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The economic and trade impact of investments in developing dry ports and transport infrastructure along the envisaged China-Europe Railway Express

by
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Abstract

The Silk Road Economic Belt (SREB) is a new economic development area formed on the basis of the ancient Silk Road concept, which aims at building an effective bridge between Europe and China through Central Asia.

Recently, with the rapid increase in international shipping costs, the comparative advantage of railway transport has become more apparent. Thus, the China-Europe Railway Express is supposed to be the cornerstone to bolster SREB (the land route of "One Belt, One Road") initiative. Besides that, the rail-based dry ports play significant roles in the realization of the efficient intermodal transport system which has been the driving force for greatly promoting the regional economic development and increasing trade flows.

This research analyzes the potential global economic and trade impact of railway and dry port infrastructure capital investments. We assess the main concerned countries by their current dry ports' development and investments level, which is the basis for various scenarios. Furthermore, in order to figure out the impact of these investments on productivity, cost reduction and customs efficiency, we used data collected from various related literatures and case studies and then made recalculations. This information feeds into the Global Simulation (GSIM) model for quantitative analysis.

The results are interesting. We found that investments in dry ports and infrastructure in the CR express will have the potential to greatly enhance welfare, GDP and trade flows between the CR express countries. We find that if China does this on its own, it gains most, and so do neighbouring countries Russia and Kazakhstan. The largest effects, however, occur when all countries on the CR express – from China to Western Europe – make significant investments. Welfare and output rise and so does trade. The gains are largest for heavily integrated countries (e.g. Germany) and leas for countries that are in the margin linked to the CR express (e.g. Sweden). For China, the greatest gains come when it flanks the CR express investments with FTAs as is the plan under the SREB-OBOR strategy it is executing.

In short: the optimal strategy for China is to increase investment in dry ports and other infrastructure, to convince the other CR-Express countries to also invest heavily, and to flank the CR express strategy with an FTA strategy: signing FTAs with countries on the CR-Express.

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List of Abbreviation

ADB	Asian Development Bank
AGE	Applied General Equilibrium
AIIB	Asian Infrastructure Investment Bank
CBA	Cost benefit analysis
CDB	China Development Bank
CETA	Comprehensive Economic and Trade Agreement
CGE	Computable General Equilibrium
COSCO	China Ocean Shipping (Group) Company
CR Express	China-Europe Railway Express
CRC	China Railway Corporation
CS	Customer Surplus
DP	Dry ports
DPD	Dry Port Dunkerque
EBRD	The European Bank for Reconstruction and Development
FDOT	Florida Department of Transportation
FTAs	Free Trade Agreements
GATT	General Agreement on Tariffs and Trade
GE	General-equilibrium
GSIM	Global Simulation Model
HKTDC	Hong Kong Trade Development Council
HPA	Hamburg Port Authority
KETDZ	Kunming National Economic and Technological Development Zone
KTZ	Kazakhstan Temir Zholy
LICs	Low Income Countries
LMICs	Lower-middle Income Countries
LPH	Lianyungang Port Holdings Group Co., Ltd.
MOT	Ministry of Transport
MSR	Maritime Silk Road
NDRC	National Development and Reform Commission
NRA	National Railway Administration
NTMs	Non-tariff measures
OBOR	One Belt One Road
OECD	Organization for Economic Co-operation and Development
PAD	Port of Dunkirk Authority
PE	Partial-equilibrium
PPPs	Public-private partnerships
PS	Producer Surplus
SREB	Silk Road Economic Belt
TCE	Trade cost equivalent
TFI	Trade facilitation indicators
TFI	Trade Facilitation Indicators

TPP	Trans-Pacific Partnership
TTIP	Transatlantic Trade and Investment Partnership
UMICs	Upper-middle Income Countries
UN Comtrade	United Nations Comtrade
UN ESCAP	United Nations Economic and Social Commission for Asia and the Pacific
WITS	World Integrated Trade System
WTO	World Trade Organization

Chapter 1 Introduction

1.1 Research background

In the context of economic globalization, regional economic integration has become one of the most striking trends in today's international economic relations. Numerous of countries have progressively cut down their tariff barriers within the frameworks of the General Agreement on Tariffs and Trade (GATT) and – afterwards – the World Trade Organization (WTO), and more recently started to address also remaining non-tariff measures (NTMs). The combination of trade liberalization, and reduction in NTMs, combined with IT and technological developments and dropping transport costs have highly stimulated the development of trade and investment (Shangquan Gao, 2000).

Since 2006, when developing its international trade strategies, the EU has emphasized the pursuit of bilateral and regional Free Trade Agreements (FTAs) with dynamic East Asian economies (Pelkmans et al, 2016) alongside a multilateral trade strategy. Most recently EU successes include the signing of the Comprehensive Economic and Trade Agreement (CETA) with Canada and conclusion of the EU-Japan FTA. In East Asia, China has become an increasingly strong economic power and it is likely to become even more crucial in global trade in the future. The One Belt One Road (OBOR) strategy is the Chinese strategy that was recently (2013) unveiled and now moves ahead to shape how China deals with and co-shapes globalization. It is the cornerstone strategy for the largest economy in the world (GDP at PPP) to link up countries globally. On the other hand, the US, under President Trump, has withdrawn from the Trans-Pacific Partnership (TPP) and the Transatlantic Trade and Investment Partnership (TTIP) is in the 'freezer'. This provides a unique opportunity for OBOR to co-shape globalization towards a Chinese version of it.[1]

Within OBOR, the Silk Road Economic Belt (SREB) is a new economic development area formed on the basis of the ancient Silk Road concept, which strives to build an Eurasian infrastructure network. As shown in Figure 1, OBOR consists of two different routes: "Silk Road Economic Belt" (SREB) and "Maritime Silk Road" (MSR) to connect China with Europe, Africa and Southeast Asia. During the 12th Five-Year Plan period, the total import and export trade between China and Europe was US$ 3.023 billion, an increase of 33 percent compared with last year (NDRC, 2016). Due to continued upgrading efforts of railway transport (since the beginning of the China Railway

[1] Note: The Trans-Pacific Partnership (TPP) is a proposed regional FTA among 12 countries that border the Pacific Ocean, which was pushed forward by Obama in 2009 and it is responsible for roughly 40% of world trade. However, President Trump signed the statement to withdraw the United States' participation in TPP on January 2017.

Express in 2011), the volume of freight transported by rail has increased yearly. Over 800 container trains have been sent from China to the west in 2015.

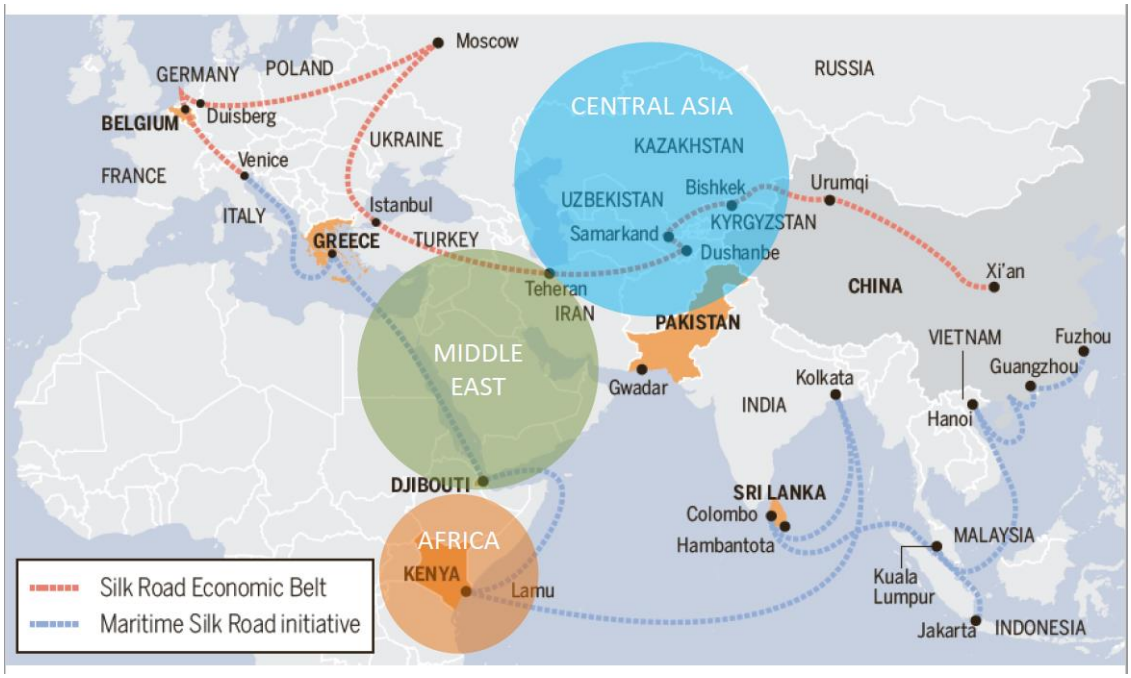

FIGURE 1 TWO ROUTES OF OBOR INITIATION
Source: INTERMODAL SILK ROUTES (APSA)

