengers between two points in the same country by a foreign company.[56]

Generally speaking the domestic freight market is open to competition across the EU since January 2007, the international freight followed soon after. But the domestic and international passenger market remains a patchwork of access.[57] For example in Germany the regional and local train services are ordered and financed by the Länder (States) governments, the public procurement is carried out Europe-wide and thus several competing companies are present in the market besides the former national monopolist Deutsche Bahn. This is not the case for long-distance and cross-border (international) trains, only DB is operating them in Germany or in a joint-venture with another neighbouring former state monopolist for instance between Paris and Frankfurt (DB/SNCF) or between Vienna and Munich (DB/ÖBB).[58] With the partial opening of the passenger market in 2010, a number of operators have applied for slots outside of their home markets.

Due to its historical and technical heterogeneity, the deregulation of the railway sector in the MS has been driven by different types of economic, institutional and legal goals. The UK wanted to pursue a comprehensive liberal market agenda, whereas Sweden's key concerns were the need to find investments in the railway sector and to increase efficiency through competition. Other countries like Portugal and France initially only acted in accordance with the new EU legislation. Despite these divergent paths of liberalisation, one can nonetheless find a number of common significant changes that occurred in the European railway landscape since the 1990s (table 4 in the appendix).[59]

Conclusively the objective of a single European railway area is far from reached. Problematic are the two major conditions, the liberalisation of the national markets and the creation of an interoperable network. Both are potentially contradictory, because liberalisation requires specific regulation for economic and financial performance, and interoperability requires specific regulation for technical and operational performance. Achieving technical interoperability results in high and immediate cost to railway operators and infrastructure managers without generating major returns in the short-term. Another factor of the dragging liberalisation progress is the recurrent unwillingness of MS to transpose and implement European regulation on time because of national reluctance to

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56 Eisenkopf (2006), pp.293f.
57 Railway Gazette: An open passenger market beckons (published 19 Feb 2008).
58 Railway Gazette: An open passenger market beckons (published 19 Feb 2008).
59 Laperrouza and Finger (2009), p.7.

hand over control and authority. As a consequence the European railway sector remains fragmented on several levels:

1) Technical: interoperability is difficult due to the complexity of the difference of technical standards, therefore interoperability is operated first and tested on new high-speed lines and along a number of major corridors, conventional rail service will follow;

2) Financial: the financing of many railway operators remains a patchwork between government subsidies and EU together with national authorities;

3) Organisational: the former vertically integrated monopolies have been unbundled and are under competitive and performance pressure; the centrally-controlled railways are increasingly decentralised and run by markets (passenger demand); ownership too is being transformed from one/few actors to several actors; at times public ownership is replaced by private or public-private arrangements.

4) Administrative/legal: obeying the subsidiarity principle, national railway legislations are diverse both in terms of their design and implementation.[60]

The creation of an integrated European railway area also calls for improved "interoperability" – or technical compatibility - of infrastructure, rolling stock, signalling and other subsystems of the rail system, as well as less complex procedures for the authorisation of use of rolling stock across the European Union's rail network. Over 100 years of national rail networks have developed different technical specifications for infrastructure. Different gauge widths, electrification standards and safety and signalling systems all make it more difficult and more costly to run a train from one country to another. Specific EU legislation exists to promote interoperability and overcome such differences.

The European Railway Agency plays a central role in promoting interoperability and harmonising technical standards, a process in which cooperation between EU Member States and rail stakeholders is essential.[61] The diversity of signalling systems in Member States has long been recognised as a barrier to international rail traffic. Member States have committed themselves to the European Rail Traffic Management System (ERTMS). ERTMS creates a single Europe-wide standard for train control and command systems (CCS). The two main components of ERTMS are the European Train Control System (ETCS, a standard for in-cab train control), and GSM-R (the GSM mobile communications standard for railway operations).[62] In the years to come, ERTMS will play a major role as the common European signalling and train control system. ERTMS implementation is

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60 Laperrouza and Finger (2009), p.8f.
61 http://ec.europa.eu/transport/modes/rail/interoperability/ (ret. 7 Jul 2015).
62 ERA: Final Report TSI CCS Scope Extension by Wouter Malfait from 14 May 2014, p.11.

covered by a Memorandum of Understanding signed between the Railway sector and the European Commission in 2005.[63]

1.4 Limitations

The paper concentrates on the railway freight in the EU. Hence, the results should primarily be seen in the light of the freight sector and not in general for the entire railway sector.

The search for suitable and reliable data over the whole period of time (1988 to 2013) was difficult. The IVs (infra_inv and rail_pax) are not ideal as control variables for the DV but were chosen out of the lack of alternatives in the available data sources.

A lot of data is not freely available. In addition the available data panels providing the base for the statistical analysis were not complete, for instance single missing values per country; but also whole years without data entries. As the data is not complete it may offer difficulties in providing complete results. In general, "[a] researcher should always keep in mind that the results of research are only as good as the quality of the data."[64]

This paper limits its research to the EU's transport policy legal acts (railway packages) and their direct impact on the railway freight. Therefore the obligatory transposition of EU directions (which outnumber regulations by far) into national law according to article 288 TFEU, especially its quality and on-time completion are a matter of the member states and hence excluded for reasons of simplifications in this study. Implementation issues and delays in the MS are not covered and not considered by this study.

Furthermore the number of EU countries was reduced to 23, excluding Cyprus and Malta, which have no railways at all, as well as Greece, Ireland and Luxembourg because of no relevant rail freight transport (for more information see section 3.2). This of course means a reduction in the overall coverage of the EU.

There is no control group of countries who are not in the EU but have a significant rail freight sector that underwent reforms like in Europe. This thesis looks exclusively at the development in the EU, further studies could take a global perspective and include non-EU countries in their analysis and compare the results.

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63 CER: Towards a Primary European Rail Freight Network, October 2007, p.26.
64 Gujarati (2004), p.30.

1.5 Disposition

Following this first part of introductory words about the aim of the paper and the history of the European railways, the second part offers an outline of selected previous research. The third part explains the research design, the variables, the used data panel and the applied methods. The fourth part presents descriptive and inferential statistics of the sequential multiple regression. Finally part five draws conclusions from the results and gives suggestions about possible further research.

2 Literature review

This section looks into previous research on the reform of the European railways and presents a selected literature review. It concludes with a resume on how this thesis fits into previous research and how it is relevant for it.

An economic assessment of the opening of the rail freight market, according to Eisenkopf (professor of economics), has to answer the question of the consequences of the liberalisation for the rail freight sector and the economy as a whole. Did the efficiency and the competitiveness of the rail freight sector improve and did the liberalisation stabilise or increase the market share of railways in the freight market.[65] The economic expectation of the railway liberalisation were set high by the EC, which nonetheless had to confess that its targets, especially in the freight traffic have not been meet.

A fundamental problem remains the dominance of the former state monopolies in the market share. They often remained the infrastructure owner and made huge profits of the high track charges from new competitors. But these new competitors have driven down the prices for rail cargo because of a more efficiently and attractive service for their customers. Eisenkopf is convinced that open access to the freight market will boost competition for incumbent railway firms as new ones will enter. Problems may arise from dominant competitors preferring the most profitable services, leaving the less profitable to their smaller competitors. This "cherry picking" could force out new entries due to lack of revenue, which would hamper the competition. Another negative scenario of intramodal competition is the entering of a big state-owned railway in adjacent markets and by economies of scale pushing out smaller private rail operators. Inevitably the market will be in motion by additional competitors and consequential experience a trend of concentration. Namely mergers and acquisitions, which can lead to higher efficiency but at the same time

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65 Eisenkopf (2006), p.293.

strengthen the market dominance of big competitors buying smaller ones and thus undermining the desired competition.[66]

Another dimension of the rail freight market liberalisation is the further integration of the national markets to a Single European Market facilitating the free flow of goods, services, persons and capital. National monopolies on infrastructure and operation, Eisenkopf argues, hamper free trade across the union and create unnecessary trade barriers.[67]

Eisenkopf continues by examining in detail the legal instruments that open up the market and enable competition, the railway packages. These packages are part of the EU's vision of the Connecting Europe Facility (CEF).[68] They aim for "[...] competition in rail transport markets and the integration of formerly separated and closed national markets. It is the integration goal which brings the [EU] as lawmaker into play. [EU] law has to define access rights on the level of directives. Directives are addressed to Member States, which have to transform them into their national law. The legal process takes place on three levels: creation of Community law, transformation of directives into national law and implementation of national law."[69] Eisenkopf states that "the liberalisation goal can only be attained if the different kinds of entry barriers are successfully tackled." He therefore dissects the 'legal tool box' of the railways liberalisation, the directives and regulations of the RPs.

The objective target of the "Second Railway Package" from 2004 was, according to Eisenkopf, the free access to infrastructure for international rail freight services by January 2006 and the liberalisation of cabotage (transport services by foreign companies in domestic areas) by 2007.[70]

Georg Jarzembowski, in his role as MEP, explains the evolution of European railway legislation and points out two core obstacles of the liberalisation. First, "[t]ypically, the national governments were, and partly still are, the owners of national railway companies that control the national railway networks and that at the same time run the operating services. For that reason the Member States were, and partly still are, reluctant to accept the principle of the single internal market for the railway sector."[71] Secondly , "[a]lthough in the now applicable co-decision procedure of the European railway legislation the

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66 Eisenkopf (2006), p.294.
67 Eisenkopf (2006), p.296.
68 The Connecting Europe Facility (CEF) is a genuinely European instrument aimed at supporting the development of high-performing, sustainable and efficiently interconnected trans-European networks in the field of energy, telecommunications and transport. (=> europa.eu).
69 Eisenkopf (2006), p.296.
70 Eisenkopf 2006, p.292.
71 Jarzembowski 2006, p.298.

Member States decide all directives together with the European Parliament, some MS are slow to transpose the European law into their respective national laws. The failure to implement European law both within the required timeframe and, occasionally, also in substance might also be considered as intent to dodge the new European provisions and thereby to prolong unfair competition positions for the national railway companies."[72] The European Commission, as the guardian of the European Treaties, has to watch over the implementation of European law by the Member States and, if necessary, take action. In line with this responsibility, argues Jarzembowski, in 2006 the Commission published a report on the implementation record of the first railway package, in an effort to put more pressure on the MS.

Furthermore certain principles of railway liberalisation are neglected. Current legislation, for example, does not oblige the MS to separate the networks (rails) and the operations (trains) into independent companies, but only to have separate accounting for the network infrastructure and for the operational services (subdivided into passenger and freight) within one company. Instead the opening of the national railway networks (liberalisation), according to Jarzembowski, should mean that train operating companies (TOC), whether state-owned or private and from whichever MS, must be granted the right of access to the national networks without any national restrictions. In this regard Dir. 2004/51/EC completed the internal market for freight services from the year 2007 on. The Dir. obliged MS to allow any railway company to operate cross-border or national freight services in the entire European Union. This is not the case for passenger service yet.[73]

Jarzembowski also refers to new opportunities for the traditional national railway companies, "to overcome the old national borders of action and horizons and to develop into European players." He views the success of the liberalisation in the aviation sector in recent years as a good role model. The liberalisation brought growth and employment; new companies emerged and added service for customers. In general the private aviation industry has become more cost-efficient, more customer-oriented, the fares on average went down (making it affordable to new user groups), and the usage of this transport mode increased significantly. In this sense Jarzembowski believes "[...] that especially in the long-distance cross-border freight services the active railway companies have great chances to gain more customers and more transport volume." Railway transport will become more competitive compared to road transport and change the modal split back in favour of the railway sector.

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72 Jarzembowski 2006, p.301 and 302.
73 Jarzembowski 2006, p.300.

A precondition to be able to seize the aforementioned opportunities is the reorganisation of the current TOCs. Following Jarzembowski's advice, the companies "[...] need to restructure their patterns of investment and employment. They should clearly decide in which way they want to offer services in the freight, long-distance passenger and regional passenger services in their Member State and in the European Union." Member States who are owner of railway companies have to supply their companies with the necessary capital for new investments and for the restructuring process. In case of strict austerity measures by the government a partly or total privatisation of said TOCs is recommended. Railway companies are advised by Jarzembowski "[...] to make up their minds whether they want to achieve the necessary European dimension by growing on their own, by buying up or merging with other companies and/or by establishing alliances with other companies either generally or on certain European corridors."

The less liberalised and strong contested passenger rail, especially the high-speed long-distance cross-border service, still remains outside the common internal market. An agreement between the protectionists MS could not be reached in the Third Railway Package (RP). Consequently Jarzembowski rightly predicts the "[...] need for an Fourth RP to regulate this last subject of the European [legislative] framework." more than 20 years after the advent of the liberalisation.[74]

Johannes Ludewig[75] argues that the market liberalisation of European railways was the right way to go, but emphasises the need for more measures in order to achieve the long called-for modal shift from road transport to the cleaner and safer rail transport. The following two other vital policy instruments are indispensable to create a level playing field between transport modes (road and rail): a fair infrastructure pricing and more investments in new infrastructure. In the case of freight transport the benefits of liberalisation are already evident; according to the EC 2006 report on implementation of the 1st RP the rail freight market shares have stabilised since 2001. This marks the first time that the decline of the railways share in the total market of freight transport has stopped in decades; for example in Western Europe from 32 % in 1970 to 15 % in 2006. Since the launch of the RPs in 2001 the market share of rail freight has stabilised and traffics are increasing in absolute terms. Furthermore the restructuring of the TOCs resulted in impressive figures in productivity gains of more than 150 %. The achievements of passenger service in contrast do not appear as successful because it follows different and more complicated rules with higher stakes from the MS involved.[76]

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74 Jarzembowski 2006, p.302.
75 Executive Director of the Community of European Railway and Infrastructure Companies (CER).
76 Ludewig 2006, p.303.

