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Economic and transport policy challenges of the European rail freight transport with special attention to the market liberalisation and the significance of the Eurasian landbridges

Main findings of the PhD dissertation

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1. Introduction

The relevance of rail freight transport declined in the recent half century dramatically in Europe, but challenges related to the global climate change resulted an increased attention regarding it lately. In the turn of the recent decades policies of the member states of the European Union (EU) continuously envisaged the growth of the modal share of rail freight transport. Despite that the declining of this mode of freight transport in the modal share was continuous till the beginning of the 21st century, ant it is more or less stagnant following the global financial crisis in 2008. Till today we cannot know which incentives could be the most efficient to reduce the modal share of road freight transport and to grow the share of the less polluting rail transport.

Due to containerisation in the international transport maritime transport plays a dominant role, close to 90% of all international trade volumes are transported by sea. Following the 2008 global financial crises the trend, that international trade was the engine of global economic growth was interrupted. The growth of the share of international trade to global GDP halted after the global crisis: it was 58% in 2018, which legs behind its peak value at 61% in 2008. If this trend reversal is enduring, than it can be expected that the significance of intraregional and domestic trade will gain importance over extra regional trade in the future, where rail transport can gain once more importance.

Despite the fact that Europe was the cradle of rail transport it lags behind other leading economic regions when compared on efficiency and output of rail freight transport. There are various causes for that but one aspect worth to emphasize is that passenger rail services have a very important role, what in turn limits the possible development of (cost)effective rail freight transport. But to be able to understand the detailed processes of the recent decades of the rail freight transport an analysis is need on the structure of goods transported by rail, the mapping of modal share of goods transported. The European processes show a wide regional discrepancy, therefore the recognition of differences between the individual regions is also a very important task.

The liberalisation efforts of the rail market by the EU resulted maybe the most important changes in the industry in the recent 150 years history of rail transport on the continent. This process started in the 1990s, but cannot be considered completed to date. The aim was to assist the creation of an efficient, competitive rail freight transport market, which in turn will safeguard the growth of rail modal share. This however did not happened, and therefore it is vital to research if the goals, instruments, or external factors lead to the failure. A further important question is, what how the transformation of the economic structure – mainly the reduction of heavy industries – influenced the transport volumes and the modal share of it.

Competitiveness of rail freight transport is unavoidable in the aspect of global climate change. Carbon-dioxide emissions of the EU declined by 21% between 1990 and 2017. However, in this period transport emissions grew by 19%, transport accounted for 21% of total CO_2 emissions in 2017 – up from 14% in 1990. The transport related CO_2 emissions saw a 19% growth in this period. Of all transport related emissions 94.7% was caused by road transport based on most up to date data, whereas rail transport accounted only for 0.7%. To achieve a

10% decrease in the CO_2 emissions of freight transport it would be enough to divert 12% of road transport to rail transport. A 25% decrease in emissions could be possible by the modal shift of one third of road transport on tracks – and even so, the modal share of rail transport would be lower than in the United States currently. The modal shift from road to rail is one of the easiest way to reduce CO_2 emissions with already given technologies, as the emissions of rail freight transport are less than the tenth of road transport.

There were hardly any achievements in the field of rail freight transport, which can be accounted as successes. One of the rare success stories is the considerable growth of rail container transport volumes. This is fueled mainly by the transport growth between ports and inland intermodal terminals, but it is also vital to research the modal share and compare the results to other land transport modes.

At the end of the 2010s a new initiative appeared which is interesting from the intermodal rail transport perspective: container transport between East Asia, mainly China and Europe attracted lot of media and research interest. There was an almost never seen attention paid to the Transeurasian rail freight transport. This was however mainly concentrated around geopolitics, trade and economic development, and little attention was given to transport geographic and transport economics research. The identification of deficiencies can serve as a vital addition to the research results, and it can underpin a realistic assessment of the Chinese initiated intercontinental rail transport concept.

2. Aims of the research

This dissertation aims to review the trends of recent 4-5 decades of the rail freight transport of Europe with the goal to present the changes of the performance of the different freight transport modes, the economic and social processes invoking these changes, and to show what kind of special and economic changes these processes caused in the different regions and countries of Europe.

Since the introduction of liberalisation reforms by the EU there is a dataset available for almost a decade, which helps by the analysis of the effects of this very substantial change. This is highly important due to the fact, that the overwhelming majority of research focused to some parts of the rail market only. Most of the research concentrated on the Western European countries, and therefore the understanding the complex processes within our region is highly desirable. To understand the trends of the European rail freight market I aimed to answers the following research questions:

- **How did the modal share of the different land transport modes changed in the EU?**

Little progress has been made in the field of rail freight transport in Europe, the decline and later the stagnation of the modal share of rail was accounted as a rationale by the transport policies. The international comparison makes it possible to research whether it was a legit concept, or were there countries, which could lastingly provide a more important role for rail transport in their modal share.

- **Could the goal of the establishment of a unified European rail transport market be reached?**

The EU's actions and rulings resulted in various markets in the development of common markets. Therefore it is a very interesting question whether the railway market, which was controlled mostly by state owned corporations, characterised by a number of national difference for a very long time could be turned into a functioning common market. In the case of the railway market the differences between the countries are defined by technical and infrastructure related specifications which can be only changed on the long term, therefore it is essential to analyse a relatively long time period.

- **What were the main drivers of the different development paths of the individual modal shares?**

The transformation of the role of rail freight transport in the modal share has been influenced by numerous factors. It is vital to understand whether the changes of the regulatory environment, the state of the infrastructure, the economic features, the changes of the expectations of the clients, the spatial structure or something else had influenced these changes. To be able to understand these, the long term trends of rail freight has to be analysed.

- **Could the rail liberalisation advance the position of rail freight transport in the modal competition compared to other modes of transport?**

The main awaited advantage from rail liberalisation was that it will have similar effects like the liberalisation of energy and air transport sectors – the greater competition will advance the quality and reduce the costs. In the case of natural monopolies however the relationship is not that simple, as the higher coordination and maintenance costs can result that some kind of infrastructure can be organised more efficiently centrally compared to the market coordination. The main question is, whether the introduction of market forces to the rail freight market could safeguard such benefits, which could result grow the competitiveness of the sector compared to other modes of transport.