Furthermore, in October 2016, China's state planner announced a five-year "Development Plan of the China Railway Express Construction (2016-2020)" to develop the China Railway Express to Europe. This railway network is seen as an important part of the OBOR initiative, in particular the SREB part. The goal is to enhance transportation infrastructure and promote the development of the new Eurasian land bridge economic corridor. According to National Railway Administration (NRA), by 2020, China aims to spend US$ 507 billion on building railways during China's 13th Five Year Plan (2016 – 2020). In addition to focusing on the expansion of the railway, port infrastructure plays a critical role in supporting the economic growth among countries and regions under the ambitious target of efficiently achieving OBOR.

Due to the vast distances between major inland manufacturing hubs on the one hand and seaports on the other, increasing of container volumes put high pressures and significant requirements on improving cargo handling capabilities and alternative methods to resolve inland congestion issues. The development of inland freight distribution systems has been a positive strategy to boost the hinterland of maritime gateways world-wide. Particularly, intermodal rail and dry ports are involved in an important way in the process of port regionalization. (Rodrigue and Notteboom, 2012). The established dry ports can serve as significant hubs for Asia-Europe trade along the China-Europe Railway. UNESCAP defines a "dry port" as: *"the established*

logistics center connected to different modes of transport with port services" (e.g. issuing bills of lading, customs declarations and inspections) in international trade (UNESCAP, 2015). Recently, the Intergovernmental Agreement on Dry Ports, which was signed by Asia-Pacific countries in 2013, under the auspices of the ESCAP, entered into force (23 April 2016), after eight of the 17 signatory countries became parties to it (UNESCAP, 2015). This agreement aims at exploring a new path of development for landlocked countries and regions facing the challenges of achieving a more efficient and rapid Intermodal Transport system. Through similar functions as in seaports (such as mergers and distribution centers), dry ports can create new economies of scale, lower transportation costs and create jobs opportunities for residents.

Since 2002, when China's first dry port was built, the domestic economic development of inland port cities accelerated gradually, as was reflected in the number and scale of Chinese dry port developments. Chinese state banks have already invested US$ 250 billion in infrastructure construction projects that are part of OBOR, such as railways, ports and power plants (PIIE, 2016). Thus, it is significant to understand how these public investments in rail and dry port infrastructure create more economic activities and trade flows not only for China, but also for all the regions along the rail route.

1.2 Research Objectives

The main discussion of this research is based on China SREB-OBOR strategy and the development of the China Railway Express between Europe and China. There are abundant capital investments and interregional cooperation agreements to support and promote this strategy. However, the economic and geopolitical significance between the development of dry ports and increases in international trade are still unclear. Therefore, this research intends to analyze the economic and trade impact of the China Railway Express plan in the context of SREB on regional economic development as well as the impact of transport infrastructure investments on dry ports.

In order to figure out the economic and trade impact of transport infrastructure investments on dry ports, we will use the logistics performance index of different investment levels to measure the impact of investment on productivity of dry ports, and from that point onwards the effect of more efficient dry ports on regional economic development. Apart from that, previous historical illustrations will also be analyzed as the foundational support to answer our research question. Founded on the model-based results and qualitative analysis, this research will focus on the opportunities and threats of dry ports based on the relationship of logistics performance and investment levels.

As such, the main research question that this research aims to answer is the following: **What is the economic and trade impact of investments in developing dry ports along the envisaged China Railway Express?**

To comprehensively answer the research question, the following sub-research questions need to be answered:

1. *What exactly do OBOR, SREB, and the China Railway Express stand for and what is the motivation (what are the policy objectives) of investments in railway and dry port infrastructure? (Answered in Chapter 2)*
2. *What is the current state of the China Railway Express, what are currently the main bottlenecks and where has any investment gone so far? (Chapter 2)*
3. *What is the Dry port concept and Dry ports' development situation of the main countries along China-Europe Railway Express? (Chapter 2)*
4. *What is the effect of transport and dry port infrastructure investments on productivity, costs and streamlining logistics flows? (Chapter 3)*
5. *What methodological approach would be best to answer this research question in a quantitative sense? (Answered in Chapter 4)*

1.3 Research Design and Methodology

The thesis will use both quantitative and qualitative methods to answer the posed research question.

From a quantitative angle, what we intend to do is the following. First, we aim to collect data on investments in infrastructure over time. We will also collect different variables that allow us to look at the productivity, competitiveness, cost base and efficiency of dry ports. For example, the time it takes for containers to clear customs and move on, the jams in a dry port, the efficiency of customs procedures, the logistics performance etc. We use previous case studies to estimate the coefficients (i.e. the impact) of investments on productivity of dry ports in the past. This allows us to get an idea of how much logistics performance or dry port performance improves with different levels of investments (for the modest and ambitious scenarios in our quantitative analysis). The second step is that we use the productivity data collected from literature and case studies to proxy trade cost equivalents (TCE). We use this TCE in the Global Simulation (GSIM) model, corrected for a transport cost parameter, to estimate economic and trade effects of the investment policy. The analysis focuses on 11 countries along the China-Europe Railway Express (CR Express) that are most important (but also includes all other countries to estimate global effects, including substitution of trade to or away from the core focus countries.

First, this three-step approach allows us to solidly quantify the effect of investments in dry ports for those dry ports, to then measure the economic and trade impact of these investments. We define economic impact as the effects in terms of welfare (consumer and producer surplus), output (production), and prices. Trade will be expressed in terms of changes in bilateral trade values (imports, exports).

The qualitative analysis provides inputs from desk research and literature for the quantitative analysis and also complements the quantitative analysis afterwards. We will first carry out a focused literature review to investigate the history and current state of the railroad connection between China and Europe as well as the dry ports along the route. We continue by looking at statistical evidence of the impact of transport infrastructure investments on productivity, costs, and streamlining of logistics flows. Any information we can find is useful and sheds light on potential investment effects. In the results and analysis chapter, we complement the quantitative findings of the analysis by a short sustainability analysis of dry port investments given the quantitative results. This will aid in formulating relevant policy recommendations in the last chapter.

1.4 Thesis Structure

This study is structured into six chapters that cover different elements of the research question and that are linked to each other. Figure 2 below illustrates the structure of this study.

Chapter 2 is the policy chapter. It describes the current situation of the CR Express with its three main routes, starting with the background and initiative of OBOR (including SREB), and the CR Express. Furthermore, we provide a short statistical overview of the importance of inland trade flows and the trends compared to other modes of transport, including coverage of inland trade distribution systems and centers. In this Chapter, we also provide information on the current status of dry port development in selected countries or regions as well as policy objectives set regarding dry ports.

In Chapter 3 we look at various case studies, describing the types of investments and subsequent expansion of transport facilities or dry ports. We then provide a literature review of investments in railways and logistics infrastructure projects, from a China perspective, but also by looking at other countries in the past who have done this. The focus of this analysis is on gathering quantitative empirical evidence on the effects of investments on productivity and trade costs from other case studies and information sources.