Fair transport infrastructure pricing means fair and efficient charges for all transport modes, it includes external costs of transport (costs for congestion, air pollution, climate change, accidents, noise, etc.), and should be based on the "polluter pays" principle instead of the conventional "user pays" principle. Switzerland is a good example where "[...] a fair pricing policy can have a radical impact on the ability of rail to compete with road along international corridors, as well as on the financing of transport infrastructure."[77]

"[P]revious investment policy, reflected in decades of underinvestment in rail, [...]" needs to be reversed in order to achieve the modal shift from road to rail. According to Ludewig the revenues generated by a fair infrastructure charging "[...] should be used as a source for cross-modal financing of new railway infrastructure."[78] The EU can help MS' investment decisions by referring to the commonly defined Trans-European Transport Network (TEN-T) to create the necessary new lines, expand existing lines and reduce the number of traffic bottlenecks. Recent reductions in the TEN-T budget at EU level and further cut-backs in national transport budgets are ignoring the needs for more investment in the face of rising transport volume predicted for the next decade.[79]

Werner Rothengatter[80] underlines the development gap between the still fragmented and national scattered European railways in contrast to free European lorries and passenger cars moving across borders without interruption, who can refill their tank everywhere and follow widely standardised international signs, regulations and signals. The aviation sector already displays a high degree of internationalisation and standardisation in form of common rules for piloting and traffic control as well as a common communications language. "[T]he reality for railway systems is completely different." states Rothengatter. Fundamental technical aspects such as track gauge, control systems or electrical power supply differ with one MS to another, resulting in time-consuming and inefficient border traffic; which is the biggest disadvantage compared to road and air transport. Because of their military importance and hostile relation between various European countries, railways have for a long-time been treated as national treasure/secret resulting in a history of heterogeneity leading to the current fragmentation: a "[...] European railway system according to national flags."[81]

In the times of horse carriages and small ships on inland waterways, roughly until the Second World War, the railways were the most competitive mode of transport for mass goods on long distances, but with the rise of road vehicles this position was lost and a long

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77 Ludewig 2006, p.304.
78 Ludewig 2006, p.304.
79 Ludewig 2006, p.306.
80 Prof. of Economics, Head of the Institute of Economic Policy Research, University of Karlsruhe.
81 Rothengatter 2006, p.307.

decline followed. The market for road freight transport was liberalised by a European Court of Justice ruling in 1985. This process got completed in 1998 by granting cabotage (transport services of foreign companies within domestic areas) to road haulage companies across the European Union. Rothengatter, however, points out that "[i]n reality the road haulage companies and the forwarders had already begun this process years in advance and won big market shares through better logistic quality at lower prices, in particular on the rapidly growing international transport market. At the same time the railways stagnated, lost market shares and increased their [financial] deficits as well as the corresponding subsidies provided by the state."[82] This continued despite the introduction of first measures to reform the European railways, namely Dir. 91/440/EEC from 1991[83], until the year 2000/2001.

Rothengatter emphasises that interoperability is not just a technical side-topic of the common railway development but rather an important cornerstone of its revitalisation. Moreover interoperability is a pre-condition for intra-modal competition (train company A competes with train company B on the same network) that fosters productivity and innovation. Interoperability "[...] lead[s] to better capacity use on the tracks and to lower transport costs." Modern big freight companies like the European (mainly German) DB Schenker Rail (formerly known as Railion) makes more than 50% of their turnover from cross-border transport were interoperability between national rail systems is essential. Exactly this international bundled transport over long distances is the natural market segment for railways, according to Rothengatter.[84] Bundling or consolidation in freight traffic generally refers to the process of transporting goods with different destinations together during part of their journey in a common vehicle (like lorry or train) or in a transferable unit like a intermodal container.[85] Besides poor interoperability, insufficient common licensing and the slow adoption of a common train control system called ETCS (European Train Control System) by the MS are the main hurdles of further progress in creating a common railway market.

This paper is part of and was inspired by a wider series of academic papers analysing the development of the European railways and its rapid transformation in the past 25 years. Many authors draw comparisons between the different liberalisation levels in various Member States, investigated the liberalisation in one MS, looked at the long-distance passenger rail service in Europe, the rail regulatory reform in Europe, or examined the productivity growth in European railways; but none looked specifically at the freight

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82 Rothengatter 2006, p.307.
83 http://eur-lex.europa.eu/legal-content/EN/LSU/?uri=CELEX:31991L0440.
84 Rothengatter 2006, p.308-310.
85 Kreutzberger 2010, p.160.

railway sector. To the authors knowledge no similar study or approach has been published, examining specifically the impact of the Railway Packages on rail freight in the EU. This research could add to literature by offering an impact assessment of European legislation and to measure its efficiency in achieving the set goals.

A wider contribution to legislation impact assessment can be drawn from the approach of this paper. By looking at statistical effects correlated to legislation.

3 Methodology

This chapter has three sections: first, a layout the overarching research design, second, the used data together with the sources, and third, an explanation of the applied methods.

3.1 Research design and variables

The research design specifies the composition of this study. It is the created framework to seek answers to the research questions as well as to test the hypotheses mentioned in section 1.1. This thesis uses a quantitative research method: sequential multiple regression[86]. A definition of this method is given in the following section 3.3.

This research seeks to generate hypotheses by examining datasets and estimating potential relations among the chosen variables. It is also called exploratory research as it starts with a (rough) idea about the relation between variables without specific knowledge of the direction and strength of that said relation.

The linear regression model can be described as a straight line (function) laid in between all observations in a way that summarises best the pattern (spread) of the data.[87] The model of this research uses the following equation (1)[88]:

$$\ln\_rail\_freight_i = \ln\_infra\_inv_i + \ln\_rail\_pax_i(+D_{EU} + D_{Dir91} + D_{RP2001} + D_{RP2004} + D_{RP2007} + D_{recast2013}) + lnE_i \tag{1}$$

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86 The case of one explanatory variable is called *simple regression*. More than one explanatory variable is *multiple regression*. (This in turn should be distinguished from *multivariate linear regression*, where multiple correlated dependent variables are predicted.)
87 Field (2009), p.209ff.
88 Also called single-equation model, see Gujarati (2004), p.5.

where

      ln_rail_freight   = railway goods transported per year in each EU Member State

                     (transformed into natural logarithm = ln)

      ln_infra_inv   = public expenditure on railway infrastructure per year and country (ln)

      ln_rail_pax   = total inland passenger numbers (ln)

      D_{EU} = EU membership dummy

      D_{Dir91} = Directive 91/440/EEC dummy

      D_{RP2001} = 1st railway package from 2001 dummy

      D_{RP2004} = 2nd railway package from 2004 dummy

      D_{RP2007} = 3rd railway package from 2007 dummy

      $D_{recast2012}$ = recast of 1st railway package from 2012 dummy

      lnE   = is an unobserved error term (ln)

      i   = country year

This equation presumes that the dependent variable (DV), railway freight, has a linear relation with the independent variables (infrastructure investment and rail passengers). With the use of a regression analyses this paper tries to identify indications of causal relationship between a cause, the railway packages, and its (direct) effect, a (positive) change in the railway freight figures.

The dependent and independent variables are continuous variables, these measure quantitative values. Dummy or proxy variable(s) are categorical binary (dichotomous) variables that take on only the values 0 or 1 to indicate the absence or presence of a category that may be expected to shift the outcome. In other words: numeric stand-ins for qualitative facts, where 0 means not in effect and 1 means in effect. The error term E is sometimes called disturbance and is not taken into account explicitly in the model.

Table 1: Summary of the dependent, the independent and the dummy variables

Variable	Type	Description	Expected sign	Data source
rail_freight	Dependent (DV1)	railway goods transported per year in each EU Member State (in million tonne*kilometre, tkm)		ITF
infra_inv	Independent (IV1)	public expenditure on railway infrastructure per year and country (in Euro)	+	ITF
rail_pax	Independent (IV2)	total inland railway passengers per year (in million passenger*kilometre, pkm)	+	ITF
D_{EU}	Dummy	EU membership in the specific year (0 = not member, 1 = member)		EC website
D_{Dir91}	Dummy	Directive 91/440/EEC (0 = not in effect, 1 = in effect)		EC website
D_{RP2001}	Dummy	1st railway package from 2001 (0 = not in effect, 1 = in effect)		EC website
D_{RP2004}	Dummy	2nd railway package from 2004 (0 = not in effect, 1 = in effect)		EC website
D_{RP2007}	Dummy	3rd railway package from 2007 (0 = not in effect, 1 = in effect)		EC website
$D_{recast2012}$	Dummy	recast of 1st RP from 2012 (0 = not in effect, 1 = in effect)		EC website

3.2 Data panel and sources

This section presents the used data, their explanation and classification. The two best suited data sources for the purpose of this research were EuroStat[89] and the International Transport Forum (ITF) of the OECD[90]. Both provide extensive data on railway transport in the EU. The ITFstat reaches back until 1975 whereas the EuroStat data starts in the year 2003. Because this paper wants to explore the effects of the EU legislation on railway transport since its beginning in 1991 the ITF dataset was chosen over the EuroStat dataset.

The type of data for this empirical analysis is *pooled*, that is a combination of cross-sectional (i.e. data collected at one point in time) and time series (i.e. data collected over a period of time). More specific the data is collected in a panel in which a fixed number of countries are recorded in several variables (see section before) every year. Please see tables 6 and 7 in the appendix for the data and variable view in the SPSS programme.

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89 http://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=rail_pa_typepkm&lang=en (acc. 25 Jan 2015).
90 http://stats.oecd.org/Index.aspx?DataSetCode=ITF_GOODS_TRANSPORT# (acc. 30 Jan 2015).

Of the 28 EU Member States five were sorted out. Malta and Cyprus do not have railways,[91] while Greece, Ireland and Luxembourg have only a small rail freight sector (less than 1,000 million t*km per year).[92] Consequently the sample of the analysis (subset of the population of 28) is 23 EU countries during the time span from 1988 until 2013 (26 years). The countries are: Austria, Belgium, Bulgaria, Croatia, Czechia (Czech Republic), Denmark, Estonia, Finland, France, Germany, Hungary, Italy, Latvia, Lithuania, Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, and the United Kingdom.

The unit of analysis is 'country years', that is per country and year one value for each variable (the recorded data entries); thus 23 annual observations. In total 598 observations per variable (23 observations per year times 26 years). But the dataset is not complete, often whole years of data entries are missing or single countries do not have a figure in a specific year. These omissions do not pose a problem because the total amount of calculable cases is still high enough and compensates the missing values.

The chosen timeframe (1988 – 2013) reflects the time span from the first railway reforms in Sweden in 1988 and includes three years before the first European legislation addressing the European railway market (Directive 91/440/EEC) in 1991, to be able to monitor an before and after effect, until the latest available data on railways.

The unit of measurement of the DV rail_freight is *tonne-kilometre*, abbreviated as t*km, which represents the transport of one tonne of goods (including packaging) by a given transport mode over one kilometre. Similarly the IV rail_pax is measured in *passenger-kilometre*, abbreviated as *pkm*, representing the transport of one passenger by a defined mode of transport (here rail) over a distance of one kilometre. The transport mode refers to the way in which passengers and/or goods can be transported (car, bus, train, ship, etc.). The IV infra_inv is measured in public expenditure on railway infrastructure per year and country (in Euro).[93]

Considering that the chosen DV and IVs are quantitative the level of measurement (abstraction) for each of them is 'Ratio scale'.[94] Ratio scale means the difference between two values (the ratio) of a variable is meaningful and there is an absolute (unique and non-arbitrary) zero value.

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91 http://ec.europa.eu/eurostat/statistics-explained/index.php/Passenger_transport_statistics (acc. 8 Apr 15)
92 http://stats.oecd.org/Index.aspx?DataSetCode=ITF_GOODS_TRANSPORT#:
93 http://ec.europa.eu/eurostat/statistics-explained/index.php/Glossary (acc. 8 Apr 2015).
94 Gujarati (2004), p.16.

3.3 Methods

This paper, as mentioned above, uses quantitative research methods. First, descriptive statistics and frequency distribution (histograms) are presented; and second, a sequential multiple regression analysis, which tries to determine how much of the variation in the dependent variable (railway freight) can be explained by each the independent variables (model 1), the EU membership (model 2) and the railway packages (model 3). The advantage of a sequential or hierarchical multiple regression is the possibility to enter the IVs and Ds into the regression equation in an order of choice. This allows to: (a) control for the effects of covariates on the results; and (b) take into account the possible causal effects of IVs when predicting a DV. The sequential multiple regression uses the ordinary least squares (OLS) method for constructing the regression line (model) in a given data set.

The relative, unique contribution of each independent and dummy variable towards the total can be calculated.[95] Thereafter the statistical significance of the overall model and of each IV and D is calculated; concluding with a measure of the effect size.

The regression includes a correlation analysis, which measures the strength of linear association between two variables and is expressed as a coefficient. A linear regression needs a continuous DV and a continuous IV; whereas a multiple regression, a regression with more than one IV, can include categorical IVs or dummies.

To make sure the regression provides valid and reliable results the following assumptions must be observed:
1) Normal distribution of DV and IVs
2) Independence of observations
3) A linear relationship between the independent variables and the dependent variable
4) Homoscedasticity of residuals (equal error variances)
5) No multicollinerarity
6) No significant outliers or influential observations
7) Normal distribution of residuals

Assumption 1) is checked in section 4.1 and the assumptions 2) till 7) are checked in section 4.2.

These assumptions will (1) provide information on the statistical significance of the regression, (2) test how well the regression model fits the chosen data, (3) determine the

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95 https://statistics.laerd.com (acc. 23 Jul 15).

variation in the dependent variable explained by the independent/dummy variables, and (4) test the hypotheses H0 and H1 against the regression equation.[96]

The terms errors and residuals in a regression are two closely related and easily confused measures of the deviation of an observed value in a data set from its "theoretical or predicted value". The error (or disturbance) of an observed value is its deviation from the (unobservable) population or general mean, and the residual of an observed value is its deviation from the calculated value of the sample or specific mean. The sign of the deviation (positive or negative), reports the direction of that difference (the deviation is positive when the observed value exceeds the reference value). The magnitude of the value indicates the size of the difference.

The calculations of this study were conducted with the computer software SPSS from IBM, a widely used programme for statistical analysis in social science.

4 Operationalisation and empirical data

This part conducts the sequential multiple regression and presents its results: first, a quantitatively description of all variables; and second, determining statistical significance with the findings of the regression. Tables and figures were moved to the appendix (section IV) for a better reading experience.

4.1 Descriptive statistics

In order to run a multiple regression it requires a continuous dependent variable (DV) and two or more independent variables (IVs); these need to be continuous or categorical. DV and IVs are continuous in model 1 and 2. Dummy variables are no precondition but can be added.