- **Is there a casual link between the rail infrastructure development and the EU subsidies supporting it and the development of rail freight transport?**

The most important concrete support from the EU from the rare measures supporting the rail freight market development was the creation of the rail freight corridors. For the development of these corridors substantial EU and member state funds have been mobilised. My aim is to investigate whether or not a casual link can be observed between the scale of infrastructure development and the progress of rail freight transport output.

- **Can the China – Europe Transeurasian containerised rail transport safeguard a substantial revenue and profit stream for the European rail freight market, which can be sustainable in the long term?**

The innovations and novelties on the European rail freight market have been scare in the recent decades, therefore it is a very interesting question what impact can be awaited form

the direct China – Europe rail freight transport connections. To be able to answer this question one has to research the background of the initiative's background within China, the transport and economic processes within China, the capacities of the Transeurasian rail transport infrastructure, the possible further developments of it. Overwhelming portion of analysis prepared to date lack factual statistical data on the transport volumes, therefore new approaches need to be drown up to be able to conclude an estimate for the real volume of rail transport between the two economic centres, and only based on that a judgement can be made on the importance of this transport connection.

3. Research methods

I could mostly rely on secondary data sources for my research on the trends of rail freight transport, as vast amount of data is needed to analyse a timeframe of numerous decades. Only statistical offices, international organisations and former research was therefore available for me for this work.

Whilst my research I tried numerous times to collect primer data. I have chosen a more strictly defined topic for that: the rail freight transport between China and Europe. The reason for that is that the list of companies involved in this transport can be well defined. I tried to collect data in two ways. Firstly, I asked and interview opportunity from the involved companies, and secondly I asked to fill in an anonymised online questionnaire from close to half a hundred companies. I could not get sufficient number of answers due to the refusal or lack of reply from the companies. I was conducting numerous background meetings which could however not be used for structured data collection.

A field trip to China and Kazakhstan (Urumqi, Khorgas, Alashankou and Almaty) in August 2018 helped me greatly to better understand the rail transport between China and Europe, as I had the chance to conduct interviews with managers of railway undertakings, terminals, forwarders, logistics companies and customs brokers. This field trip was important to collect first-hand experiences and to get to know new data sources and databases, which in turn delivered such novel information, which contributed to the deeper understanding of the topic.

Eurostat was the most detailed database for my work on the European transport market, however these datasets are overwhelmingly only available from the second half of the 1990s or the 2000s. From the other data source the UNECE and the World Bank datasets on transport needs to be highlighted, as they cover a very long time horizon.

Whilst using these secondary data sources it was a vital task to verify and check the data, as most of the time these statistical data sources contain false or missing data. I tried to compare international data with national statistics where it was possible. Furthermore, I tried to check the plausibility of data also from other source, like corporate annual reports, scientific publications, railway and transport organisations' annual reports. On top of that, I analysed the available metadata information and conducted the filtering, cleansing and correction of the data.

For the analysis of trade flows I used the database of the European Commission which is based mainly on the value added tax declaration for intra-EU trade and on customs

declaration for extra-EU trade. These datasets include information on the mode of transport. This Comext database was not used for complex transport analysis in the sources available for me, and it served as a very useful resource for my research.

The most useful measurement for the output of rail freight transport is the volume of it (measured in tons and tonkms). The share of each transport mode in the modal split is the best way to show the relative changes of the importance of each transport mode. The international and national statistics on modal share diverge a lot, as they account different modes of transport whilst calculating it. Therefore I tried to calculate that by myself whenever it was possible, even if I had to collect the necessary information from different data source. The broadest use of transport modes include rail, road and internal waterways, pipes, air and costal shipping and/or the intra-regional sea transport (e.g. in the EU). In many cases it was impossible to collect data for all of these transport modes, therefore I tried to compare the three most important land transport modes (rail, road and internal waterways), and in some cases I compared only road and rail transport.

For the introduction of the characteristics of the European railway market I used the Rail Market Monitoring Scheme (RMMS) from the European Commission (EC), the EU Transport in Figures: Statistical Pocketbook also published by the EC. The RAILISA database of the International Union of Railways (UIC), data collected by the Independent Regulators' Group – Rail where especially useful for my work.

Whilst the analysis of the datasets I was calculating the growth rate, the yearly average growth rate, the different trend lines (linear, logarithmic, etc.). The linkages between the variables were tested by correlation and regression analysis, and in the case of the analysis of the linkages between the outputs and transport modes of different industries panel regression method was used.

Country level data served as the main territorial basis, as most of the data is available in sufficient quality for that. I put particular emphasis on the analysis of sub-national data whenever it was possible. The Eurostat databases made it possible to analyse NUTS2 level data in different aspects. This made it possible to calculate the regional modal split which can be considered as a novel outcome.

I crosschecked the outcomes from the analysis of the databases with the results of available scientific results, and I tried to show the supporting and contradicting conclusion by others too. I presented the results from the data collection and the analysis on informative figures and maps with the goal to make the understating of my doctoral thesis easier.

For the analysis of databases and editing of the graphs I used Microsoft Excel and Microsoft Access software. For the correlation and regression analysis Excel Solver add-on and JASP software were used. For panel regression analysis I used gretl (Gnu Regression, Econometrics and Time-series Library) open access software.

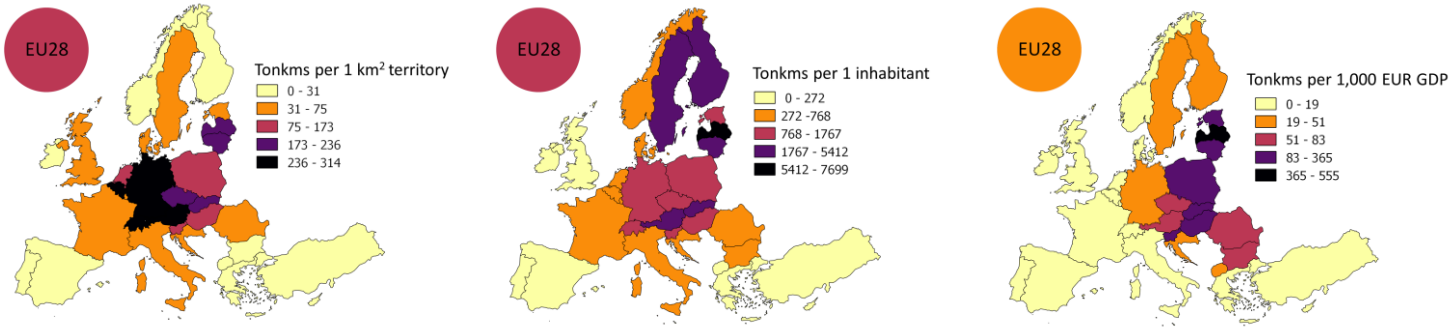
Digital maps were created and edited by QGIS 2.18.26. Attribute tables were edited in Microsoft Excel. Openstreetmap was used as base map. Country and region borders were used from the Eurostat geodatabase.