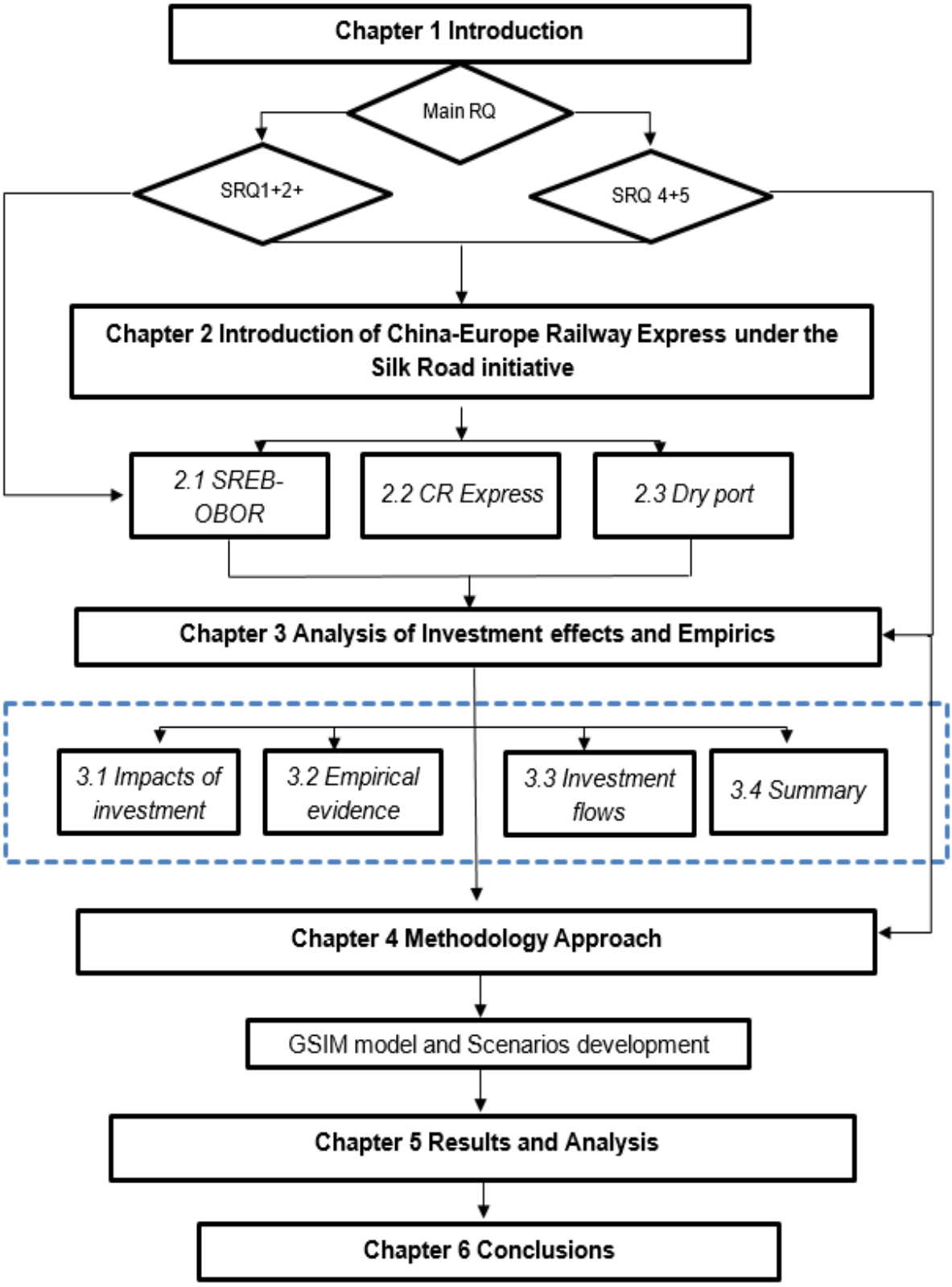

FIGURE 2 STRUCTURE OF THE STUDY
Source: own elaboration

Chapter 4 describes the choice of quantitative model and then explains how the Global Simulation (GSIM) model works in detail. We use the GSIM model to evaluate the economic and trade impact of investments under CR Express – linked to OBOR-SREB – for selected countries. We also present the detailed data and explain their sources. Finally, we construct relevant possible investment scenarios as part of OBOR-SREB and 'translate' those into tariff and NTM effects of the policy. In particular, we convert the coefficient of the effect of investments into a TCE that enters the GSIM model as an initial NTM. The scenario presenting the NTM reduction then depends on the level of investments made.

The results of the quantitative analysis will be presented, interpreted and discussed in Chapter 5. First, we present the effects of the investment strategy under the CR express on trade flow changes. Second, we look at the effects in economic terms for the focus-countries (welfare and output).

Chapter 6 concludes by summarizing the principal findings of the research and drafting relevant policy recommendations for focus-country governments. In this Chapter, we also make suggestions for further research.

Chapter 2 Introduction of China-Europe Railway Express under the Silk Road initiative

2.1 The motivation of SREB-OBOR

Over the past decades, China as a rising power is seeking a highly proactive policy to maintain its economic profile and prowess globally. In 2003, Chinese President Xi Jinping unveiled the idea of a Silk Road Economic Belt (SREB) to revive the historical Silk Route which is through central Asia and achieve China's long-term ambitions. Fallon (2015) states, the construction of the Silk Road is a way to set up the foundation for new models of international cooperation. According to his views, this plan has positive influence on economic development and wealth globally.

In 2015, the National Development and Reform Commission of China (NDRC,2015) release a document entitled, "Visions and Actions on Jointly Building Silk Road Economic Belt and the 21st Maritime Silk Road," which embodies China's new opening-up strategies with regards to facing domestic and international situation changes (Lin, 2015). Various of literatures also study the mutually beneficial model of cooperative relations between Central Asia and China. China has invested enormous amount of funds in developing energy sector in Central Asia and its long-term objective is to ensure beneficial oil prices as well as to be easily accessible to raw materials. Meanwhile, Central Asian countries start pay more attention on economic cooperation with China (Contessi 2016, Sárvári & Szeidovitz 2016). The motivation behind this announcement is China's overcapacity in steel, cement and building materials as well as the growing trade with the Central Asian States (CAS)[2] (RIAC, 2017).

In the Chinese view, the target is on promoting a series of interests for China. In this conceptual framework, the NDRC has identified five major goals which are Policy coordination; Facilities connectivity; Unimpeded trade; Financial integration and people-to-people bonds (NDRC, 2015). The further explanation of these five key areas is shown in Figure 3. In accordance with Pantucci and Chen (2015), countries involved in the Belt and Road projects are assumed to "represent 55 percent of world GNP, 70 percent of global population, and 75 percent of known energy reserves".

The formulation of OBOR could bring both domestic and abroad economic benefits. One of the driving forces is that Trans-Eurasian trade infrastructure could bolster poorer countries to the south of China, as well as promote global trade (Bruce-Lockhart, 2017). In terms of domestic regions, especially the less-developed border

[2] Note: Central Asia stretches from the Caspian Sea in the west to China in the east and from Afghanistan in the south to Russia in the north. Historically, this area has been closely related with its nomadic peoples and the Silk Road.

regions in the west of China, such as Xinjiang province, are also anticipated to be benefit.