For descriptive statistics of all variables (including dummies) please see table 8 in the appendix. A histogram illustrates the frequency distribution of a variable. Histograms of DV1, IV1, IV2 and D1 can be seen in figures 1 till 4. Variables rail_freight (DV), infra_inv (IV1) and rail_pax (IV2) do not show a normal distribution curve in their histograms; instead they are strongly skewed to the left and have a single sharp peak. Their skewness (measure of asymmetry) and kurtosis (measure of peakedness) according to table 8 are not close to zero. Skewness: DV1 (2.458), IV1 (2.006) and IV2 (1.790). Kurtosis: DV (6.386), IV1 (3.195) and IV2 (2.267). Therefore all three variables need to be log-transformed (natural logarithm = ln) to fulfil another precondition of regression analysis, that all

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96 https://statistics.laerd.com, online statistics tutorial, section: multiple regression (acc. 23 Jul 15).

continuous variables need to have an approximately normal distribution. Dummy variables are not continuous and therefore do not need to get log-transformed.

After being log-transformed all three new variables (DV: ln_rail_freight, IV1: ln_infra-inv and IV2: ln_rail_pax) have a more central position and show an approx. normal distribution curve (figures 5 till 7), but have several peaks (polynomial). Their kurtosis and skewness values are according to table 9 closer to zero (all ±0.x). Skewness: DV1 (0.076), IV1 (-0.067) and IV2 (-0.291). Kurtosis: DV1 (-0.444), IV1 (-0.849) and IV2 (-0.480).

4.2 Inferential statistics – Testing of assumptions

There were 378 cases (N) for the regression according to table 14. SPSS did not accept dummies D2: Directive 91/44/EEC and D6: recast of 1st RP in 2013, it deleted both from model 3 (table 15).

Before the coefficient results for the variables and the model fit are presented it is necessary to check the assumptions mentioned in the section 3.3.

4.2.1 Independence of observations

In order to rule out possible autocorrelation (serial correlation) between residuals (prediction error) of adjacent observations in the data set the Durbin-Watson statistics should have a value of approx. 2. It has a range from 0 to 4, whereby 0 indicates positive autocorrelation, 2 indicates neutral autocorrelation and 4 indicates negative autocorrelation. A residual is the difference between the value of an observation and the mean value of the same variable.

According to the Model Summary in table 10 the Durbin-Watson for model 3 is 2.515 and therefore it can be accepted that there is independence of observations. The Durban-Watson value was calculated in a separate multiple regression with all variables because SPSS produced no value in the sequential multiple regression. The assumption was not violated.

4.2.2 Linear relationship

The IVs separately and collectively need to be linearly related to the DV for the model to work optimal. The IVs collectively are tested by plotting the 'studentized residuals' (SRE) on the y-axis against the 'unstandardized predicted values' (PRE) on the x-axis in a scatterplot. Both SRE and PRE were created by the regression. The scatterplot in figure 8 does not show linear relationship between the collective IVs and the single DV. This violation will be neglected for now and later addressed in the weaknesses in section 5.1.

Each IV separately plotted against the DV in the partial regression plots show a horizontal band of residuals (regular spread pattern) as a sign of linear relationship (figures 9 and 10). The categorical dummy variables are ignored in that respect because they are not continuous. The assumption was not violated.

4.2.3 Homoscedasticity
The assumption of homoscedasticity (homogeneity of variance) is the evenly spread of the residuals of the collective IVs on the y-axis over the predicted values of the DV on the x-axis. For this matter figure 8 will be used again. The spread of the residuals does increase and decrease along the y-axis going across the predicted values on the x-axis, which is a sign of heteroscedasticity, the opposite of homoscedasticity. This violation will be neglected for now and later addressed in the weaknesses in section 5.1.

4.2.4 Multicollinerarity – independence of the IVs
Collinearity is a linear association between two variables. Multicollinearity occurs when two or more variables are highly correlated with each other. This leads to problems with understanding which variable contributes to the variance explained. There are two ways to identifying it: inspection of correlation coefficients and Tolerance/VIF values.

The Pearson correlation coefficients between the variables should not be higher than 0.7, except between the same variable which has the value 1. As model 3 is the final model encompassing all dummies the values of model 1 and 2 are not mentioned here but can be seen in table 11. Only IV1 and IV2 have a correlation higher than 0.7 namely 0.844. This violation will be neglected for now and later addressed in the weaknesses in section 5.1.

The tolerance value T refers to how much of the variance in one variable is shared with another one in the regression analysis. If the tolerance value is 1 none of the variance is shared with the other variable. If the tolerance is 0 none of the variance in each IV can be considered to be unique. The values for Tolerance (T)/Variance Inflation Factor (VIF) can be found in table 12. The values for model 3: Tolerance: ln_IV1 (0.147), ln_IV2 (0.214), D1 (0.404), D3 (0.499), D4 (0.327) and D5 (0.536). VIF: ln_IV1 (6.799), ln_IV2 (4.678), D1 (2.476), D3 (2.002), D4 (3.054) and D5 (1.867).

Tolerance and VIF can also be calculated using the following formulas: $T = 1 - R^2$, $VIF = \frac{1}{T} = \frac{1}{1-R^2}$. According to table 10 for model 3 $R^2 = 0.339$. This means T = 1 - R^2 = 1 - 0.339 = 0.661. To calculate VIF we divide 1 by 0.661, VIF = 1.513. The read (table 12) and calculated VIFs are below 10 and each Tolerance is above 0.1, this

indicates no presence of multicollinearity between the variables.[97] The assumption was not violated.

4.2.5 Detecting outliers

Outliers or extreme observations are data points that can be classified as unfitting the regression model (line). Outliers are described with high deviation on the y-axis and high leverage on the x-axis. They do not follow the usual pattern and are far away from their predicted value. For this reason they need to be detected and removed as they can distort the regression results. But the higher the number of cases (observations N) the less vulnerable are the results to outliers.

In a regression the deviations or difference of the dependent variable observations from the *fitted* function (sample mean) are the residuals.

There was no 'Casewise Diagnostics' produced by SPSS, which means no observation value with a standardized residual of $> \pm 3$ is in the data set. According to table 13: There were no studentized deleted residuals (SDR) greater than ± 3 standard deviations; the leveraged values (LEV) of all 378 cases of the regression were less than 0.2 and therefore considered safe; the influential points stored as Cook's Distance values (COO) were all < 1, so no case needed to be investigated.[98]

In addition one can plot SDR against LEV (figure 11), which shows that the leverage (x-axis) is below 0.2 and the residuals (y-axis) are below 5. The assumption was not violated.

4.2.6 Normal distribution of residuals (normality)

To be able to run a regression the residuals of the DV need to be normally distributed, that implies that the errors have a mean of zero. The histogram of the standardized residuals of DV1 (ln_rail_freight) shows an approx. normal distribution (figure 12). To confirm these findings, a Normal P-P Plot of the studentized residuals of DV1 shows too that the residuals (circles in figure 13) are closely aligned along the diagonal line indicating an approx. normal distribution. The assumption was not violated.

4.3 Reporting the output (results)

4.3.1 Determining how well the model fits

There are two measures that can be used to determine how well a regression model fits the data: R, R^2 and the F-ratio. All values of these measures are provided in the 'Model Summary' in table 10.

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97 https://statistics.laerd.com, online statistics tutorial, section: multiple regression (acc. 23 Jul 15).
98 https://statistics.laerd.com, online statistics tutorial, section: multiple regression (acc. 23 Jul 15).

The 'multiple correlation coefficient' R can be considered to be one measure of the quality of the prediction of the DV. In fact it is the correlation between the predicted values and the actual values of the DV. R can range in value from 0 to 1, with higher values indicating that the predicted values are closer to the actual values. For model 3 a value of $R = 0.582$ indicates a medium level of prediction, similar values for model 1 (0.576) and model 2 (0.578).

R^2 or R *square* (coefficient of determination) represents the proportion of variance in the DV that can be explained by the other variables. An R^2 near 1.0 indicates that a regression line fits the data well, while an R^2 closer to 0 indicates a regression line does not fit the data very well. A value of $R^2 = 0.339$ means that the two IVs (ln_infra_inv and ln_rail_pax) and the 4 dummies explain approx. 39.9% of the total variability of the DV (ln_rail_freight). Accordingly model 1 explains 33.1 % and model 2 explains 33.4 %.

The F-ratio in the ANOVA (analysis of variation) table (table 16) is the ratio between the mean sum of squares for regression and the mean sum of squares for residuals. A good fit for the data has a p-value of < 0.05. The table shows that the variables statistically significantly predicted the DV, F(6 variables, 371 cases) = 31.703, with $p < 0.0005$. Accordingly ln_infra_inv and ln_rail_pax of model 1 predict the DV, F(2 variables, 375 cases) = 92.866, with $p < 0.0005$; and model 2 (model 1 + EU membership) predict the DV, F(3 variables, 374 cases) = 62.442, with $p < 0.0005$.

4.3.2 Estimated model coefficients B of all accepted variables

Unstandardized coefficients indicate how much the DV varies because of one independent or dummy variable when all other variables are held constant. The greater the coefficient of the variable the greater is the effect on the DV. The minus or plus sign indicates a positive or negative effect.

The unstandardized coefficients B for each variable can be found in table 12, for model 3: Constant (6.148), ln_IV1 (-0.023), In_IV2 (0.423), D1 (-0.242), D3 (0.034), D4 (0.160) and D5 (-0.044).

4.3.3 Statistical significance of the independent and dummy variables

Table 12 reports also the Significance or p-value of the IVs and Ds, for model 3: Constant (0.000), ln_IV1 (0.697), In_IV2 (0.000), D1 (0.099), D3 (0.782), D4 (0.274) and D5 (0.725). If $p<0.05$, one can conclude that the coefficients are statistically significant. Only the constant and IV2 has statistical significance.

A summary of the regression coefficients and standard errors can be found in the table below.

Table 2: Summary of sequential multiple regression (OLS): Unstandardized Coefficients B (SPSS).

The effect of the European railway packages on railway freight since 1988.

DV: ln_rail_freight	Model 1 (IV1+2)	Model 2 (M1+D1)	**Model 3** (M1+all dummies)
IV1: ln_infra_inv	-.069*	-.023	-.023
	(.042)	(.058)	(.060)
IV2: ln_rail_pax	.443***	.412***	.423***
	(.051)	(.058)	(.060)
Dummy variables			
D1: EU membership		-.158	-.242*
		(.134)	(.146)
D3: 1st RP			.034
			(.124)
D4: 2nd RP			.160
			(.146)
D5: 3rd RP			-.044
			(.125)
Constant	6.787***	6.264***	6.148***
	(.521)	(.684)	(.697)
Model fit R^2	.331	.334	.339
Observations N	378	378	378

Note: Significance *p<0.1 **p<0.01 ***p<0.001, Standard errors within brackets.

Data: EuroStat and the International Transport Forum (ITF) of the OECD

5 Interpreting the output and conclusions

The aim of this paper was to find a statistical significant impact of the EU's railway legislation, the Railway Packages, on the figures of rail freight in the Member States. More specific to determine how much of the variation in the dependent variable (railway freight) can be explained by each the independent variables (model 1), the EU membership (model 2) and the railway packages (model 3). Using the sequential multiple regression allowed to add sets of variables to a regression equation and determine how much each set of variables uniquely adds to the explanation of the variation of the dependent variable, readable as increase in R^2 (the variance explained in the dependent variable). These sets were added to the regression equation in a fixed, sequential order.

Model 3 was the full and final model encompassing all variables. It had the best fit in the data with R^2 = 0.339, explaining 33.9 % in the variance of DV rail_freight. But alone the two IVs (infra_inv and rail_pax) explained already 33.1 % (M1), leaving only 0.3 % for EU membership, and similar small 0.5 % for the railway packages. Within this research model the PRs contributed only a fraction to the variance of the DV. In general, R^2 was low, indicating that the regression line (model) did not fit the data very well.

Looking at table 2 and comparing the unstandardised coefficients of the variables it is clear that the IV2 rail_pax has the biggest positive impact on the DV with a high significance, followed by the EU membership dummy with the biggest negative impact but a low significance. Of the three RPs dummies the second RP has the strongest impact, but all lack any statistical significance. The same is true for the impact of IV1 infra_inv. Therefore one can conclude that the effect of the RPs on rail freight were only marginal and negligible. Considering this: the null-hypothesis H0 is confirmed and the alternative hypothesis H1 is rejected.

One can try to explain the results by saying that of course the EU membership has more weight than each RP because member states have to implement EU legislation anyways. The relation between rail freight and rail pax is less clear and it is hard to explain why it is the strongest. There is no streight connection between more train passengers and rising freight numbers. Therefore it is highly plausible to be a fault of the research model. For example the correlation coefficients between IV1 and IV2 were too high.

The quality of the prediction of the DV remained stable in all three models, ranging from 0.576 (M1) over 0.578 (M2) to 0.582 (M3). This indicates a medium quality of predicting values closer to the actual values.

The results of this paper could be taken as an indicator of lack of impact on the ground. The current negotiations on the fourth RP may take into account these results in order to better apply and specify the rules concerning rail freight.

Referring back to the literature review in section 2 one could have expected the following trends-

5.1 Weaknesses and problems

The biggest weakness was the three violations of the regression assumptions. That is why the results of this thesis should be handled with caution. First the linear relationship

between the IVs and the DV was violated. Second there was heteroscedasticity between the IVs and the DV (figure 8). Third the Pearson correlation coefficients between IV1 and IV2 was higher than 0.7 suggesting multicollinerarity. Despite these violations the research was carried on because all forms of variable transformation (log) had been already used.

With the chosen research model and method it was not possible to detect a before and after effect on rail freight, in order to take into account the impact of the first EU legislation on railway liberalisation.

Especially infra_inv had big data gaps, before 1995 and after 2011, but it was the best data available. Otherwise more cases than 378 could have been used in the regression.

5.2 Suggested further research and outlook

The limited results and conclusions of this paper still hold valuable information that could be used in the impact assessments of European legislation on the railway market.