4. Findings

4.1. Output changes of the European rail freight market

Rail freight transport plays a very different role in the individual European countries. Rail transport has the highest importance in Central Europe and the Baltic countries if is compared to territory, population and GDP (Figure 1). In the individual regions and countries very diverse processes took place in the recent decades, therefore the differences between the counties did not diminished.

Figure 1: Importance of rail freight transport by the transport volume rate compared to the territory, population and GDP by countries in Europe (2017)

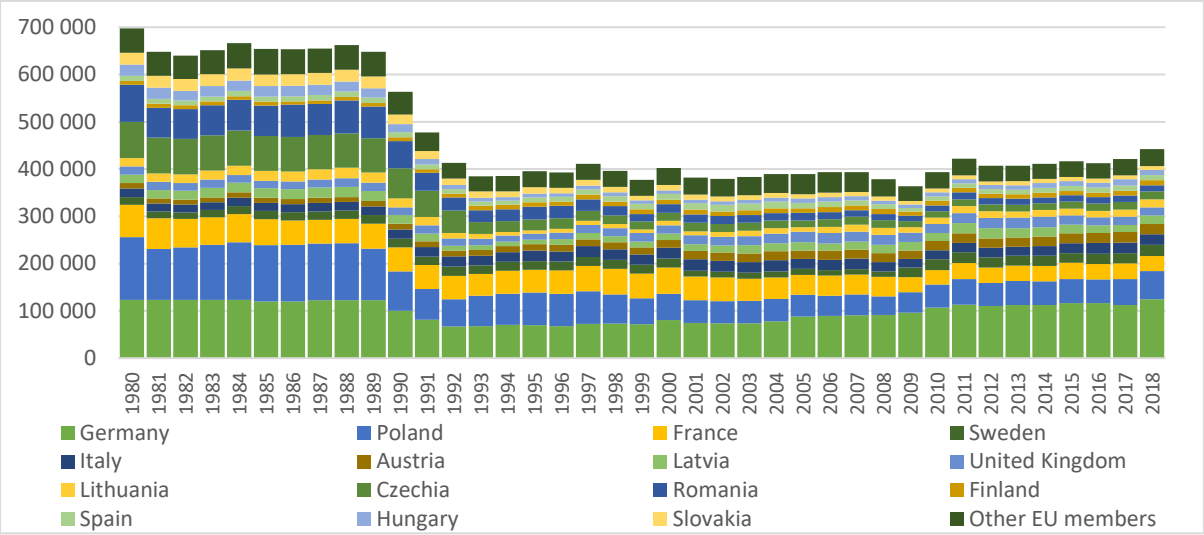


Source: own editing based on Eurostat data (2019)

The volume of rail freight transport decreased dramatically from the beginning of the 1980s until the middle of the 1990s (Figure 2). The period of stagnation followed after that, and a slight increase after the 2008 global financial crisis. This however did not result in the growth in the modal share.

The slight increase of rail freight transport in the recent decade was only enough to stabilise the role of rail transport compared to other transport modes. The modal share of rail transport if compared to the total transport volume of rail and road in tonkms was 35% in 1990, which decreased to 18% in 2017. The worst result for rail freight was in the recent three decades in this measurement in 2009 with 17.6% from where grew to 19.5% in 2013, but after that the indicator was slightly decreasing, therefore we can witness a more or less stagnation. As the modal share of internal waterways was not changing substantially in the recent decade, the low share of rail transport in the modal share became permanent compared to road transport.

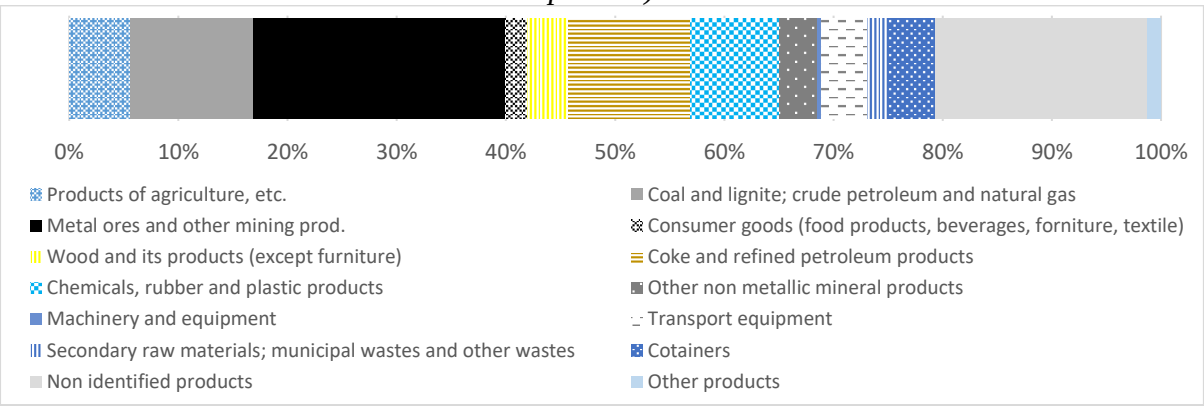
Figure 2: Rail freight volumes of the EU countries (million tonkms, 1980-2018)



Source: own editing based on World Bank and other data sources (2019)[1]

The modal share of rail in the EU measured by the broad understanding of land transport modes (rail, road, internal waterways, costal shipping, pipelines) is the lowest in international comparison with the leading economic regions. In 2016 the share of rail was 11.4% in the EU, while it was 59% in Russia, 33% in the United States, 13% in China. This is unfavourable from different aspects: transportation within the EU is costlier and more polluting than by the global rivals. One of the major challenges of the European rail freight transport is, that it is basically only competitive for the transport of low value bulk cargo (Figure 3).