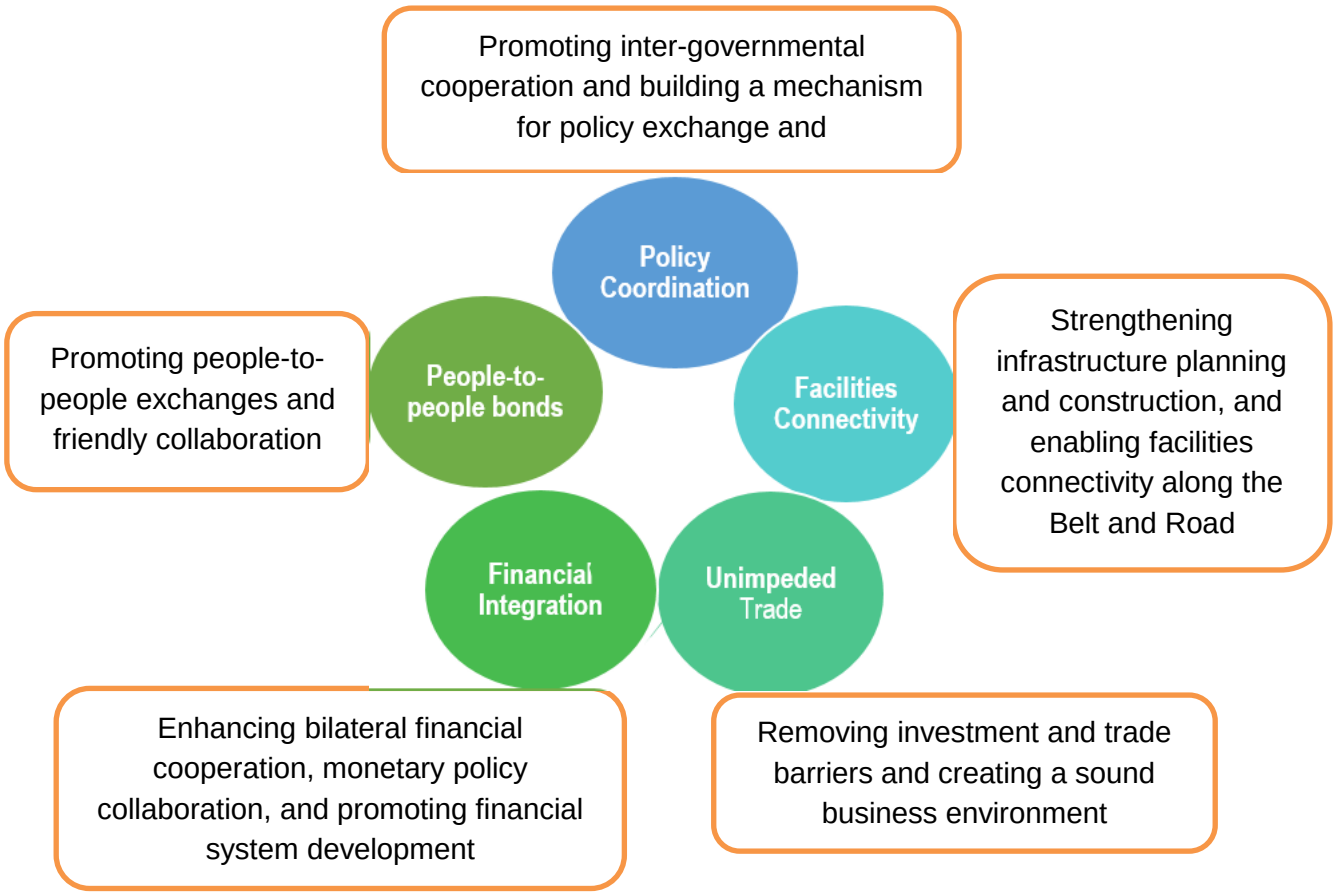

FIGURE 3. FIVE MAJOR GOALS OF OBOR

Source: own compilation based on the source of Belt and Road Hong Kong (2017)

Moreover, the OBOR is an integral part of the mega connectivity projects, which intent to enhance connectivity between the European, Asian and African continent. By taking advantage of international transport routes as well as core cities and key ports to reinforce cooperation, six international economic co-operation corridors have been identified as the China-Mongolia-Russia economic corridor; New Eurasia land bridge economic corridor; China-Central Asia West Asia economic corridor; China-Pakistan economic corridor; Bangladesh-China-India-Myanmar economic corridor; China-Indochina economic corridor (HKTDC, 2017) (Figure 4).

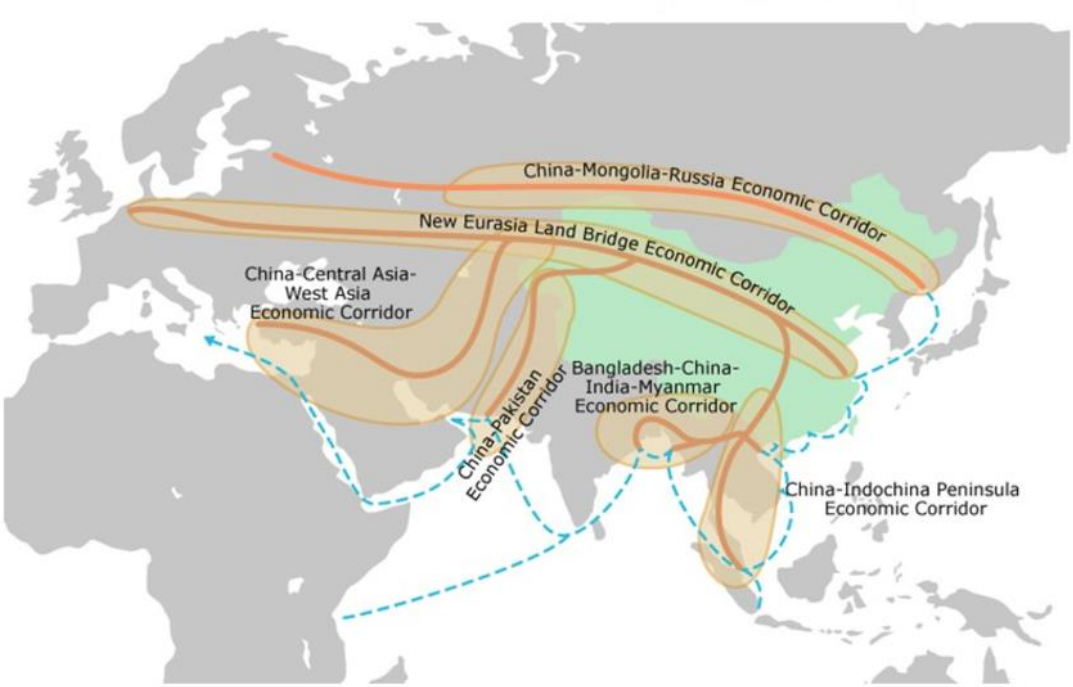

FIGURE 4. SIX ECONOMIC CORRIDORS SPANNING ASIA, EUROPE AND AFRICA
Source: HKTDC (2017)

In particular, the drivers behind SREB are the urgent need of achieving development in all of China's 31 provinces, the serious security concerns explaining why China wants to build its leverage in Central Asian States, demand of lessening dependence on the US dollar, and China's interest in energy, security and promotion of economic ties, which is driven by the image of "greater Eurasian idea" (RIAC, 2017). Even though the railway transportation is one of the oldest forms of modern trade, the potential behind the New Silk Road railways is tremendous and the idea is totally new.

2.2 The current situation of CR Express and main routes

In the era of globalisation, the construction and development of intercontinental railway may generate a revolution in transportation and logistics area. This is because the railways have significantly lowered time required in comparison with sea transportation and reduced cost expense in comparison with air express. Besides that, compared to road network, the intercontinental railways are more effective and productive in pushing forward international trade.

Regmi and Hanaoka (2012) stressed that transit railway infrastructure is extremely significant for landlocked countries since it ensures them to be accessible into open seas. It is worth emphasizing that the opening of the Silk Road will assist to reduce income inequality between the countries concerned (Karluk & Karaman 2014).

2.2.1 The introduction of CR Express

In 2016, the NDRC rebranded all services as CR Express to be a key section of its development plan, which emphasized the railway connection as crucial to the Belt and Road Initiative. For companies that want to transport Chinese products to Europe, including Western-China manufacturers and coastal companies, they are increasingly interested in finding an alternative to sea freight to seize market opportunities along the Belt and Road routes. To bring more imports into the booming domestic market, some companies even utilize the high speed of freight trains and customs clearance facilitation (HKTDC, 2016).