The fourth RP is in the making,

V Appendix

Table 3: Inland passenger transport modal split in 2012 for Europe, from highest rail share to lowest (blue bar). Source: EuroStat, Statistical Pocketbook 2014.
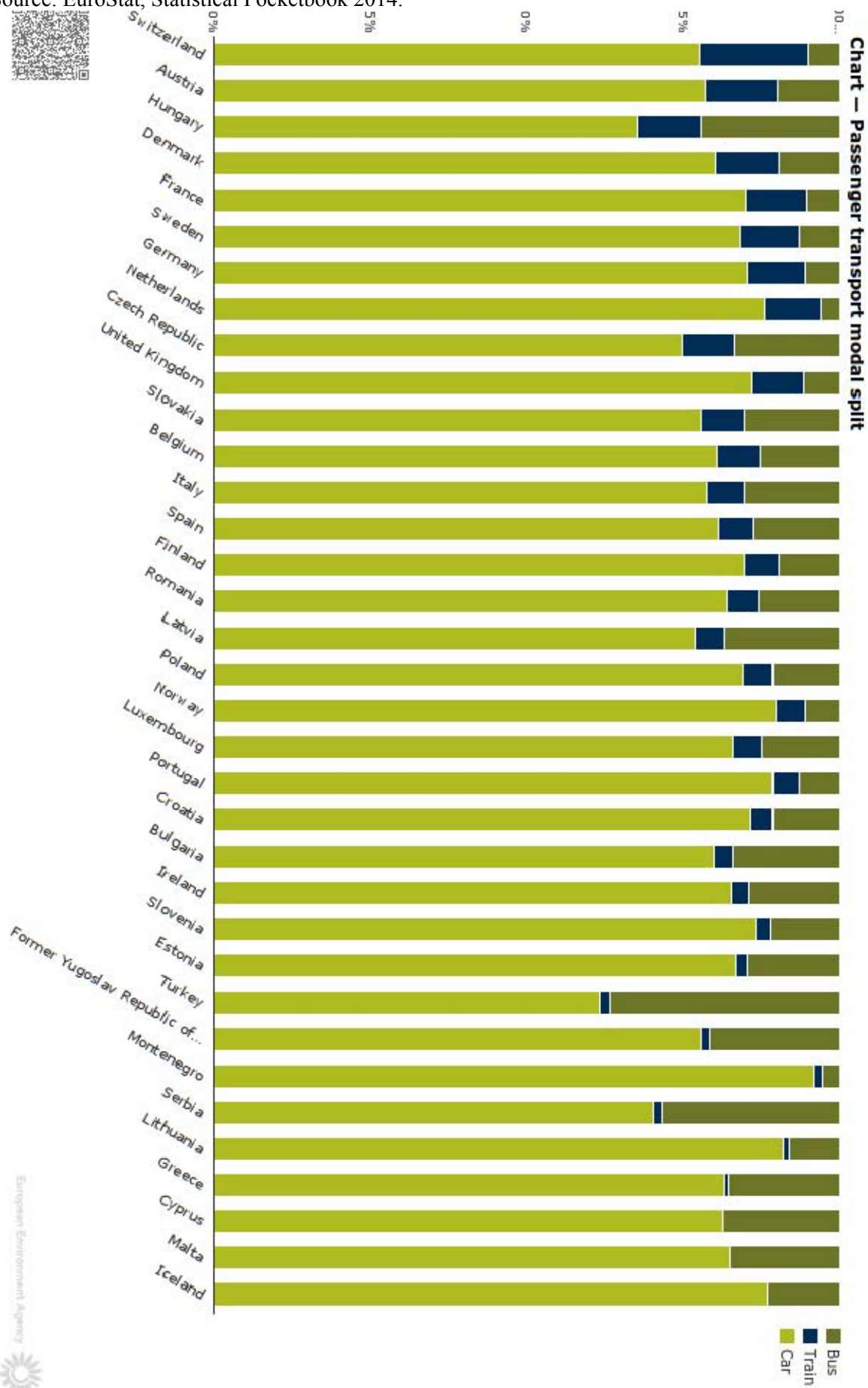
Table 4: Evolution of the European railway landscape from pre-1990 to post-2010.
Source: Marc Laperrouza and Matthias Finger (2009) Regulating Europe's single railway market -
Integrating performance and governance, p.7.

	Previous era (till 1990)	Transition era (1990-2005)	New era (2010)
Organizational structure	Vertically integrated	Voluntary unbundling	Mandatory unbundling [14]
Regulatory policy and legislation	National	National with supra-national transport policy and directives	National with EU Directives (railway packages)
Drivers	Public service	Public service, productivity and financial sustainability	Public service, productivity, financial sustainability, environmental concerns
Market structure	Monopoly	Monopolistic (infrastructure) and market (services) segments	Monopolistic (infrastructure) and market (services) segments
Market opening	Closed with limited international traffic	Ad hoc opening of domestic markets	Freight open Mandated opening of passenger market
Ownership	Public ownership [15]	Mostly state-owned	State-owned (infrastructure) Some private rail companies
Regulatory arrangements	None (Ministry)	None (Ministry)	Independent railway authority
Scale	Regional and national	National to international	Increasingly international

Table 5: Rail sector restructuring forms (MS examples were added by author).
Source: Chris Nash and Cesar Rivera-Trujillo (2004) Rail regulatory reform in Europe –
principles and practice, p.15.
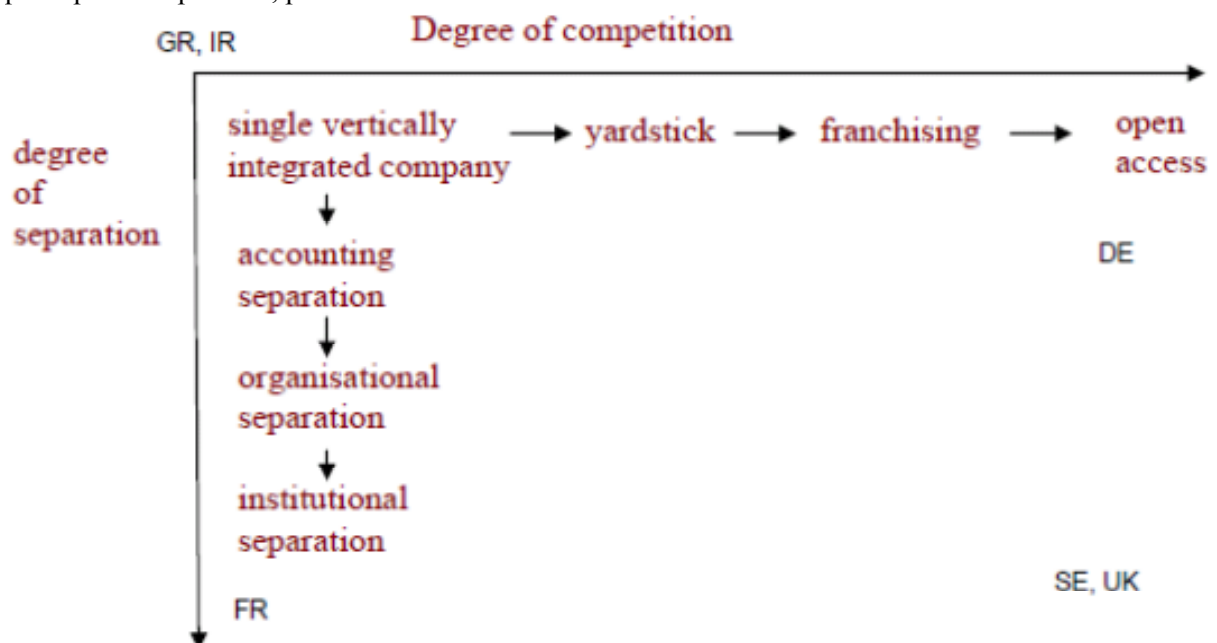
Table 6: Variable view of 'country year – time series data panel' on EU railway goods and railway packages
Source: SPSS

	Name	Type	Width	Decimals	Label	Values	Missing	Columns	Align	Measure	Role
1	y	Numeric	12	0	year	None	None	4	⊒ Right	⬤ Nominal	↘ Input
2	ms_name	String	42	0	member state name	None	None	10	⊒ Left	◢ Ordinal	↘ Input
3	DV1_rail_fre...	Numeric	40	0	DV1: rail freight (m t*km)	None	99	10	⊒ Right	◿ Scale	↘ Input
4	IV1_infra_inv	Numeric	40	0	IV1: railway infrastructure investment (Euro)	None	99	8	⊒ Right	◿ Scale	↘ Input
5	IV2_rail_pax	Numeric	40	0	IV2: rail pax (m p*km)	None	99	8	⊒ Right	◿ Scale	↘ Input
6	D1_EU	Numeric	39	0	Dummy 1: EU Membership	{0, 0 = no E...	None	5	⊒ Right	⬤ Nominal	↘ Input
7	D2_Dir91	Numeric	40	0	D2: Directive 91/440/EEC	{0, 0 = not i...	None	8	⊒ Right	⬤ Nominal	↘ Input
8	D3_RP2001	Numeric	40	0	D3: 1st railway package in 2001	{0, 0 = not i...	None	8	⊒ Right	⬤ Nominal	↘ Input
9	D4_RP2004	Numeric	40	0	D4: 2nd railway package in 2004	{0, 0 = not i...	None	8	⊒ Right	⬤ Nominal	↘ Input
10	D5_RP2007	Numeric	40	0	D5: 3rd railway package in 2007	{0, 0 = not i...	None	8	⊒ Right	⬤ Nominal	↘ Input
11	D6_recast2...	Numeric	40	0	D6: recast of 1st RP in 2013	{0, 0 = not i...	None	8	⊒ Right	⬤ Nominal	↘ Input
12	ln_DV1	Numeric	8	0		None	99	5	⊒ Right	◿ Scale	↘ Input
13	ln_IV1	Numeric	8	0		None	99	5	⊒ Right	◿ Scale	↘ Input
14	ln_IV2	Numeric	8	0		None	99	5	⊒ Right	◿ Scale	↘ Input

Table 7: Data view of 'country year – time series data panel' on EU railway goods and railway
packages
Source: SPSS

|	y	ms_name	DV1_rail_freight	IV1_infra_inv	IV2_rail_pax	D1_EU	D2_Dir91	D3_RP2001	D4_RP2004	D5_RP2007	D6_recast2013	ln_DV1	ln_IV1	ln_IV2
480	2008	Slovenia	3520	128659208	834	1	1	1	1	1	0	8	19	7
481	2008	Spain	10287	8981000000	23969	1	1	1	1	1	0	9	23	10
482	2008	Sweden	22924	1319369332	11146	1	1	1	1	1	0	10	21	9
483	2008	United Kingdom	21077	7562476454	50626	1	1	1	1	1	0	10	23	11
484	2009	Austria	17767	2061533722	10653	1	1	1	1	1	0	10	21	9
485	2009	Belgium	5947	1222638000	10427	1	1	1	1	1	0	9	21	9
486	2009	Bulgaria	3145	49596073	2144	1	1	1	1	1	0	8	18	8
487	2009	Croatia	2641	98228883	1835	0	1	1	1	1	0	8	18	8
488	2009	Czechia	12791	740309349	6503	1	1	1	1	1	0	9	20	9
489	2009	Denmark	1696	356692004	6367	1	1	1	1	1	0	7	20	9
490	2009	Estonia	5934	37496000	249	1	1	1	1	1	0	9	17	6
491	2009	Finland	8872	361000000	3876	1	1	1	1	1	0	9	20	8
492	2009	France	32129	5046915694	85612	1	1	1	1	1	0	10	22	11
493	2009	Germany	95834	3412000000	82253	1	1	1	1	1	0	11	22	11
494	2009	Hungary	7673	317419679	8073	1	1	1	1	1	0	9	20	9
495	2009	Italy	15224	5687000000	48124	1	1	1	1	1	0	10	22	11
496	2009	Latvia	18725	63766473	756	1	1	1	1	1	0	10	18	7
497	2009	Lithuania	11888	67191844	357	1	1	1	1	1	0	9	18	6
498	2009	Netherlands	5578	778229634	15400	1	1	1	1	1	0	9	20	10
499	2009	Poland	43554	650244939	18637	1	1	1	1	1	0	11	20	10
500	2009	Portugal	2174	360000000	4152	1	1	1	1	1	0	8	20	8
501	2009	Romania	11088	177362674	6128	1	1	1	1	1	0	9	19	9
502	2009	Slovakia	6964	175300000	2264	1	1	1	1	1	0	9	19	8

Table 8: Descriptive statistics of all variables
Source: SPSS

	N	Range	Minimum	Maximum	Mean	Std. Deviation	Variance	Skewness		Kurtosis	
	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
year	598	25	1988	2013	2000.50	7.506	56.344	.000	.100	-1.204	.200
DV1: rail freight (m t*km)	584	120641	1563	122204	18219.12	21430.491	459265933.0	2.458	.101	6.386	.202
IV1: railway infrastructure investment (Euro)	378	10171001044	3803956	10174805000	1377102175	2169023267	4.705E+18	2.006	.125	3.195	.250
IV2: rail pax (m p*km)	586	92263	177	92440	16426.40	21496.444	462097108.9	1.790	.101	2.267	.202
Dummy 1: EU Membership	598	1	0	1	.64	.479	.230	-.602	.100	-1.643	.200
D2: Directive 91/440/EEC	598	1	0	1	.88	.320	.102	-2.414	.100	3.839	.200
D3: 1st railway package in 2001	598	1	0	1	.50	.500	.250	.000	.100	-2.007	.200
D4: 2nd railway package in 2004	598	1	0	1	.38	.487	.237	.476	.100	-1.780	.200
D5: 3rd railway package in 2007	598	1	0	1	.27	.444	.197	1.043	.100	-.915	.200
D6: recast of 1st RP in 2013	598	1	0	1	.04	.192	.037	4.812	.100	21.227	.200
Valid N (listwise)	378										