Figure 3: Goods transported by rail in the EU by product groups (2017, based on tonkms, percent)



Source: own editing based on Eurostat data (2019)

Half of the volume of the transported goods were coal, metal ores and coke, for which road transport is not a viable solution since only the massive volume of them, and the transport of these products is highly price sensitive, but transport speed is less interesting due to the low value of the goods. 8.2% of the transport volume accounts for chemicals – most of these are dangerous goods where the road transport in greater quantity is not really viable yet alone due to safety regulation and considerations. The transport of higher value machinery and equipment

[1] Remark: in the case of Germany and Czechia no data available from international sources before 1992 and 1993 respectively, Therefore data is based on own research. If data was missing after 1995 Eurostat data has been used.

is almost non-existent by rail; this is transported almost exclusively by road in the EU. The transport of food products, machinery and equipment were transported at least 97% by road in the EU countries.

The only exception is containerised transport: in 2007 rail had a 22.7% modal share in this segment, which increased by 1.1 percentage points till 2017. But even in this market road transport is unavoidable: 23.8% of containers arriving and leaving to and from European ports have been transported by rail in 2017, a further 6.8% by internal waterways, the remaining two third by road. This segment is gaining importance for rail however continuously: in 2003 containers accounted for 8.5% of total rail freight volume, which grew to 12.9% in 2017. The total rail freight volumes measured in tons grew 1.2% between 2004 and 2017. Non-containerised rail transport volumes saw a 5.5% decrease in this period.

4.2. The establishment of a unified European rail market was not fulfilled

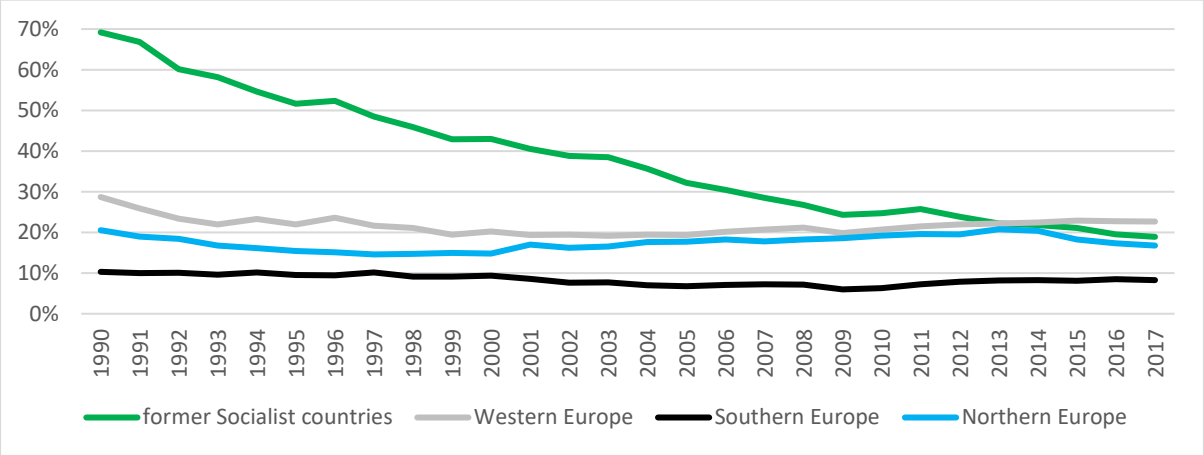
The output of rail freight transport developed very divergent in the European regions in the recent decades. Western, Central and Central and Eastern Europe accounted for 70% of rail transport volumes in 2018 from the total values for the EU. This share did not changed since 1980. The greatest decline in this period could be registered in Southern Eastern Europe (-78%), followed by Central and Eastern Europe (-53%) and Western Europe (-31%). The decline was smaller in the Baltics (-11%), Central Europe (10%), Southern Europe (23%) and Northern Europe (54%) even saw an increase.

Analysing the countries individually gave the result that nine countries could grow the rail transport volumes if compared to 1980. These are however mainly such smaller countries which use rail transport marginally and where the track-based transport plays even now a lower than average role. The greatest decline was registered in the former socialist countries. This demonstrates well how great influence the economic transition influences the transport modal share.

Road transport output in the EU countries grew continuously from 1990 till the 2008 global financial crisis, but the decline was so great that year that it could not recover to former peak until 2017. So the financial crisis hit road transport harder. But there is also another difference: road transport was not reduced whilst the political transition in Central Eastern Europe, but in the contrary, it led to massive growth of this transport mode there.

Analysed by macro regions of Europe the difference between those declined by the modal share of rail freight transport, but this was mainly achieved by the rapid decrease of the role of rail transport in the former socialist countries (Figure 4). This region lost its leading position in this perspective, Western and Northern Europe both took over.