To improve connectivity and trade flow between China and the rest of Eurasia, under the banner "China Railway Express"[3], China has opened 51 new freight rail lines linking Chinese cities with 11 European and Asian countries since 2011 when the first train setting off from Chongqing to Duisburg, Germany (He, 2017). The CR Express supports direct railway transport to Europe from China, as well as a one-stop service in cargo inspection, quarantine and customs clearance by the reason of the support from relevant government authorities (HKTDC, 2016). Recently, the Working Leadership Group Office of "Promoting OBOR construction" published the development plan (2016-2020) which points out that the cargo train service system will consist of three core routes — the west route, the central route and the east route. The routes will not only connect China with Europe, but also with East Asia and Southeast Asia (CGTN America 2017). The plan has a target on having three gateways and 43 transit hubs as part of the CR Express network by 2020 (Chen, 2017). Currently, three main routes are laid out.

- The West Channel from central and western China through the Alataw Pass (Horgos) exit.[4]
- The Central Channel from Inner Mongolia Erlianhaote port exit, through the Mongolian then Russian Siberian railway connected, access to European countries.
- The East Channel from the Inner Mongolia Manchuria (Heilongjiang Suifenhe) port exit, connect with the Russian Siberian railway, accessible to the European countries.

[3] China's Europe-bound freight-train service (now formally named the CR Express) was launched in March 2011.

[4] Note: The first route is from the Xinjiang Alashankou (Horgos port) exit, connected by Kazakhstan and Russia Siberian railway, via Belarus, Poland, Germany, access to other European countries.
The second line is from Horgos (Alashankou) port exit, via Kazakhstan, Turkmenistan, Iran, Turkey and other countries, access to European countries; or by Kazakhstan across the Caspian Sea, into Azerbaijan, Georgia, Bulgaria and other countries, to be accessible to the European countries.
The third line is connected by the Tuolgate (Ilksttan), and the planned Zhongjiwu Railway, leading to Kyrgyzstan, Uzbekistan, Turkmenistan, Iran, Turkey and other countries, access to European countries.

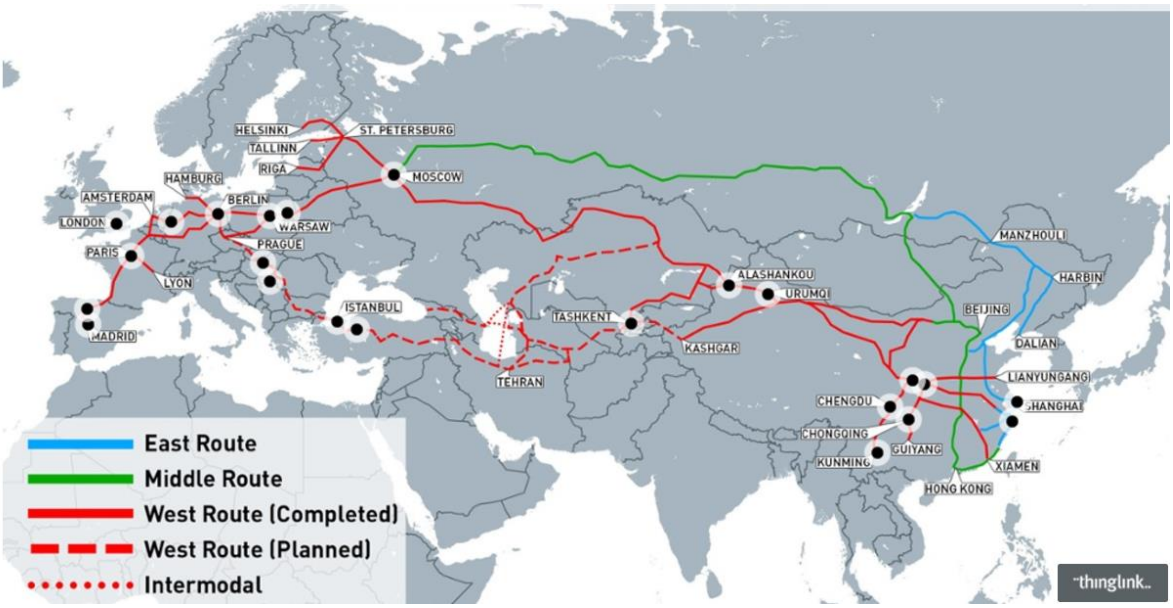

FIGURE 5. THREE MAIN ROUTES OF CHINA-EUROPE RAILWAY EXPRESS
Source: CGTN America (2017)

2.2.2 Nine main China-Europe block trains

Here we introduce nine major railway lines.

The first one, “Chongqing-Xinjiang-Duisburg”, known as “**Yuxin’Ou**” international railway, which as a pioneer linking Europe and China through the new direct railway, started operating in March 2011. This line starts from Chongqing, passing through Alashankou in Xinjiang, crossing Kazakhstan, Russia, Belarus, Poland and the ultimate destination is in Duisburg (HKTDC, 2016).

FIGURE 6. THE ROUTE OF YUXIN’OU
Source: Faster than shipping, cheaper than air freight, railway illustrates benefits of B&R initiative (Chu, 2016)

The second one, **Hanxin'Ou** begins from Wuhan, China, and its destination is Czech Republic. Apart from Foxconn products, Car and building materials are also the main transport cargo. Hanxinou sends the automobile parts back to China every two weeks (Xinhuanet 2014). The first batch of regular trains from Wuhan to Europe was despatched on April 23rd, 2014. In 2015, Wuhan operated totally 228 trains and 14,912 TEU, in a total of 92,500 tons with the worth of 3.3 billion yuan (US$ 0.5 billion). Wuhan has an expectation of operating 300 trains between China and Europe in 2016 (H&T, 2016).

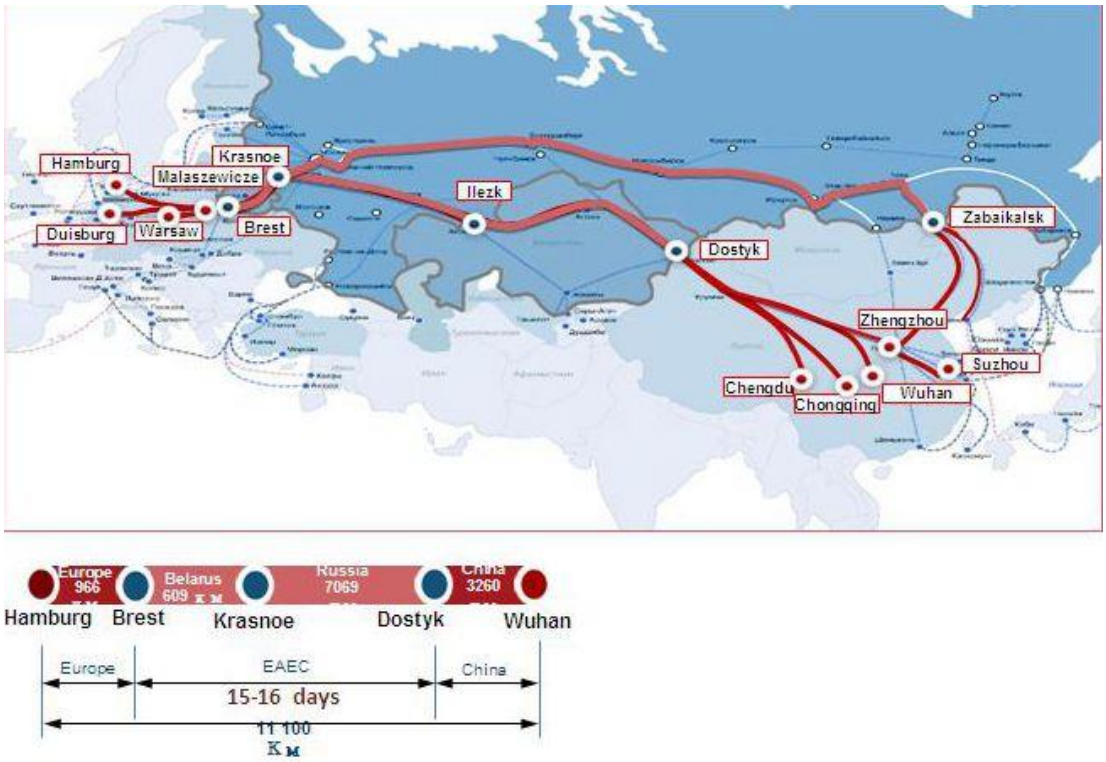

FIGURE 7. THE ROUTE OF HANXIN'OU
Source: H&T (2016)

The third one, **Suman'Ou** Railway starts from Suzhou, exiting China at Manzhouli in Inner Mongolia autonomous region, which passes through Russia, Belarus, and arrives at Warsaw of Poland by the Trans-Siberian Railway (Li, Bolton and Westphal, 2016, JSChina, 2017). This 11,200-kilometer railway firstly operated in November 2012, prior to this, Europe had no direct rail link connections to the south-eastern China. The major freights are transported through this line include Suzhou-made products, such as electronic products, machinery, clothing, household goods and so on.