Figure 1: Histogram of DV rail_freight including normal distribution curve (blue)
Source: SPSS
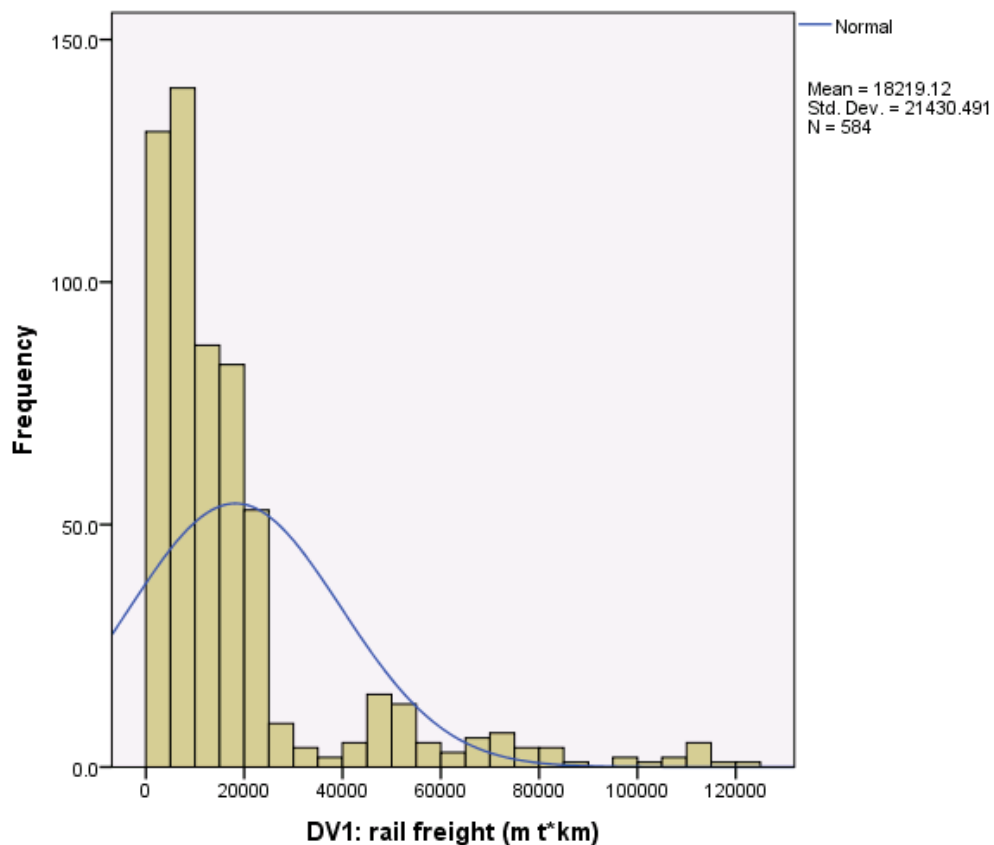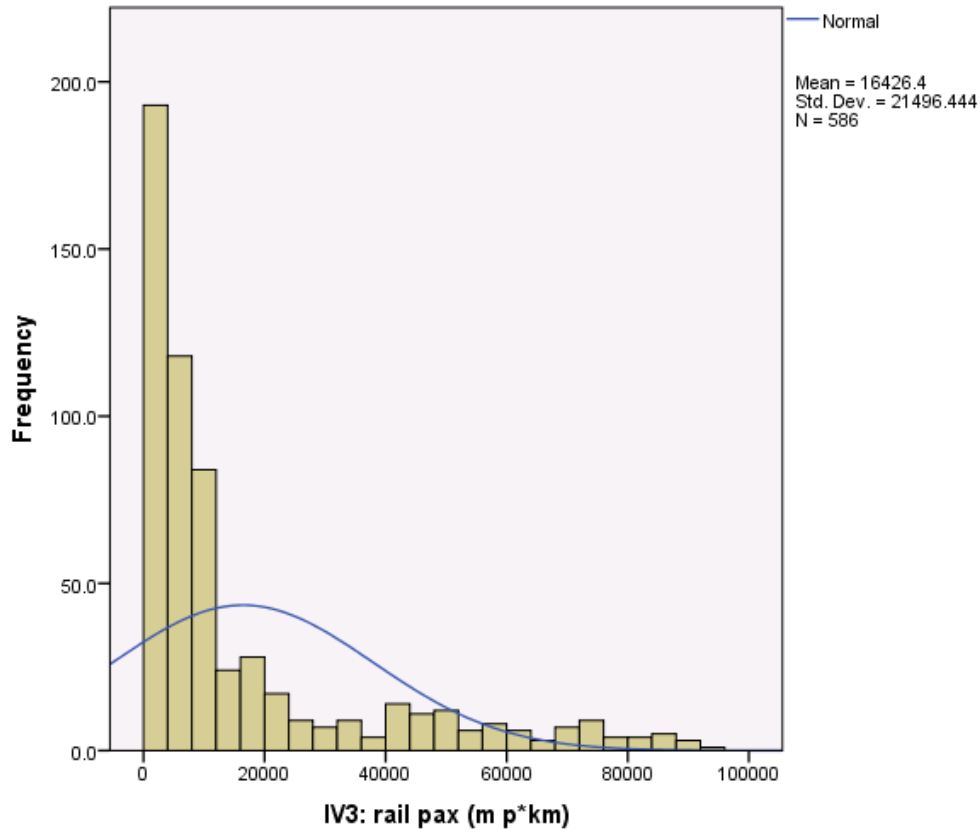

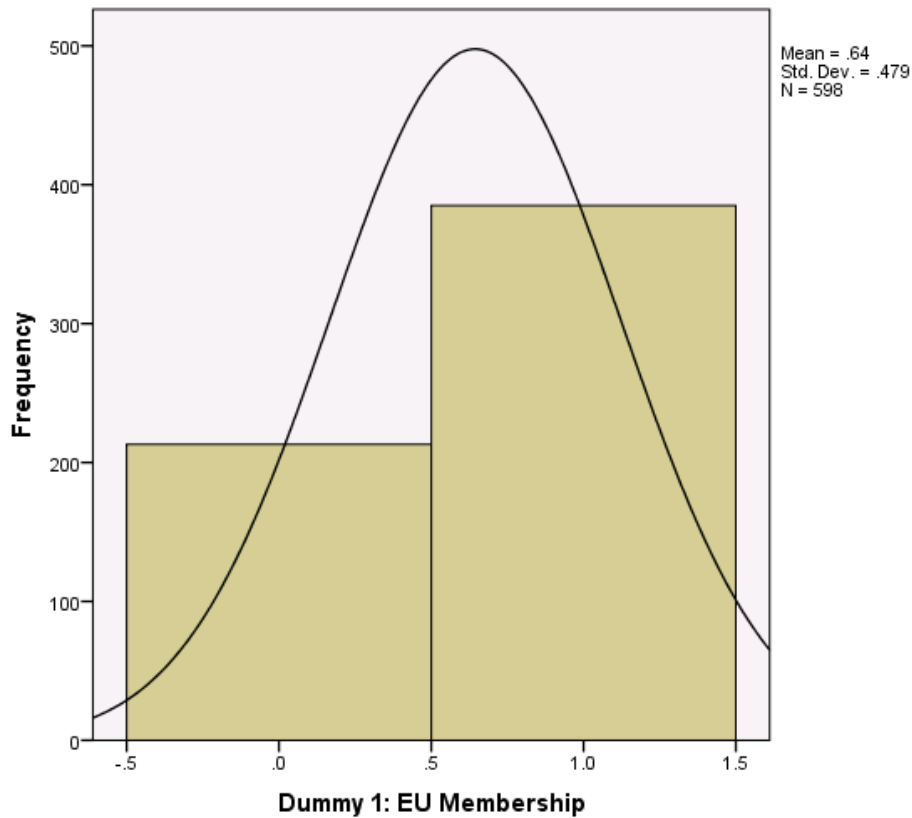**Figure 2**: Histogram of IV1 infra_inv including normal distribution curve (blue)
Source: SPSS
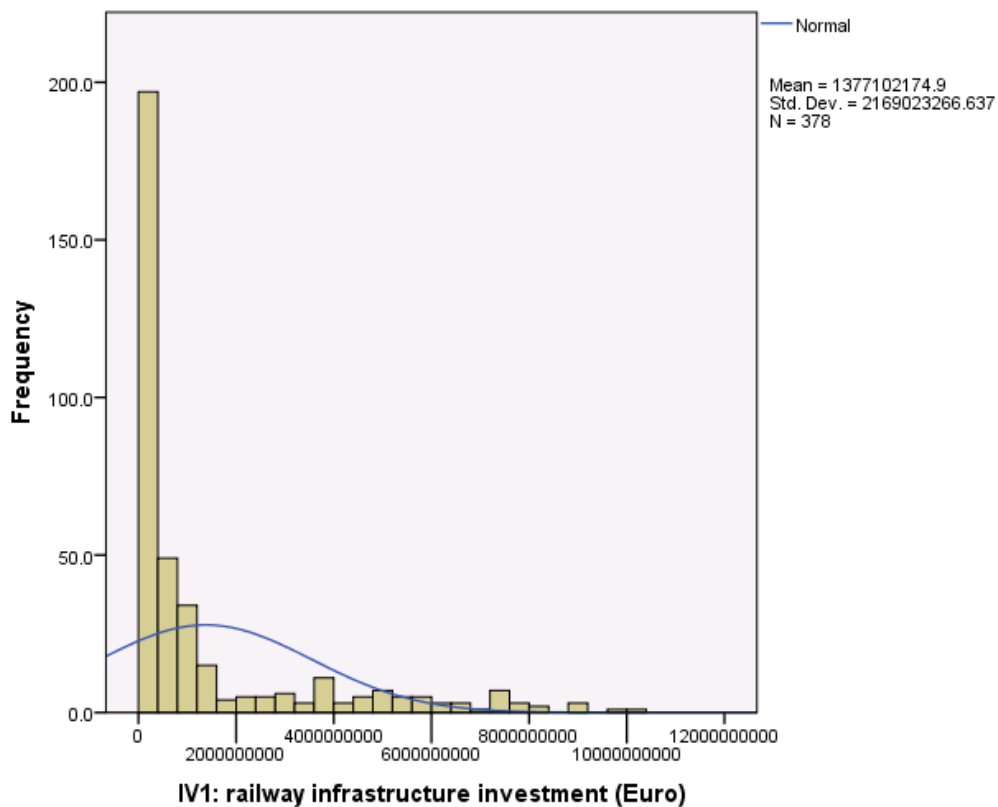
Figure 3: Histogram of IV2 rail_pax including normal distribution curve (blue)
Source: SPSS

**Figure 4:** Histogram of dummy EU, as example for all other dummies
Source: SPSS

Table 9: Descriptive statistics of rail_freight, infra_inv and rail_:pax before and after being log-transformed
Source: SPSS

|		**DV1**: rail freight	**IV1**: rail infrastr. invest.	**IV2**: rail pax	ln_DV1	ln_IV1	ln_IV2
N	Valid	584	378	586	584	378	586
	Missing	14	220	12	14	220	12
Mean		18219.13	1377102174.90	16426.40	9.29	19.71	8.82
Std. Error of Mean		886.800	111562518.729	888.010	.042	.094	.061
Median		11106.00	358346002.00	7282.00	9.32	19.70	8.89
Mode		1757[a]	20000000[a]	15400	7[a]	17[a]	10
Std. Deviation		21430.491	2169023266.637	21496.444	1.024	1.827	1.479
Variance		459265933.005	4704661931211801600	462097108.946	1.048	3.338	2.189
Skewness		2.458	2.006	1.790	.076	-.067	-.291
Std. Error of Skewness		.101	.125	.101	.101	.125	.101
Kurtosis		6.386	3.195	2.267	-.444	-.849	-.480
Std. Error of Kurtosis		.202	.250	.202	.202	.250	.202
Range		120641	10171001044	92263	4	8	6
Minimum		1563	3803956	177	7	15	5
Maximum		122204	10174805000	92440	12	23	11