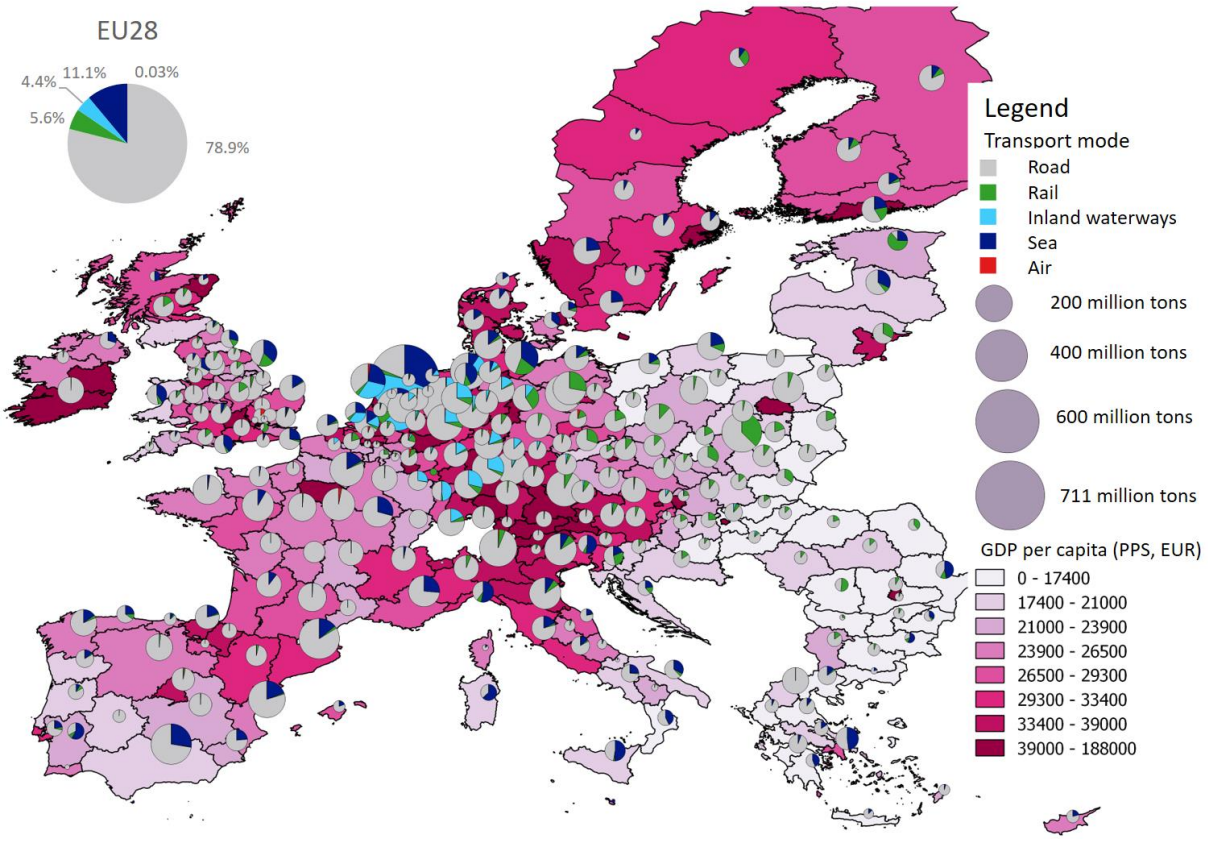
Figure 4: Modal share of rail freight transport compared to the sum of rail and road freight transport in the regions of the EU (based on tonkms, percent)



Source: own editing based on World Bank, UNECE and Eurostat data (2019)

Analysing the relationship between the modal share of freight transport and GDP per capita resulted that the statistical relationship between them is not significant for the NUTS2 regions of the EU.

Figure 5: The regional distribution of PPP GDP per capita and the modal share of NUTS2 regions of the EU based on transport volumes (tons, 2016)



Source: own editing base on Eurostat data (2019)

Higher economic output per capita at regional level also results less transport demand per economic output, but in the case of rail transport this correlation is five times higher than

by road transport. The results show that economic development results the ever higher share of more polluting transport modes.

Statistical offices or international organisations are not publishing modal share data on the regional level. With the help of multiple data sources it was possible to create the modal share map of NUTS2 regions of the EU (Figure 5). This represents illustratively that there are not only big differences between countries, but the divergence between subnational regions is also great.

Till today the former border of socialist countries is well marked, for which the difference in modal share between the Eastern and Western federal states is a good example. Internal waterways only play greater role in the ports of the Benelux states and the Rhine waterway – the Danube waterway's role is much less significant. The map also highlights that the rise of GDP per capita results lower share of rail in transport modal split, from which Bavaria and Austria are notable exemptions.

4.3. The transformation of freight modal share was caused mostly by the transformation of the economic structures

Shifting road transport to rail is the transport policy goal of the EU and the European countries since decades. One of the targets of the EU is to achieve that 30% of freight transport of consignments over 300 km will be transported by rail. The achievement of this won't be easy – yet alone due to the fact that there is no statistics to measure this indicator. There are great differences by transport needs, the volume of transported goods, the modal share and the requested service quality of the major industries. I analysed with the help of panel regression analysis how the transport demand by mode of transport (road and rail) transformed for almost hundred industries, what impact the output changes of these had on the transport demand of the transport modes.

According to my hypothesis the output changes of individual industries have different impact on road and rail transport, and the main driver for the continuous but slowing decline of rail freight transport modal share is caused by the fact, that its main users are such industries which grow slower than average. Analysis of the output of industries and their transport volumes by road and rail between 2008 and 2016 resulted that there was no significant change of transport modes used by individual industries. The results show however that the modal share of the industries are very different. This highlights the need for tailored transport policy solutions for each submarket for transport needs, where the unique requirements of the industries can be fulfilled instead of a 'one size fits all' transport policy approach.

Economic output and freight transport used to grow parallel for a long time. This was however not a constant relationship in the recent decades, freight transport volumes grew slower than value of trade or GDP. Transport intensity of the economy declined therefore continuously. The production of 1.000 euros GDP in 1995 required 179 tonkms of land transport, what shrank by 3% to 174 tonkms in 2014. Differences by transport mode are however significant in this respect too: the greatest decline was accounted by rail (-27%), followed by internal waterways (-16%), but the role of road transport actually managed to gain importance (7%).

Trade had a crucial impact on the restructuring of the transport needs. A significant potential was identified in the shifting of more external trade of the EU to rail. Rail accounts currently only for 3.8% of the total external trade of the EU with third countries measured by volume, and 1.4% measured by value. Obviously, most of the trade partners can only be reached by sea and/or air, but with non-EU member European and Asian countries the use of rail transport has a great untapped potential. Even with direct EU neighbours, such as Switzerland, Norway and Serbia the modal share of rail transport is lower than the intra-EU modal share for freight transport. Only former socialist EU member countries use rail transport in their trade with third countries in a significant extent.

The role of rail freight in the intra-EU trade in the modal share is very diverging. Only the V4 countries (Czechia, Hungary Poland and Slovakia), Austria, Romania and Lithuania had a higher share than 10% measured by volume (tons). The analysis of intra-EU trade delivers a reason for that: the goods transported by road had 2.5-times higher value per volume than by rail. Goods transported by rail had only 10% higher value per volume than those transported by sea. That shows that rail is only competitive in the transport of low-value bulk goods, and the production and trade of these grows slower than the higher value added products. Therefore, the growth potential of rail freight is capped.

4.4. Rail liberalisation could not enhance the position and competitiveness of rail freight transport

The integrated, monopolistic, state owned railway undertakings did not faced any considerable competition from each other, at most from other transport modes. Rail liberalisation, which started in the 1990s in the EU aimed to commercialise the operation of the formerly state owned corporations, to separate freight transport from passenger transport, infrastructure management and the rail capacity allocation.