FIGURE 8. THE ROUTE OF SUMAN'OU
Source: (Hltnb.com, n.d.)

The fourth route "**Rong'Ou**" also reaches Poland (Łódź) while the beginning point is Chengdu, China. Rong'Ou Railway, which the name consists of Rong (Chengdu) and Ou (Europe), supports 41 to 52 wagons per week and carries multi-sized containers (Maxxelli-Consulting, 2015). Chengdu plays a role as the principal centre for automobile manufacturing, which also has a bunch of IT equipment and electronics companies. This railway, which first started in April 2013, carries IT items, automobile parts and clothes from China to Europe, and food and beverages in the opposite direction (Mooney, 2015).

The fifth line is **Zheng'Ou** Railway (Zhengzhou-Xinjiang-Europe), which originates in Zhengzhou and finally arrives at Hamburg, Germany. Through this railway, those Chinese products that come from Henan Province do not need to be first shipped to Qingdao and by ocean shipping later. On the contrary, they can be transported directly to Europe (Li, Bolton and Westphal, 2016). It goes through 6 countries and the total distance is 10,214 kilometres.

The sixth one, **Hexin'Ou** starts from Hefei which is considered the most cost-effective freight block train for cargo produced in Shanghai, Jiangsu, and Zhejiang Province, where have numerous factories (H&T, n.d.). Its first operation is in June 2014, but at that time only shipped goods to Kazakhstan. Hexinou's business expanded into Russia afterward. In June 2015, the train spent around 15 days reached Germany in Hamburg and the distance is approximately 11,000 km. At present, Hefei also has weekly departure to Europe, reaching Malaszewicze, Poland in 13 days (H&T, n.d.). The types of cargoes transported on this railway line are mainly contained electronic and household appliances, textiles and so on (Yin 2015).

The seventh route **Xiang'Ou's** freight shipment commenced in October 2014, where the train departs from Changsha, Hunan province. At present, there are three lines for regular transportation. One of the route goes through Kazakhstan, Russia, Belarus, and Poland then arrives in Duisburg, Germany. The destination of the other two is Moscow, Russia and Tashkent, Uzbekistan separately. Products transported by Xiangou are mainly tea products, porcelain, and machinery accessories (Zhang 2014).

The eighth line Yixin'Ou, which originates from Yiwu, the world's largest hub for small commodities in eastern China, to the Spanish capital Madrid. Currently, Yixinou is the longest transportation line among all these railways routes between Europe and China. The train normally delivers miscellaneous goods to Spain and then some typically Spanish products, such as wine, olive oil, and cured ham are shipped back to China (Liu, 2015). Since the Yiwu route first appeared in November 2014, this freight service has handled 131 trips as of March 2017 (He, 2017).

FIGURE 9. THE ROUTE OF YIXIN'OU
Source: (Hltnb.com, n.d.)

The last one, Ha'Ou railway line started operations in June 2015, which operates freight shipment from Harbin to Hamburg. The first shipments comprised clothing, electronic components, and automobile parts (Li, Bolton and Westphal, 2016).

Table 2.1 provides a summary of the basic information about nine China-Europe railway routes.

Lines	*Main Route*	*Distance*	*Duration*	*Time in operation*	*Main Countries Involved*	*Frequency*
Yuxin'Ou	Chongqing-Alashankou (border port)-Duisburg	11,179 km	11-12 days to Poland 13-14 days to Germany	July, 2011	China, Kazakhstan, Russia, Belarus, Poland, Germany	3 per week
Hanxin'Ou	Wuhan-Czech (Mělník, Pardubice)/ Turkmenistan	10,863 km 11,300 km	16 days to Czech 15 days to Lyon, France	Oct. 2012	China, Russia, Belarus, Czech Republic, Turkmenistan	2-3 per week
Suman'Ou	Suzhou-Warsaw (Poland)	11,200 km	12-18 days	Nov. 2012	China, Russia, Belarus, Moscow, Poland	6-8 per week
Rong'Ou	Chengdu-Łódź (Poland)	9,826 km	10 days	April,2013	China, Kazakhstan, Russia, Poland	1 liner train/week
Zheng'Ou	Zhengzhou-Xinjiang-Hamburg	10,214 km	17-19 days	July, 2013	China, Kazakhstan, Russia, Belarus, Poland, Germany	1 liner train/week
Hexin'Ou	Hefei-Germany	11,000 km	13 days to Poland 15 days to Germany	June, 2014	China, Kazakhstan, Russia, Poland, Germany	2 per month
Xiang'Ou	Changsha-Duisburg/Moscow/Tashkent	11,808 km	18 days	Oct. 2014	China, Kazakhstan, Russia, Uzbekistan Belarus, Poland, Germany	Every 10 days
Yixin'Ou	Yiwu-Madrid	13,052km	21 days	Nov. 2014	China, Kazakhstan, Poland, Germany, France, Spain	3x until now
Ha'Ou	Harbin-Hamburg	9,820 km	15 days	June, 2015	China, Germany	1 liner train/week

TABLE 1. SIGNIFICANT CHINA-EUROPE RAILWAY LINES
Source: own elaboration based on data from (Li, Bolton and Westphal, 2016) and (HKTDC, 2016).

2.3 The development of dry ports

2.3.1 The concept of dry ports

Inland allocation has become a crucial part of globalization, but also the cornerstone helping the ports to be more competitive (CEMT, 2001). The hinterland intermodal terminals are significant nodes in the transportation network, which has been extensively discussed by numerous researchers (Roso, 2007). These nodes have been mentioned as dry ports (DP), inland terminals, inland ports, inland hubs, inland logistics centers, inland clearance depots, intermodal freight centers and inland freight terminals (Roso, Woxenius, & Lumsden, 2009, Rodrigue and Notteboom, 2012). In this paper, we mainly discuss the rail-based dry ports.

Leveque and Roso (2002) defined 'dry ports' as as "an inland intermodal terminal directly linked to seaport(s) with high capacity transport means, where customers can leave or pick up their standardized unit as if directly as a seaport. With the process of port regionalization, the development of dry ports is conducive to extending the accessibility of the hinterland and solving the shortcomings of the lack of railway connection with seaports (Notteboom and Rodrigue, 2005). The functions of dry port not only contain traditional transshipment, but also other services, such as distribution, combination, maintenance of containers, the storage of commodities and containers in empty, and customs services (Wang and Wei, 2008). Apart from the benefits on ecological environment and the quality of life for the citizens living closely to main roads by offering the possibility of using rail instead of road, the concept of dry port largely provides the possibility of seaports access to the inland market, enhancing the throughput without physical port expansion as well as better services to environmentally conscious shippers and transport operators (Black et al., 2013)

According to its location, there are diverse types of dry ports. Based on the services and location of dry port from the seaport, Roso et al. (2009) defined dry ports into three distinct categories (1) Distant dry port: The distance between it and the seaport is 500 kilometers or more (Henttu, V et.al, 2010). In this situation, since the model of rail transport is cheaper than the road. the main benefits of distant dry ports are related to the transition from road to rail, leading to a reduction in congestion at the seaport and environmental impacts as well as the maintenance of long-distance transport capacity. One of the example is Isaka Dry Port in Tanzania. (2) Midrange dry ports: It is around 100- 500 km far away from the seaport (Henttu, V et.al, 2010). The midrange dry port as a merger point for different rail services plays a role of buffer for mitigating the seaport's stacking areas. One of the case is Virginia Inland Port (VIP) which is located at Front Royal. The VIP has fascinated about $ 100 million investment in Home Depot and Sysco distribution centers to ensure that the seaport's import container throughputs (Woodbridge, 2004b). (3) Close dry port: The distance from close dry port to seaport is less than 100 km (Henttu, V et.al, 2010). The close dry

port is located at the margin of the seaport city, which not only integrates road transport to relieve pressure on the city main roads and port gates but also provides a rail shuttle service to enlarge possibilities for buffering containers.