Figure 5: Histogram of DV ln_rail_freight including normal distribution curve (blue)
Source: SPSS
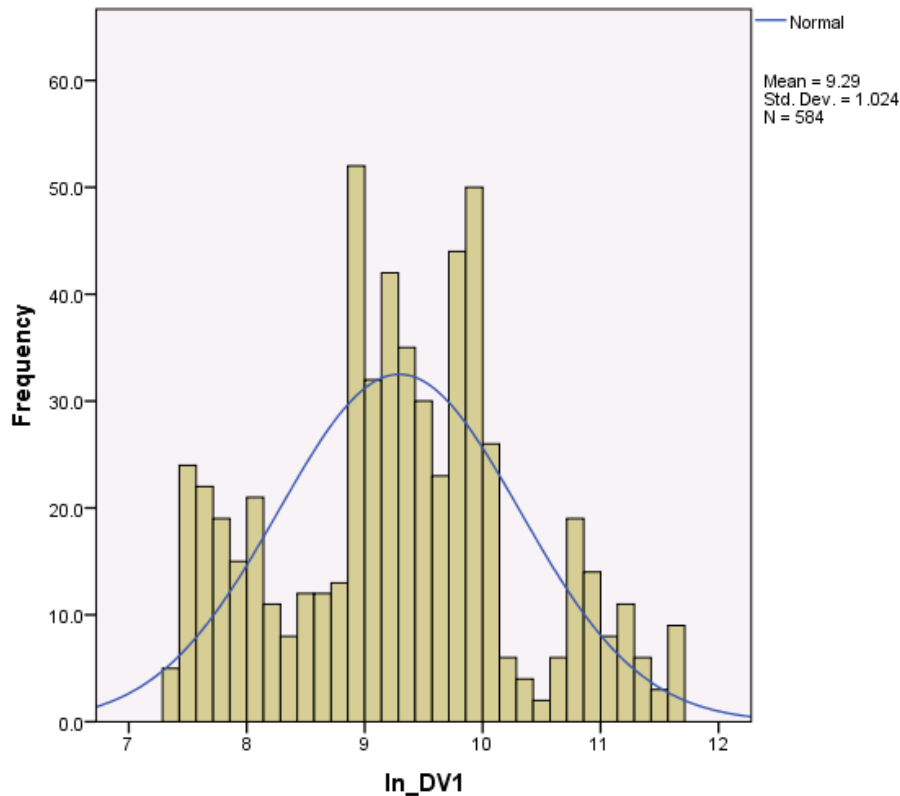
Figure 6: Histogram of IV1 ln_infra_inv including normal distribution curve (blue)
Source: SPSS
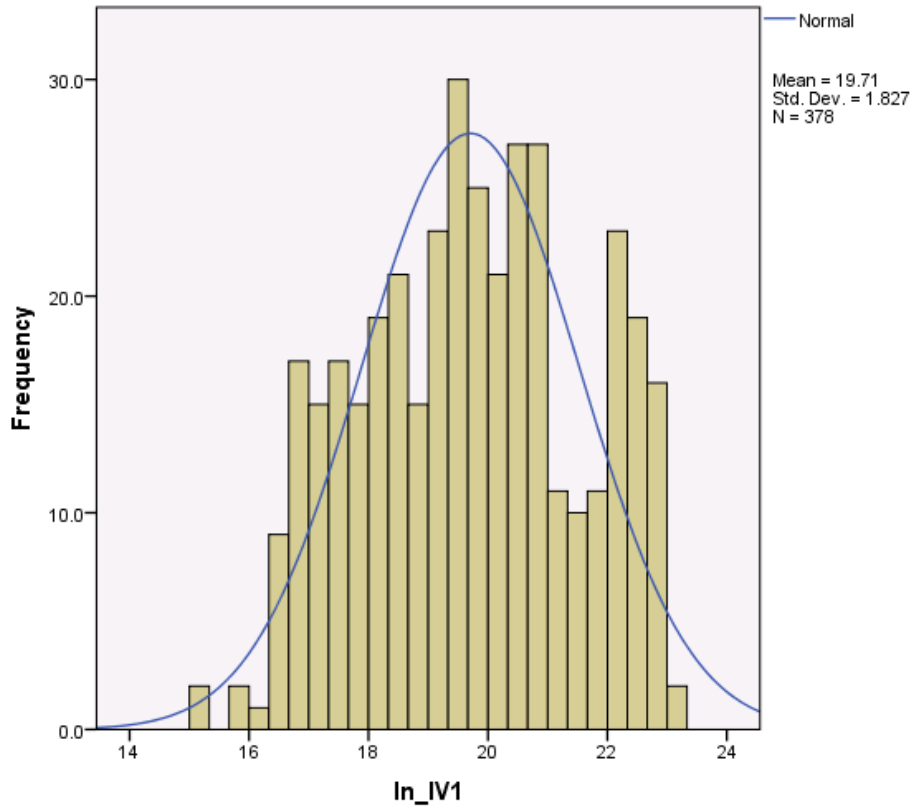
Figure 7: Histogram of IV2 ln_rail_pax including normal distribution curve (blue)
Source: SPSS
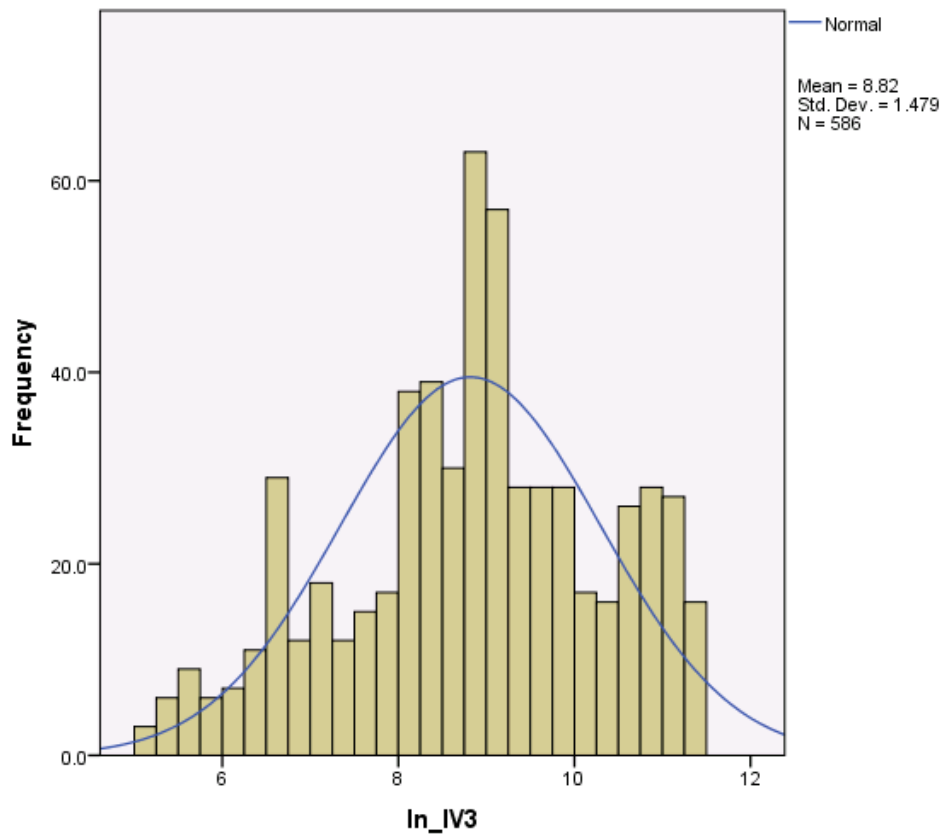
Table 10: Model Summary of the sequential multiple regression

Mode*	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics					Durbin-Watson
					R Square Change	F Change	df1	df2	Sig. F Change	
1	.576	.331	.328	.811	.331	92.866	2	375	.000	-
2	.578	.334	.328	.811	.003	1.398	1	374	.238	-
3	.582	.339	.328	.811	.005	.975	3	371	.404	2.515**

Model 1: (Constant), ln_IV2, ln_IV1

Model 2: (Constant), ln_IV2, ln_IV1, Dummy 1: EU Membership

Model 3: (Constant), ln_IV2, ln_IV1, D1, D3: 1st railway package in 2001, D4: 2nd RP in 2004, D5: 3rd RP in 2007; D2 and D4 were excluded by SPSS

*Dependent Variable: ln_DV1

**Value calculated in a separate multiple regression

Figure 8: Scatterplot of SRE against PRE for testing linear relationship and homoscedasticity between collective IVs and DV

Figure 9: Scatterplot of ln_DV1 against ln_IV1 for testing linear relationship
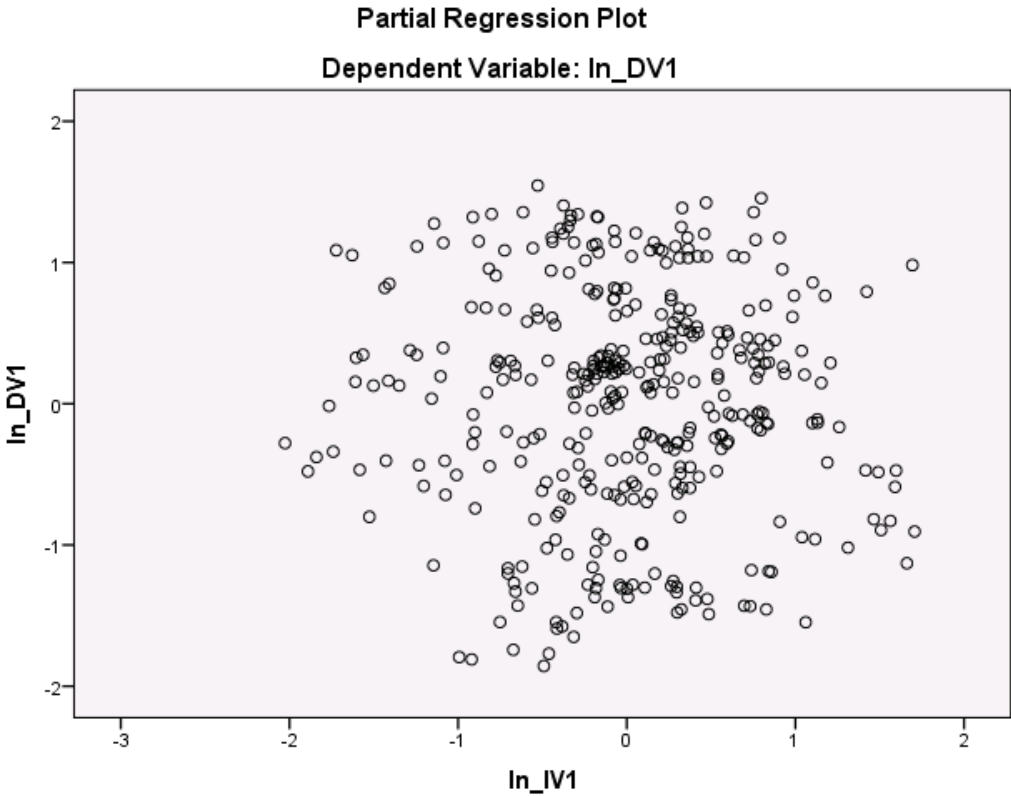
Figure 10: Scatterplot of ln_DV1 against ln_IV2 for testing linear relationship
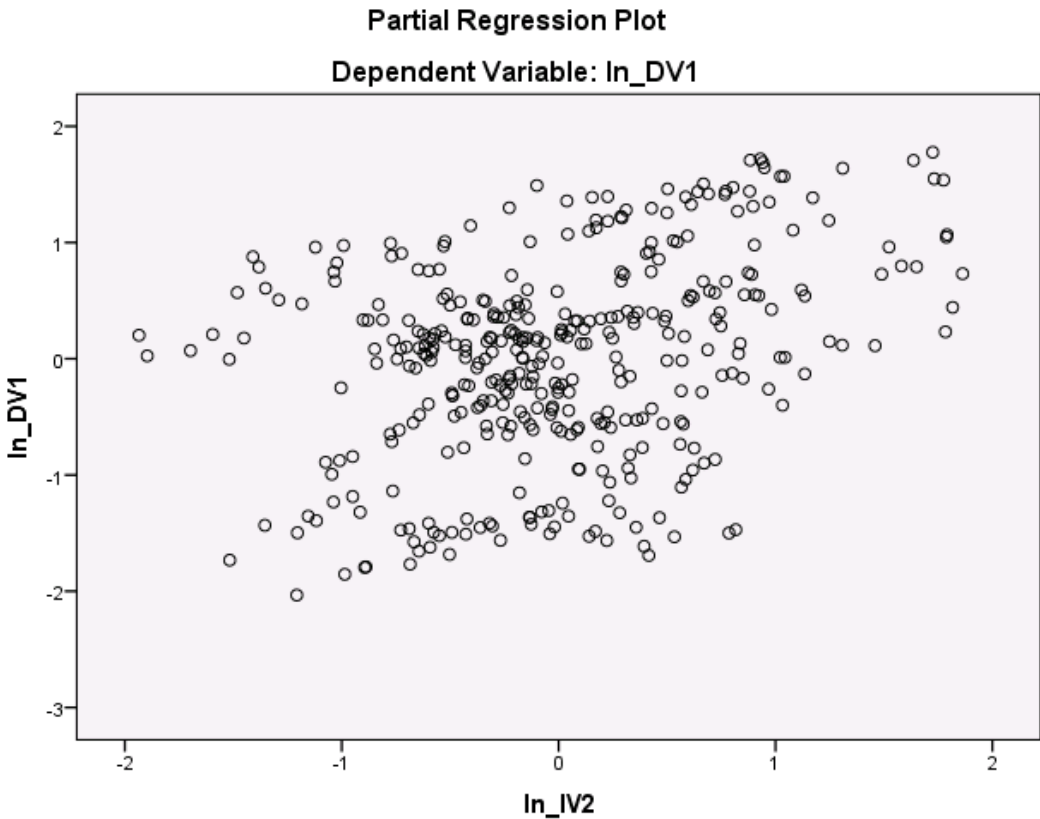
Table 11: Correlation coefficients and their significance of all variables

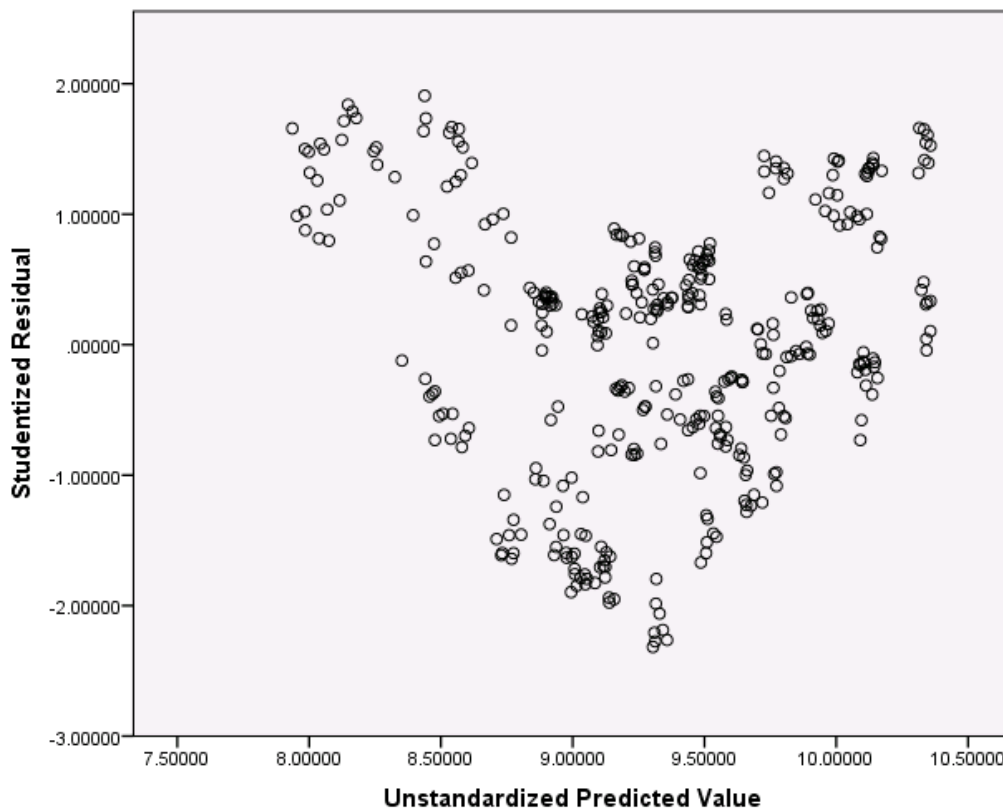|		ln_DV1	ln_IV1	ln_IV2	D1	D2	D3	D4	D5	D6
Pearson Correlation	ln_DV1	1.000	.446	.571	.118	.	-.012	.003	-.015	.
	ln_IV1	.446	1.000	.844	.629	.	.130	.134	.134	.
	ln_IV2	.571	.844	1.000	.343	.	-.058	-.035	-.022	.
	Dummy 1: EU Membership	.118	.629	.343	1.000	.	.284	.430	.338	.
	D2: Directive 91/440/EEC	.	.	.	.	1.000	.	.	.	.
	D3: 1st railway package '01	-.012	.130	-.058	.284	.	1.000	.686	.464	.
	D4: 2nd railway package '04	.003	.134	-.035	.430	.	.686	1.000	.676	.
	D5: 3rd railway package '07	-.015	.134	-.022	.338	.	.464	.676	1.000	.
	D6: recast of 1st RP in 2013	.	.	.	.	.	.	.	.	1.000
Significance (1-tailed)	ln_DV1	.	.000	.000	.011	.000	.410	.479	.386	.000
	ln_IV1	.000	.	.000	.000	.000	.006	.005	.004	.000
	ln_IV2	.000	.000	.	.000	.000	.131	.249	.338	.000
	D1	.011	.000	.000	.	.000	.000	.000	.000	.000
	D2	.000	.000	.000	.000	.	.000	.000	.000	.000
	D3	.410	.006	.131	.000	.000	.	.000	.000	.000
	D4	.479	.005	.249	.000	.000	.000	.	.000	.000
	D5	.386	.004	.338	.000	.000	.000	.000	.	.000
	D6	.000	.000	.000	.000	.000	.000	.000	.000	.
N	ln_DV1	378	378	378	378	378	378	378	378	378
	ln_IV1	378	378	378	378	378	378	378	378	378
	ln_IV2	378	378	378	378	378	378	378	378	378
	D1	378	378	378	378	378	378	378	378	378
	D2	378	378	378	378	378	378	378	378	378
	D3	378	378	378	378	378	378	378	378	378
	D4	378	378	378	378	378	378	378	378	378
	D5	378	378	378	378	378	378	378	378	378
	D6	378	378	378	378	378	378	378	378	378