It was anticipated that with ongoing liberalisation the long-distance, cross-border rail transport will pick up, while the domestic rail freight markets can continue their operations without any major disruption. It was also expected that efficient, new private railway undertakings will be ventured. For the accomplishment of these the EU introduced four railway packages between 2001 and 2013.

The results are however far from convincing. The market opening was successful in light of the rapid expansion of the number of railway undertakings: there were 787 such organisations in 2018, which is a rapid growth compared with only 68 pieces in 2006. The former state owned incumbent railway undertakings lost from their market shares a lot: they controlled 85% of the market in 2007, which declined to 64% in 2017. Despite the anticipated shrinking of the incumbent railways' market share the modal share of rail freight could not catch up in this period. There is no statistically significant correlation between the openness of rail freight market and the rail freight volumes of the EU countries despite the very diverging paths they have chosen.

Rail liberalisation reduced the costs of rail freight transport. This is well illustrated by the fact, that between 2008 and 2017 the revenue of the rail freight undertakings was basically untouched despite inflation and the slightly growing transport volumes. So the revenue per

tonkms declined by one tenth from 20 to 18 euros. That means that the liberalisation could indeed reduce transport costs, but unfortunately this could not increase the demand for rail services. Whilst the liberalisation process the particular features of the markets have been ignored. Price elasticity of rail transport is low – due to factors discussed in section 4.3.

The decline of revenues could not be fully compensated with the reduction of costs by the railway undertakings despite the reduction of workforce – which was partially caused by outsourcing. Gross profit ratio decreased from 0.9% in 2008 to 0.6% in 2017. This has proven as a constraint for investments, which further erodes the competitiveness of rail freight transport.

EU paid special attention to the level playing field, but this was only meant within the rail transport market. The regulation of the individual transport modes were and are very distinct, and that has direct effect on their cost levels. In the case of rail transport it is a requirement that railway undertakings should cover the costs of infrastructure management and development from track access charges revenues. In the case of road transport there is no such requirement. Whereas the users have to pay for the use of every meter of the European railway network, only 1.7% of the European road network is tolled, which is a competitive disadvantage for the rail transport. Track access charges account for 14.3% of the revenue of railway undertakings, road transport companies spend only 6.2% on tolls based on 2017 data.

4.5. Rail infrastructure development could not support the growth of rail freight volumes

The railway network of Europe change only little in the recent decades. Between 1980 and 2017 the network contracted by 8.7% (21 thousand km) and it was 222 thousand kms long. The length of electrified tracks increased by two third in this period, and the double tracked segments saw an increase of 27%. Tracks exclusively used for passenger transport tripled between 1990 and 2017. The length of mixed-use network, that is used for both passenger and freight services was practically unchanged, rail lines used exclusively for freight services declined drastically. The changes of the length of the railway lines alone however can be misleading, as the estimated capacity of the network was not decreasing, but on the contrary, it increased by 4.3% mainly due to electrification and double tracking of lines.

It would be possible to transport many times the current freight volumes on the current network. If the utilisation of the rail network would catch up with the level of 1990, than it could be possible to transport 651 billion tonkms on the EU network, which is substantially higher than the actual 406 billion tonkms – if passenger service were at the 1990 level, but it increased dramatically. In 2017 84% of the total traffic of the EU rail network was passenger service, but in 1990 it was only 70%.

Rail freight volume expressed in trainkms decreased between 1990 and 2017 by 28%, whereas rail passenger volume in trainkms increased by 57%. The total volume of trainkms increased by 32%, what is higher than the estimated network capacity increase of ca. 4% in this period. It can be concluded that the free capacities of rail transport infrastructure decreased in Europe, what could hinder the growth of rail freight transport in the future. Rail policies seem to favour the more frequent as faster passenger transport against rail freight services.

Passenger services overtook a substantial capacity from rail freight on the European tracks, what is undermining further the competitiveness of rail freight.

Whilst this process the differences of the European rail infrastructure (gauges, electrification and signalling systems, technical specifications of interoperability, etc.) did not diminished significantly, the European rail market remains fragmented. Barriers of road freight transport of the Single Market meanwhile reduced significantly, the motorway network was expanded significantly, border controls basically vanished within the Schengen Area, therefore the relative speed of rail transport compared to road decreased continuously.

In international comparison the EU countries spend little on transport infrastructure development and management. Government expenditure on these accounted only for 0.7% of GDP, whereas Japan and Russia spent 0.9-0.9%, China 5.3% in 2016. Only the government of the United States spent less on transport infrastructure (0.6%), but a substantial part of transport infrastructure is in private ownership there. Furthermore, transport investment in Europe decreased over time. Expenditure on rail transport infrastructure was 0.3% of GDP in 2000 and 2017 and was stagnant in this period.