Figure 10 shows the combination of the three types of dry ports and their connections to the seaports and the shippers.

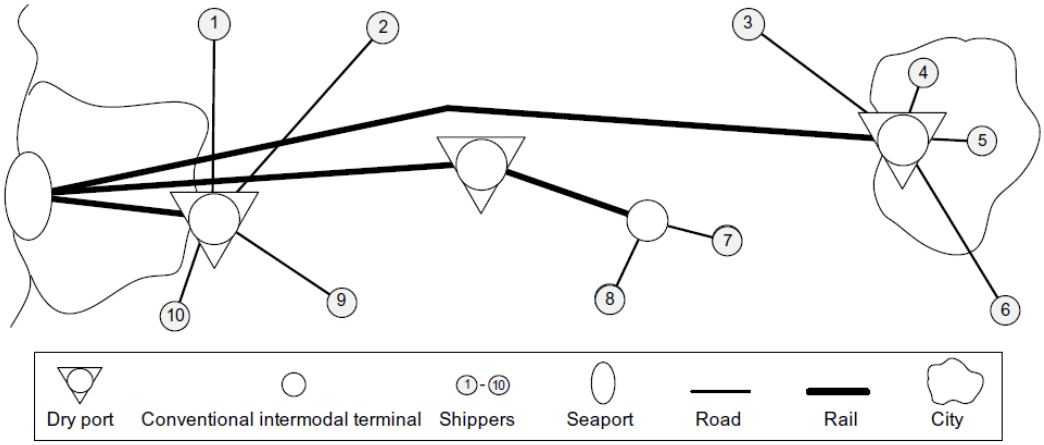

FIGURE 10. AN IMPLEMENTED DRY PORT CONCEPT OF THREE DIVERSE TYPES
Source: Roso, 2009

2.3.2 The current situation of Dry port in major countries

The countries we choose here are based on the analysis of main countries involved in China-Europe Railway Lines under Section 2.2.2, which contain China, Russia, Poland, Germany, Spain, Sweden, Netherlands, France, Czech Republic, Kazakhstan, Belarus.

1. China

As we know China's current role as the factory of the world, the import and export volume as well as general traffic at Chinese sea ports is increasing. For instance, in 2010, Shanghai surpassed Singapore in container transport and became the busiest port globally (Felix Richter, 2013). The dry port in China plays a significant role in promoting the development of international trade and international logistics, ameliorating investment environment in the west, central and northeast China, serving "The Belt and Road" strategy and facilitating trade connections between China and Asian-Pacific region (MOT, 2017). At present, there are four major dry port groups in China, which are North-east dry port cluster which is led by Dalian, North and North-west, East cluster, and Shandong-Peninsula dry port group. A few of dry ports that locate in Chongqing, Chengdu, Zhengzhou, Wuhan, etc are working with frontier ports to be the foundation of China-Euro Railway Express.

The policy measures, legislation and countermeasures to support the development of Chinese dry port in the recent years are summarized in Table 2.

Year	*Promulgator*	*Documents and Events*
March 2009	The State Council	The Adjustment and Revitalization Planning for Logistics Industry
2010	Local governments in Guangxi	Suggestion on Construction of Dry Port to Accelerate Development of Bonded Logistics System
	Local governments in Kunming	Implementation Plan for Promotion of Construction of Dry Ports in Kunming City
2013	The General Secretary Xi Jinping	The strategic concept of the "The Belt and Road"
May 2014	The Chinese Ports Association	It established the dry port branch and convoked the seminar for the development of dry ports in China
September 2014	The State Council	The Medium-and Long-term Planning for Logistics Industry Development (2014-2020)
December 2014	The General Administration of Customs	The Scheme for the Implementation of "Three-mutual" and Construction and Reform of Faster Going Through Customs
March 2015	The National Development and Reform Commission, Ministry of Foreign Affairs and Ministry of Commerce jointly proposed it	In the Vision and Action for Promoting the Co-construction of The Belt and Road.
2016-2017	The Ministry of Transport of the People's Republic of China	Freight Hub (Logistics Park) Construction Scheme during the "13th Five-Year Plan" Action Plan for Promoting the Construction of Large Logistics Channel (2016-2020)
		Construction Scheme for the Collection and Distribution System for the Ports during the "13th Five-Year Plan"
		Several Opinions on the promotion of Supply-side Structural Reform and "Cost Decreasing and Benefit Increasing" in the Logistics Industry and Opinions on the Implementation of the "The Belt and Road" Proposal and Acceleration of International Road Transport Facilitation

TABLE 2. SUMMARIZATION OF MAJOR POLICIES AND EVENTS TO PROMOTE DRY PORT DEVELOPMENT IN CHINA

Source: own elaboration based on the report from Ministry of Transport (MOT) of the People's Republic of China. (2017).

Number	*Sea port*	*Dry port City*	*Total Import and Export (Hundred Million US Dollars)*	*Number*	*Sea port*	*Dry port City*	*Total Import and Export (Hundred Million US Dollars)*
1		Pinggu, Beijing	**4291**	40		Harbin	65.43
2		Shijiazhuang	140	41		Changchun	204
3		Zhenzhou	427.5	42	**Dalian Seaport**	Jilin	11.02
4		Dezhou	35.38	43		Tonghua	5.82
5		Huinong, Shizuishan	4.77	44		Shenyang	143.3
6		Baotou	21	45		Tongliao	2.00
7		Taiyuan	91.63	46	Yingkou Seaport	Shenyang	143.3
8		Anyang	18.67	47		Shangrao	31.8
9		Zhangjiakou	3.88	48		Tanying	44.21
10		Yinchuan	24.1	49		Nanchang	97.22
11		Zibo	90.1	50		Yiwu	186.1
12	**Tianjing Seaport**	Chaoyang, Beijing	**4291**	51	**Ningbo Seaport**	Shaoxing	333,7
13		Hebi	264	52		Quzhou	37.76
14		Huhehaote	15.99	53		Jinhua	342.75
15		Xingtai	18.31	54		Yuyao	83.24
16		Chifeng	11.68	55		Xiaoshan	140.80
17		Handan	36.1	56		Xiangyang	16.2
18		Bayanzuoer	14.3	57		Sanming	16.32
19		Hanzhong	0.73	58		Nanchang	97.22
20		Baoding	51.7	59		Ganzhou	33.02
21		Jiayuguan	8.28	60		Ji'an	35.62
22		Erlianhaote	36.5	61		Yingtan	44.21
23		Dulata, Xinjiang	98.11	62	**Xiamen Seaport**	Xinyu	20.7
24		Urumqi	77.98	63		Dehua	2.15
25		Xi'an	179.82	64		Nanan	21.26
26		Zibo	90.1	65		Nanping	16.7
27		Luoyang	17.95	66		Jinjiang	89.57
28		Zhengzhou	427.5	67		Longyan	32.58
29		Chengdu	505.8	68		Kunming	174.2
30	**Qingdao Seaport**	Lanzhou	40.63	69	**Guangzhou Seaport**	Heshan, Jiangmen	197.3
31		Urumqi	77.98	70		Guiyang	63.18
32		Xi'an	179.82	71		Hengyang	18.14
33		Taiyuan	91.63	72		Changsha	98.93
34		Houma	5.42	73	**Shenzhen Seaport**	Chenzhou	38
35		Qingzhou	4.8	74		Ji'an	35.62

Number	Sea port	Dry port City	Total Import and Export (Hundred Million US Dollars)	Number	Sea port	Dry port City	Total Import and Export (Hundred Million US Dollars)
36	**Rizhao Seaport**	Linyi	94.1	75		Ganzhou	33.03
37		Juxian	62.3	76		Nanchang	97.22
38	**Lianyungang**	Houma	5.42	77	**Zhanjiang Seaport**	Yongzhou	4.5
39		Luoyang	17.95				

TABLE 3. THE DISTRIBUTION AND TOTAL EXPORT AND IMPORT VOLUME OF MAIN INTERNATIONAL DRY PORTS IN CHINA

Source: own elaboration based on the report from Ministry of Transport (MOT) of the People's Republic of China. (2017).