Model 1: (Constant), ln_IV2, ln_IV1

Model 2: (Constant), ln_IV2, ln_IV1, Dummy 1: EU Membership

Model 3: (Constant), ln_IV2, ln_IV1, D1, D3: 1st railway package in 2001, D4: 2nd RP in 2004, D5: 3rd RP in 2007; D2 and D4 were excluded by SPSS

Table 12: Coefficients of all accepted variables

| Model*		Unstand. Coefficients		Stand. Coeff.	t	Sig. p	95.0% Confid. Interval for B		Correlations			Collinearity Statistics	
		B	Std. Error	Beta			Lower Bound	Upper Bound	Zero-order	Partial	Part	Tolerance	VIF
1	(Constant)	6.787	.521		13.022	.000	5.762	7.812					
	ln_IV1	-.069	.043	-.127	-1.615	.107	-.153	.015	.446	-.083	-.068	.287	3.484
	ln_IV2	.443	.051	.679	8.613	.000	.342	.544	.571	.406	.364	.287	3.484
2	(Constant)	6.264	.684		9.163	.000	4.920	7.608					
	ln_IV1	-.023	.058	-.042	-.397	.692	-.136	.091	.446	-.021	-.017	.157	6.386
	ln_IV2	.412	.058	.632	7.157	.000	.299	.525	.571	.347	.302	.229	4.375
	D1	-.158	.134	-.072	-1.182	.238	-.421	.105	.118	-.061	-.050	.481	2.077
3	(Constant)	6.148	.697		8.824	.000	4.778	7.518					
	ln_IV1	-.023	.060	-.043	-.389	.697	-.140	.094	.446	-.020	-.016	.147	6.799
	ln_IV2	.423	.060	.649	7.106	.000	.306	.540	.571	.346	.300	.214	4.678
	D1	-.242	.146	-.110	-1.655	.099	-.529	.045	.118	-.086	-.070	.404	2.476
	D3	.034	.124	.017	.276	.782	-.210	.279	-.012	.014	.012	.499	2.002
	D4	.160	.146	.081	1.095	.274	-.127	.447	.003	.057	.046	.327	3.054
	D5	-.044	.125	-.020	-.352	.725	-.290	.202	-.015	-.018	-.015	.536	1.867

Model 1: (Constant), ln_IV2, ln_IV1

Model 2: (Constant), ln_IV2, ln_IV1, Dummy 1: EU Membership

Model 3: (Constant), ln_IV2, ln_IV1, D1, D3: 1st railway package in 2001, D4: 2nd RP in 2004, D5: 3rd RP in 2007; D2 and D4 were excluded by SPSS

*Dependent Variable: ln_DV1

Table 13: Residuals Statistics

|	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	166.07	106288.16	17957.43	18764.949	377
Std. Pred. Val.	-.948	4.707	.000	1.000	377
Std. Error of Pred. Value	566.992	2173.604	897.439	290.161	377
Adjusted Pred. Value	143.18	105687.30	17945.71	18732.357	377
Residual	-25793.791	34251.336	.000	8145.234	377
Std. Residual	-3.150	4.183	.000	.995	377
Stud. Residual	-3.165	4.215	.001	1.002	377
Deleted Residual	-26037.119	34788.855	11.716	8273.693	377
Stud. Deleted Residual (SDR)	-3.204	4.314	.001	1.008	377
Mahal. Distance	.805	25.494	3.989	3.897	377
Cook's Distance (COO)	.000	.061	.003	.008	377
Centered Leverage Value (LEV)	.002	.068	.011	.010	377

Figure 11: Scatterplot of SDR against LEV to detect outliers (extreme observations)
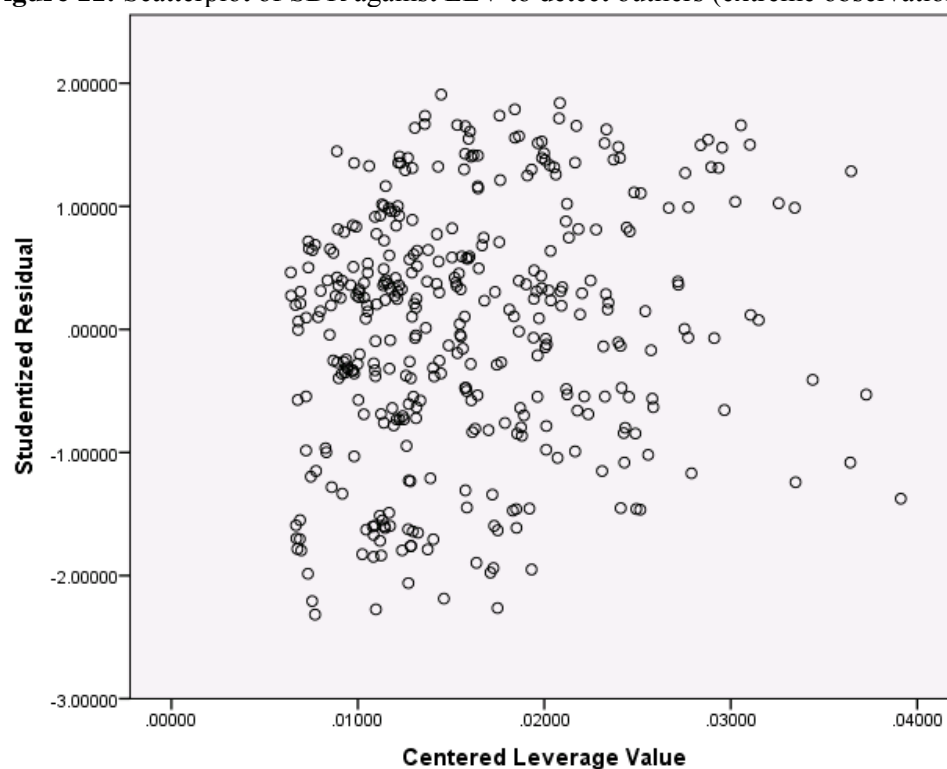
Table 14: Descriptive Statistics of the sequential multiple regression

| Variables	Mean	Std. Deviation	N
ln_DV1	9.32	.989	378
ln_IV1	19.71	1.827	378
ln_IV2	8.78	1.517	378
Dummy 1: EU Membership	.72	.450	378
D2: Directive 91/440/EEC	1.00	.000	378
D3: 1st railway package in 2001	.66	.475	378
D4: 2nd railway package in 2004	.48	.500	378
D5: 3rd railway package in 2007	.29	.456	378
D6: recast of 1st RP in 2013	.00	.000	378

Table 15: Warnings of SPSS

For models with dependent variable ln_DV1, the following variables are constants or have missing correlations: D2: Directive 91/440/EEC, D6: recast of 1st RP in 2013. They will be deleted from model 3.

Figure 12: Histogram of the standardized residuals of DV1 (ln_rail_freight) with normal distribution curve
Source: SPSS
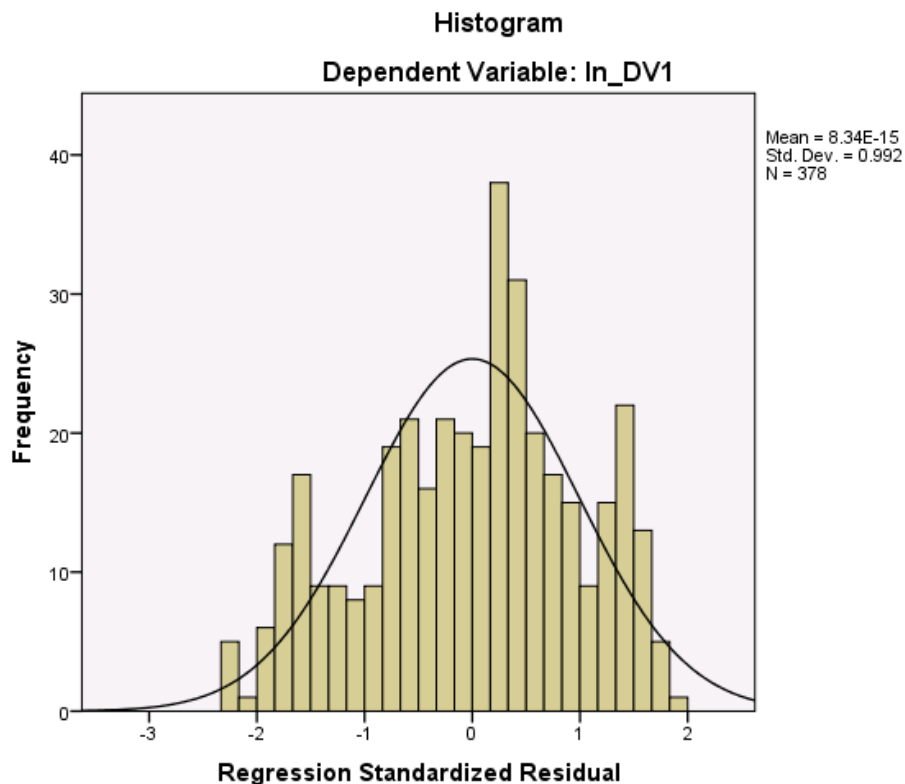
Figure 13: Normal P-P Plot of the studentized residuals of DV1 (ln_rail_freight)
Source: SPSS
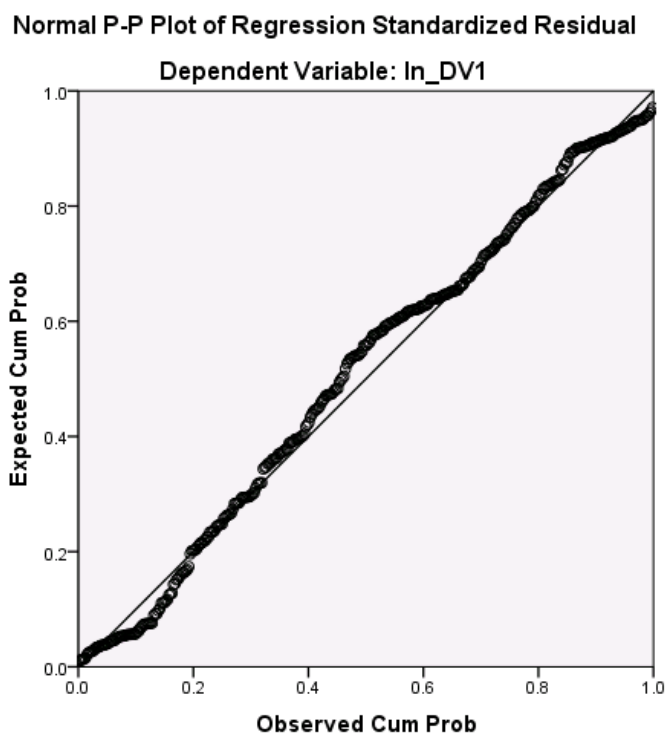
Table 16: ANOVA (analysis of variation) of the regression and residuals
Source: SPSS

Model*		Sum of Squares	df	Mean Square	F-ratio	Sig. = p-value
1	Regression	122.161	2 (variables)	61.081	92.866	.000
	Residual	246.648	375 (cases)	.658		
	Total	368.809	377			
2	Regression	123.080	3 (variables)	41.027	62.442	.000
	Residual	245.729	374 (cases)	.657		
	Total	368.809	377			
3	Regression	125.003	6 (variables)	20.834	31.703	.000
	Residual	243.807	371 (cases)	.657		
	Total	368.809	377			

Model 1: (Constant), ln_IV2, ln_IV1

Model 2: (Constant), ln_IV2, ln_IV1, Dummy 1: EU Membership

Model 3: (Constant), ln_IV2, ln_IV1, D1, D3: 1st railway package in 2001, D4: 2nd RP in 2004, D5: 3rd RP in 2007; D2 and D4 were excluded by SPSS

*Dependent Variable: ln_DV1

Table 17: Timeline of country reforms, EU railway legislation and White papers on transport

When?	What?
1988	start of the railway reform in Sweden
29 Jul 1991	'mother' Dir. 91/440/EEC: foundations for a single European railway area
Dec 1992	Commission's first White Paper on the future development of the common transport policy
1993	start of the railway reform in the UK
1994	start of the railway reform in Germany
1995	follow up directives Dir. 95/18 & 19/EC: licensing companies, allocation and charging
1996	CEC, EC's White Paper on Railways on "a Strategy for Revitalising the Community's Railways"
1997	start of the railway reform in France
Feb 2001	1st Railway Package: aiming to create a single European railway area
Sep 2001	EC's White Paper 'European transport policy for 2010'
2004	2nd Railway Package, amending first package
2004	Creation of the European Railway Agency through the 2nd RP
2006	EC report on the Implementation of the 1st RP, => COM(2006) 189
2007	3rd Railway Package
Aug 2009	DG Tran: Evaluation of the Common Transport Policy (CTP)
2011	White Paper 'Roadmap to a single European Transport Area'
Dec 2012	Dir. 2012/34 or 44 (?)/EU - Recast of 1st railway package (Dir. 2001/12 + 13 + 14/EC) - Repeals Dir. 91/440/EEC, Dir. 95/18/EC
Jan 2013	Impact Assessment of the prospective 4th RP
since Jan 2013	in process: 4th Railway Package: EC => EP + Council in negotiations, market and technical pillar
Feb 2014	partly adoption of 4th RP (technical pillar) by EP
2013-15	negotiations on market pillar, trialogue (3): EP + EC + Council
Jul 2015	agreement in trialogue reached on technical pillar