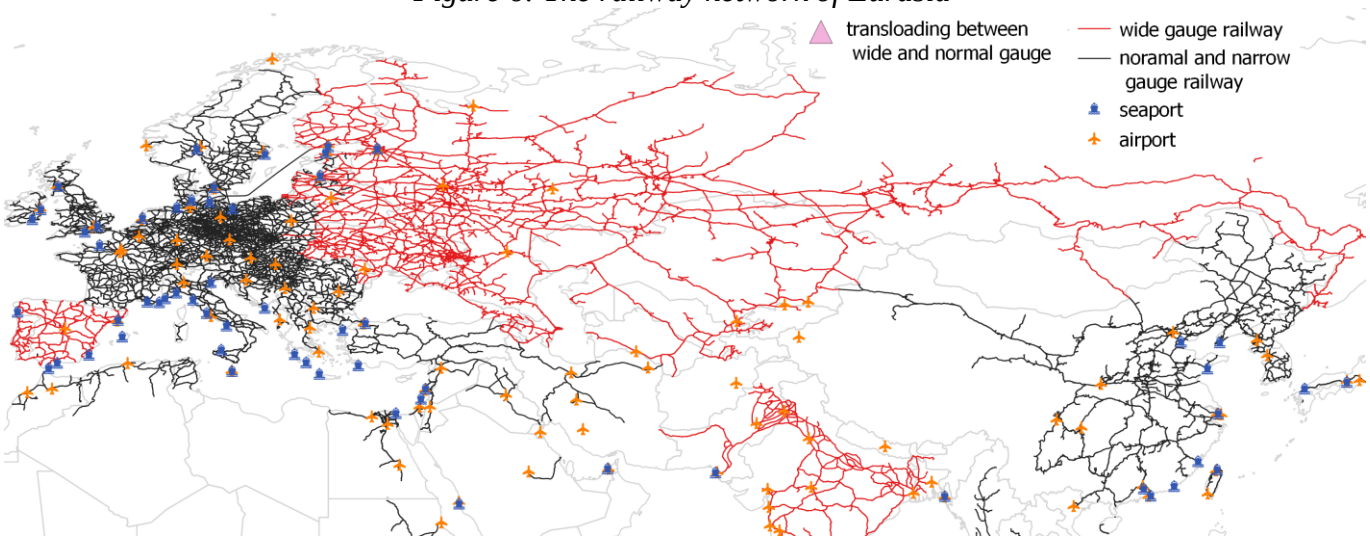
Analysis of the investments of European countries shows, that there is no statistically significant connection between the magnitude of rail infrastructure investment and rail transport volumes. On the contrary, less infrastructure spending can be registered in the countries, where rail transport has a higher share in the modal split. The cause of it is most probably, that less investments can help to keep track access charges lower, more expensive investments usually serve the needs of passenger transport only, and not freight services. EU subsidies played seemingly also no major role: countries with high share/value of subsidies had no higher government infrastructure spending. In the contrary, a crowding-out effect could be noticed as EU subsidies did not accounted as additional funding, but they seem to substitute government spending at least partially.

4.6. Containerised rail transport between China and Europe does not offer a realistic possibility for the development of a long term profitable revenue stream for the European rail freight market

Rail transport attracted an unpresented interest after the introduction of the One Belt One Road (OBOR) by China. The Transeurasian rail freight transport was interpreted by various scientific research and media reports as a novelty, despite the fact that this a century old possibility since the inauguration of the Transsiberian railway line in 1917. Furthermore, the containerised rail transport between East Asia and Europe also has a long history as there were substantial traffic flows between Japan and South Kora and Western Europa since the 1970s via the Soviet Union until it was halted by the collapse of it. The traffic volumes of these flows were comparable to the China-Europe volume in 2018. The Transeurasian rail link was not born due to economic rationale, but it was encouraged by the politically motivated closure of the Suez canal. Even so, after the reopening of it the transport connection continued to operate. The historical review of the Eurasian landbridges has shown that the container transport between China and Europe is not at all a novelty.

The rail connections between Asia and Europe were very limited however. The interconnection between the Soviet Union and China in a shorter route was possible with the opening of the Transmongolian railway in 1955. The next connection was the Kazakh-Chinese in 1990, and the second on that border in 2011 at Khorgas. This second connection opened new routes not to Europe, but to Central Asia by shortening the transport route to that direction. Figure 6 shows that between the European standard gauge network and the broad gauge network there are dozens of crossing points, in the direction of China there are only a handful of available crossing till today what greatly limits the possibilities of the development of cargo volumes.

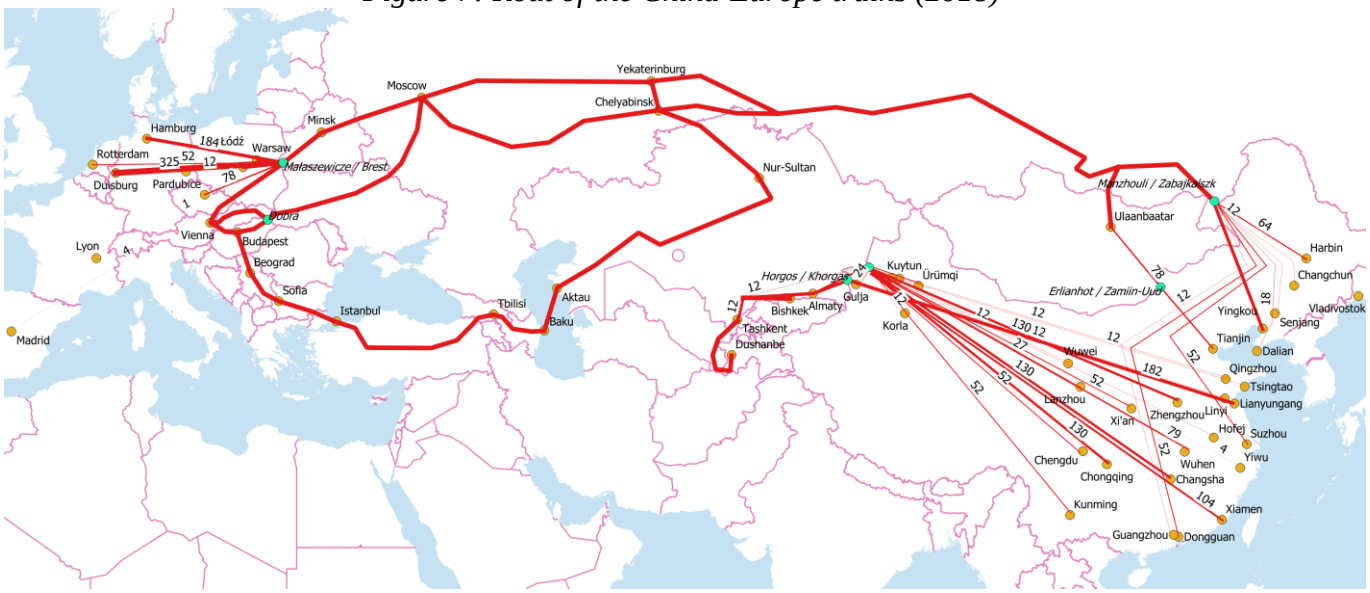
Figure 6: The railway network of Eurasia



Source: own editing (2019)

There was already rail transports before OBOR between China and Europe, but these were not unit trains, therefore it was costly and the transport time was slow. Cargo transport was modernised between the former Soviet region and Europe thanks to the cooperation of the German (DB) and Russian (RZD) railways. They speeded up and modernised the transport, introduced common consignment notes and they initiated the expansion of the service in the direction to China. The first direct container train was introduced in 2009 between Chunking and Duisburg, mainly to support the transport needs of the electronics production facilities in Inland China. So the China-Europe direct rail transport already developed before the introduction of the OBOR in 2013, the enabling developments were not initiated by China.