Table 18: Overview of European railway legislation (sources: European Commission, EUROlex)

First step		Second step	Third step	Fourth step		Fifth step
1st Railway Dir.		1st Railway Package (RP)	2nd RP	3rd RP	Recast of 1st RP	4th RP
Nov 1989[99]		1998	Jan 2002	Sep 2004		Jan 2013
Sep 1991	1995/96	April 2001	Apr 2004	Dec 2007	Nov 2012	in process
Council Directive[100] 91/440/EEC on the development of the Community's railways aim: to facilitate the integration process of European railway markets, and to increase their efficiency + instruments: - ensuring management independence of railway		Dir. 2001/12/EC amending/recasting/ revising Dir. 91/440/EEC on the development of the Community's railways - allowed cross border freight operations on a network of tracks – to be called the *Trans European Rail Freight Network* - which includes ports and freight terminals - required separate accounting of freight and passenger service revenues and costs - separation of "essential functions": infrastructure manager and transport/train	Dir. 2004/51/EC - amend. Dir. 91/440 - includes reference to the *Trans European Rail Freight Network*, and future access by 2007 for licensed rail freight operators of all the European rail network as originally described in directive 2001/12 - completing the internal market in rail freight services		Repeals Directive 91/440/EEC Recast Dir. 2001/12/EC	

99 Date of legislation initiation by the EC until date of proclamation in the Official Journal of the European Union.

100 A **directive** is a legal act of the EU, which requires member states to achieve a particular result without dictating the means of achieving that result. A **regulation** is a legal act of the EU that becomes immediately enforceable as law in all member states simultaneously (accord. art. 288 TFEU).

undertakings, -separating the management of railway operation and infrastructure from the provision of railway transport services (separation of financial accounts), - ensuring access to the networks of other MS[101]		operator				
	Dir. 95/18/EC[102] - set out a framework and guidelines for the way in which countries of the EU provide licenses to operate railway companies; a license provided in one member state	Dir. 2001/13/EC amending Dir. 95/18/EC - Licensing of railway companies in the EU			Dir. 2012/34/EC - Repeals Dir. 95/18/EC - Recast Dir. 2001/13/EC - to allow general access to run domestic passenger services – but with the	COM(2013) 29; amending Dir. 2012/34/EC

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101 Eisenkopf (2006), p.298.

102 Directive 95/18 required states to designate licensing authorities, so that it could be clear that any operator wishing to run international trains had appropriate financial capacity, professional qualifications, insurance and safety certification.

being generally valid in all other member states					possibility to limit access when the economic equilibrium (viability) of a public service contract is compromised	
			Reg. (EC) 1370/2007 - open domestic rail passenger markets to competition (open access) - authorities in Member States have the choice to either directly award public service contracts for rail (limited to 15y) or organise competitive tender procedures (subsidised public services)			COM(2013) 28; amending Reg. (EC) 1370/2007 - "market pillar" - make competitive award of public service contracts for railways mandatory
	Dir. 95/19/EC[103] - set out the framework for the	Dir. 2001/14/EC amended Dir. 95/19/EC			Recast Dir. 2001/14/EC	

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103 Directive 95/19 required governments to define an infrastructure manager and a path allocation body, and to lay down non-discriminatory rules for the allocation of paths and for access charges.

construction of bodies that control and regulate the allocation of line possessions to companies, and the charges for using the track	(Railway Safety Directive) - on capacity (track) allocation, railway infrastructure (usage) charging and safety certification				
			Reg. (EC) 1371/2007 - International Rail Passengers' Rights and Obligations - rules for the compensation of passengers in the case of train delays, limited to cross-border trips		
Dir. 96/48/EC - on interoperability of the trans-European high-speed rail system[104]	Dir. 2001/16/EC - standards for interoperability of rail systems - long-term goal of common European rolling stocks - is dedicated to the implementation of common technical	Dir. 2004/50/EC - amended Dir. 96/48/EC and 2001/16/EC - harmonised interoperability requirements, particularly for high-speed rail.	Dir. 2007/57/EC - amended Dir. 2004/50/EC - interoperability of the rail system within the Community		COM(2013) 30; recasting Dir. 2007/57/EC

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104 Jarzembowski (2006), p.299.

		specifications to achieve the interoperability of rail services in Europe on the *Trans-European Conventional Rail Network*				
				Dir. 2007/58/EC[105] - open access services proposed by private companies - *"International passenger service" shall mean a passenger service where the train crosses at least one border of a Member State and where the principal purpose of the service is to carry passengers between stations located in different Member States.'*		
				Dir. 2007/59/EC - harmonised		

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105 The rapid expansion of cheap air travel across Europe has had a serious impact on the rail business, and Directive 2007/58 - which is the legal basis in the Third Railway Package for opening up of the market - mentions 'strong competitive pressure from low-cost airlines', noting that 'it is therefore essential to stimulate new initiatives by promoting competition between railway undertakings'.

				licenses for train drivers		
			Reg. (EC) 881/2004 (Agency Regulation) - establishment of a European Railway Agency (ERA) - a effective steering body to coordinate across the MS the development of safety standards and the technical specifications for interoperability efforts			COM(2013) 27; replacing Reg. (EC) 881/2004
			Dir. 2004/49/EC - 'Railway Safety Dir.' - common safety targets on the Community's railways, common safety methods and indicators for the ERA - It harmonised safety principles, including	Directive 2008/110/EC - amend. Dir. 2004/49/EC		

			procedures for granting safety approval to railway operators and infrastructure owners			
		Dir. 2001/34/EC ("Recast")				
						COM(2013) 26; repealing Reg. (EEC) 1191/69* => "technical pillar"
						COM(2013) 31; amending Dir. 1191/69/EC
First step		Second step	Third step	Fourth step		Fifth step
1st railway Dir.		1st RP	2nd RP	3rd RP	Recast of 1st RP	4th RP

VI References and bibliography

Books:
Publication of the European Conference of Ministers of Transport (ECMT) in cooperation with the OECD (2007): *Competitive Tendering of Rail Services.* Paris. ISBN 9789282101636. Retrieved 5 March 2015.

Field, Andy (2009): *Discovering statistics using SPSS*. Third Edition, Sage publications.

Gujarati, Damodar N. (2004): *Basic Econometrics*. 4th edition, The McGraw−Hill Companies.

Research papers and articles:
Alexandersson, Gunnar; Hulten, Staffan; Nilsson, Jan-Eric and Pyddoke, Roger (2013): *The Liberalisation of Railway Passenger - Transport in Sweden*. Journal of Transport Economics and Policy, Volume 47, Part 2, May 2013, pp. 307–312.

Canoy, Marcel; Hindriks, Frank and Vollaard, Ben (2000): *Yardstick competition Theory, design, and practice* (working paper). CPB Netherlands Bureau for Economic Policy Analysis, The Hague, December 2000, ISBN 90-5833-059-1.

Eisenkopf, Alexander (2006): *The Liberalisation of Rail Transport in the EU*. In: Intereconomics, November/December 2006, pp.292-298.

Jarzembowski, Georg (2006): *European Framework for the Internal Market in the Railway Sector*. In: Intereconomics, November/December 2006, pp.299-303.

Laperrouza, Marc; Finger, Matthias (2009): *Regulating Europe's single railway market: Integrating performance and governance*. Centre For European Policy Studies, Brussels, Belgium.

Ludewig, Johannes (2006): *Market Liberalisation Alone Is Not Enough*. In: Intereconomics, November/December 2006, pp.303-306.

Kreutzberger, Ekki (2010): *Lowest Cost Intermodal Rail Freight Transport Bundling Networks: Conceptual Structuring and Identification*. in EJTIR, Issue 10(2), pp. 158-180 ISSN: 1567-7141.

Nash, Chris and Rivera-Trujillo, Cesar (2004): *Rail regulatory reform in Europe – principles and practice*. Institute for Transport Studies, University of Leeds, Paper presented at the Conference on Competition in the rail industry, Madrid, Sep 2004.

Rothengatter, Werner (2006): *Issues of Interoperability in the European Railway System*. In: Intereconomics, November/December 2006, pp.299-303.

Schipper, Fank (2009): *Driving Europe - Building Europe on Roads in the Twentieth Century*. Amsterdam University Press, 318 pages.

Wetzel, Heike (2008): Productivity growth in European railways – technological progress, efficiency change and scale effects. University of Lüneburg Working Paper Series in Economics, No. 101.

Reports, policy papers and parliament interpellation

Centrum für Europäische Politik (CEP) Background paper: European Railway Regulation

Community of European Railway and Infrastructure Companies (CER) - Annual Report 2013-2014 (www.cer.be).

Community of European Railway and Infrastructure Companies (CER): *Towards a Primary European Rail Freight Network (PERFN)*, October 2007.

European Commission White Paper on Transport (2001): *European transport policy for 2010: time to decide*. (COM (2001) 370 final of 12 September 2001). http://europa.eu/legislation_summaries/environment/tackling_climate_change/l24007_en.htm (16 Dec 2014).

European Commission White Paper on Transport (2011): *Roadmap to a single European transport area - Towards a competitive and resource -efficient transport system*. (COM (2011) 144 final of 28 March 2011). http://ec.europa.eu/transport/themes/strategies/doc/2011_white_paper/white-paper-illustrated-brochure_en.pdf (16 Dec 2014).

European Railway Agency (ERA): Annual Activity Report 2013 http://www.era.europa.eu/Document-Register/Documents/ERA-Annual-Activity-Report-2013-web.pdf (ret. 21 Jan 2015).

European Railway Agency (ERA): Economic Evaluation Unit - Final Report TSI CCS Scope Extension by Wouter Malfait from 14 May 2014 http://www.era.europa.eu/Document-Register/Documents/140514-ERA-EE-Report-CCS-TSI-Scope-extension-v4-7.pdf (retrieved 24 Jun 2015).

European Services Strategy Unit (ESSU), Research Report No. 1: A Typology of Privatisation and Marketisation (November 2006) by Dexter Whitfield http://www.european-services-strategy.org.uk/publications/essu-research-reports/essu-research-paper-1/essu-research-paper-1-2.pdf. (ret. 21 Apr 2015).

In German: Große Anfrage der Fraktion Die Linke zu 20 Jahre Bahnreform, Drucksache 18/3266, Deutscher Bundestag, November 2014. Available here: http://dipbt.bundestag.de/doc/btd/18/032/1803266.pdf (retrieved 1 Dec 2014).

Press releases, blogs and news articles:
Amadeus: European Rail Deregulation: Can we learn lessons from UK and Swedish Rail privatization? (published 5 Feb 2010, retrieved 8 Dec 2014).

Press release of the European Commission: Rail Transport - Simplifying procedures to achieve a Single European Railway Area (published 5 June 2014): http://europa.eu/rapid/press-release_IP-14-643_en.htm (retrieved 8 Dec 2014).

Press release by the EC: European Parliament adopts equivocal first reading position on fourth railway package (published 26 Feb 2014): http://europa.eu/rapid/press-release_IP-14-192_en.htm (retrieved 15 Jan 2015).

Press release of Commissioner Siim Kallas: European railways at a junction: the commission adopts proposals for a fourth railway package (published 30 Jan 2013): http://ec.europa.eu/archives/commission_2010-2014/kallas/headlines/news/2013/01/fourth-railway-package_en.htm (retrieved 20 Mar 2015).

Press release by the EP: 4th RP: lifting market entry barriers to improve passenger services (pub. 17 Dec '13): http://www.europarl.europa.eu/news/en/news-room/content/20131217IPR31103/html/Fourth-Railway-Pack-lifting-market-entry-barriers-to-improve-passenger-services (ret. 24 Apr 2015).

Press release of the Council: *Council and European Parliament reach agreement on single European railway area directive*. Brussels, 19 June 2012; 11543/12; PRESSE 273. (http://register.consilium.europa.eu/doc/srv?l=EN&f=ST%2011543%202012%20INIT, retrieved 22 Jan 2015)

Euroactive: MEPs vote in changes to fourth railway package (published 27 Feb 2014): http://www.euractiv.com/transport/parliament-votes-changes-fourth-news-533796 (retrieved 8 Dec 2014).

International Transport Forum: Presentation by Stephen Perkins in October 2010, Joint Transport Research Centre at the OECD. http://internationaltransportforum.org/docs/pdf/SPVictoriaDoTOct10.pdf (retrieved 26 Jan 2015).

Network Rail closer to Railtrack takeover". *BBC News*. (pub. 18 Sep 2002): http://news.bbc.co.uk/2/hi/business/2267597.stm (ret. 4 Dec 2014).

"Railways Act 1993". *The Railways Archive*. (originally published by Her Majesty's Stationery Office): http://www.railwaysarchive.co.uk/docsummary.php?docID=12 (retrieved 4 Dec 2014).

Railway Gazette: Compliance Verification Clause unlocks the Fourth Railway Package (published 30 Jan 2013). http://www.railwaygazette.com/news/policy/single-view/view/compliance-verification-clause-unlocks-the-fourth-railway-package.html (retrieved 17 Dec 2014).

Railway Gazette: An open passenger market beckons (published 19 Feb 2008). http://www.railwaygazette.com/news/single-view/view/an-open-passenger-market-beckons/browse/5.html (retrieved 16 Dec 2014).

The Parliament Magazine: Ministers discuss 4th railway package (published 10 Oct 2014). https://www.theparliamentmagazine.eu/articles/eu-monitoring/ministers-discuss-4th-railway-package (retrieved 8 Dec 2014)

UNIFE: The Fourth Railway Package's Technical Pillar: a top priority for the railway sector (published 3 Dec 2013). http://unife.org/news_detail.asp?n=The-Fourth-Railway-Package-s-Technical-Pillar:-a-top-priority-for-the-railway-sector&nid=3125 (retrieved 8 Dec 2014).

EU legislation
Council Directive No 91/440/EEC

Statistics websites
EuroStat – Glossary
http://ec.europa.eu/eurostat/statistics-explained/index.php/Glossary (acc. 8 Apr 2015).

EuroStat – Statistics explained, section: Passenger transport statistics > Rail passengers
http://ec.europa.eu/eurostat/statistics-explained/index.php/Passenger_transport_statistics (acc. 8 Apr 2015).

European Commission: Energy and Transport in figures. Statistical pocket book 2003.

EuroStat Statistical pocketbook 2014
http://ec.europa.eu/transport/facts-fundings/statistics/pocketbook-2014_en.htm (acc. 11 Apr 15)