Figure 7: Rout of the China-Europe trains (2018)



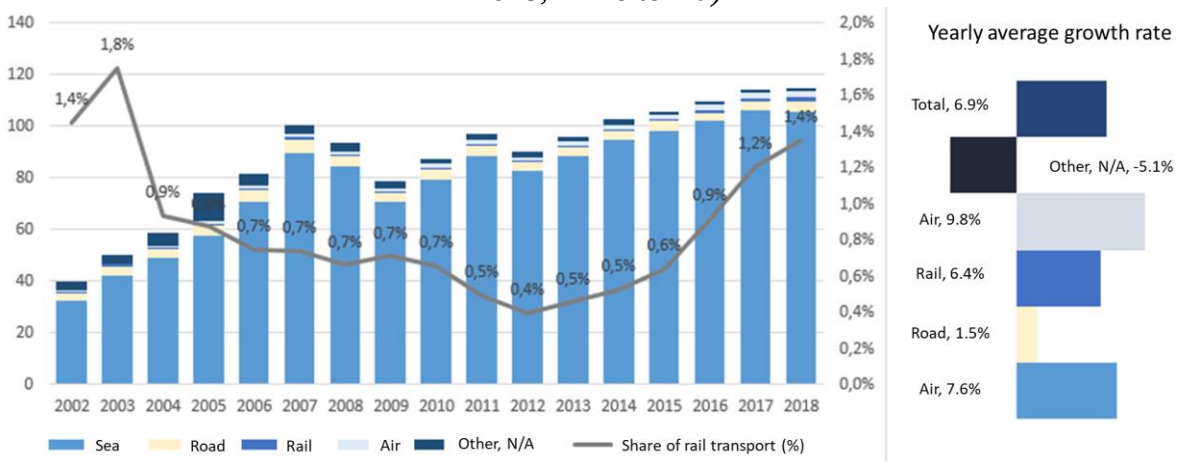
Source: own editing based on Silkroad.cn, OSJD and UNECE timetables (2019)
Remark: the thickness of the line represents the number of trains per year

For the Inner Chinese territories, which can be several thousand kms away from the coastal ports, rail transport offers a faster direct link to the post-Soviet region and Europe. The state of the underdeveloped Chinese domestic intermodal transport and the capacity limits oft the costal ports also supported the development of the landbridges. But the most important factor had to be the generous state aid. This helped to create in just in a few years an extensive network, which connects mainly Inner China with Germany, Czechia and Poland, overwhelmingly via Kazakhstan (Figure 7).

Determining the actual volume of the traffic flows between China and Europe was a challenging task. Chinese sources announce continuously very high growth rates, but these are far from consistent. Academic research lacked also the discovery of real transport volume sources. According to Chinese customs statistics rail accounted to less than 1% of the total Chinese trade volumes in 2018, and the export and import to and from Europe was only a fraction of that. As China only has a handful of railway border crossings (precisely 12) the capacity of these simply does not allow that rail could account for an appreciable portion of external trade flows.

I compared 14, partially from each other independent European, Russian, Chinese and international sources. The results show that the Chinese sources reported two-three times higher traffic volumes than the others. According to the Eurostat databases it can be stated that despite the growth in the recent years of the China-EU rail freight transport, the modal share of rail was higher in 2000 than in 2018 (Figure 8).

8. ábra: A Kína és az EU közti áruforgalom megoszlása közlekedési módok szerint (2002-2018, millió tonna)



Source: own editing based on Eurostat Comext database (2019)

The volume of the China-EU containerised rail transport for 2018 can be estimated at 200-300 thousand TEU (twenty-foot equivalent unit) which is not a considerable amount compared to the 18 million TEU traffic on the EU network in the same year. Even the 0.5 million TEU traffic which is forecasted for 2020 could mean a 2.8% traffic development for the European container transport by rail. It is however important to emphasize that the China-Europe rail traffic does not necessarily mean additional traffic flows for the European railway market automatically. If these containers are transported by sea to the European ports they are partially transported by rail to inland EU markets.

Analysis of the China-EU trade volumes show that rail could achieve 1.4% modal share in 2018 what shows, that this kind of transport can be viable in special cases, as a supplementary logistics service. The volume of rail freight transport in these relations is comparable with air transport. Rail however cannot serve as an alternative to air transport: they serve very different product categories, the unit value per volume of the goods is ten times higher on average in the case of air transport. Rail transport can server an alternative to maritime transport for the relatively more expensive products measured by unit value per volume. But the transport costs are very different of these two modes, rail is at least five times more expensive.

The greatest concern about the long-term sustainability of the China-Europe containerised rail transport has to be about the Chinese state aid and its future development. Currently up to one third of the transport costs are covered by state aid, and according to the available information it will be gradually decreased starting from 2020/2021. The public support however is not only provided by the central government, but also by local governments what makes it complicated to track the exact value and rules of it. Concluding the available information: the further dynamic growth forecasts seem unrealistic, and also the preliminary data for 2020 shows that the previous growth rate of containerised rail transport slowed significantly.

The majority of the Transeurasian rail transportation uses the Central Asian corridor and the capacities of this are close to fully utilised. Bottlenecks are also present due to high traffic in Russia on the Transsiberian and parallel railways, and the Polish-Belorussian railway

terminal for brake of gauge is overloaded. Despite the numerous announcements on rail infrastructure developments in accordance with the OBOR initiative, there were no actual China backed major developments on the Transeurasian rail corridors. Proposed rail developments in Central Asia and projected Russian developments have been listed in the dissertation and it was shown what impact it can have in the future on capacity extension. A possible alternative could be the use of the Transcaspian corridor, but the use of it faces technical, legal and various other limitations. Therefore it cannot be realistically expected that more than 1 million TEU can be transported by rail between China and Europe. In summary, rail transport will only play a marginal role also in the future in the China – and East Asia – to Europe goods transport in comparison to the maritime transport, and it will not generate any significant traffic flows for the European rail market.

5. Publications related to the topic of the research

Journal articles related to the topic of the dissertation:

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BUCSKY, P. – KENDERDINE, T. (2020): Is the Iron Silk Road Really So Important? – Rail Freight Use on China's New Silk Road Economic Belt, 13(*5*) MGIMO Review of International Relations pp. 168-193.

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