2. Russia

Due to the continuous increase in container ship sizes, the volumes of container transport back and forth the inland production and distribution center greatly grow. In the east of Russia, one of the key drivers of container transport is China's imports to Russia (21.3% of all Russian import container transports). The new transport lines connecting China, Russia and other countries in the Asia-Pacific region was operated by the Far East Railway (Korovyakovsky and Panova, 2011). Currently, there are three principal Russian container gateways, which is shown in Figure11. The dry ports serve as the custom clearance depots located inland around major seaports Port of Saint-Petersburg, Port of Vladivostok, and Port of Novorossiysk in Russia. Four inland terminals: Voskhod, Interterminal-Predportovy, Predportovy Distriport, and Shushary Distriport are located in close geographic proximity to Russian paramount container port of Saint Petersburg which is considered as a pilot of the dry port concept. The Novorossiysk seaport is serviced by the inland terminal Ruscon and the Yuzhniy Primorsky Terminal project is proposed to cooperate with the seaport in Vladivostok (Korovyakovsky and Panova, 2011).

3. Europe

Poland-The dry port in Poznan locates on the core trade line between Berlin and Moscow and is a key hub for handling cargo from Germany and other Western European markets. Based on Andrzejewski and Fechner (2012), The main factors of Poznan's dry port' success are its preferably strategic location in relation to the key regions, its sufficient capacity to handle huge container volumes, and the support from railway infrastructure. At present, Poznan's dry port deals with about 150,000 TEU per year by rail transport, however, as Germany's auto components exports to China continue to grow, Poland arises as the automobile manufacturing center in Eastern Europe, and trade volumes is forecasted to increase (Liuima, 2014).

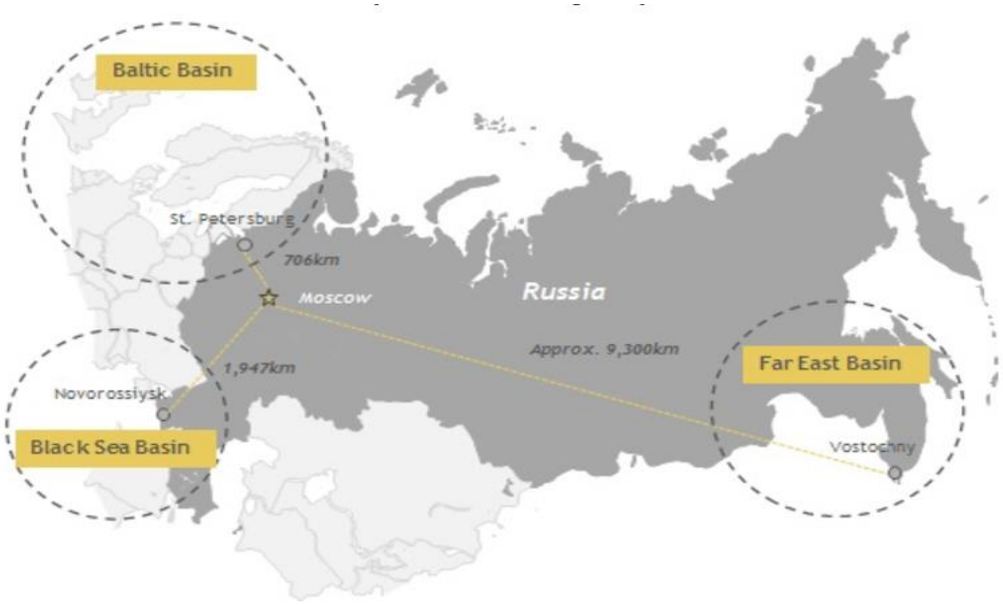

FIGURE 11. KEY RUSSIAN CONTAINER GATEWAYS
Source: Globalports.com. (2017)

Another important one is PKP CARGO's dry port in Małaszewicze (where rails of the two different gauges - 1520 mm and 1435 mm – meet) located on the Polish-Belarussian border. There are 7 reloading terminals (each adjusted to various types of freight) to reload all cargoes transported by the railways, Terminal Małaszewicze I II III, Terminal Raniewo, Terminal Kowalewo, Terminal Wólka, and Terminal Podsedków 2 (Figure 12).

FIGURE 12. THE MAP OF DRY PORT IN MALASZEWICZE
Source: Malaszewicze.3i.pl. (2017). Polish National Railroads.

Germany-In Germany, as one of the principal crossroad of the Silk Road, the dry port of Duisburg handle more than 3 million of containers and 130 million of tons of commodities annually. From the beginning of Chongqing - Duisburg route in 2001, more and more Chinese trains need to be handled at rail-based dry ports. In the long run, Germany's ambition is to expand the cargo freight by rail transportation, making it a competitive alternative to other modes of transport (Cmacgm-log.com, 2017).

Spain-Due to the liberalization of railways in Spain, the Continental Rail as one of the privately-owned operators has captured all of the Maersk traffic from Valencia seaport to Coslada inland terminal (Madrid) by cooperating with dry ports (about 40% in 2010) (Monios, 2011). Dry Port Madrid in Coslada was operated in 2000, which reduced transport costs, environmental impact and congestion at the seaports as well as created new jobs.

Except the Madrid Dry Port, Azuqueca de Henares dry ports opened in 1995, where ownership of Gran Europa is 75%. Another one is Dry Port Santander-Ebro (in Zaragoza area) which is started in June 2000.

Sweden-In 2010, the Port of Gothenburg and dry ports in Scandinavia are the central components of the Scandinavian shuttle system consists of 26 dedicated services for 23 dry ports, like railway ports (Almotairi, Floden, Stefansson, & Woxenius, 2011). Eskilstuna Dry port is the first multimodal terminal in Sweden to officially begin using the term dry port, which was settled up in 2002. Another important dry port is in Hallsberg, Sweden, which handled 65 000 TEU annually.

Netherlands-In the Netherlands, two main economic centers: Emmen and Coevorden are located in the Southeast Drenthe (SE Drenthe) region. Under the EU Interreg IVB project Dryport 5 , Emmen and Coevorden have made significant progresses in the sustainable development of dry port activities and operations.

France-In October 2000, Dry Port Dunkerque (DPD) was put into use as the on-dock intermodal terminal in Dunkerque. The Port of Dunkirk Authority (PAD), NFTI container terminal operator IFB, and the French rail track authority (RFF) jointly invested EU€ 8.2 million into this project (Worldcargonews.com, 2000).

Czech Republic- At present, the Czech Republic has no mature dry port.

[5] "Dryport – a modal shift in practice" is a three-year public/private sector project set up with Interreg IVB North Sea Region funding to examine the way in which inland multimodal freight transport hubs can best operate to cope with current and future traffic flows and the challenges of port congestion. The project was launched in Gothenburg in September 2008.

4. **Other involved countries**

Kazakhstan-The main route from Kazakhstan to China is connected by the Khorgos Gateway which has a crucial geostrategic location. The major parties included in this gateway project are the dry port in the Khorgos-East Gates free economic zone as well as exchange railway stations on both side of the border. (Marco Hernandez, 2017). This kind of Interconnection port contributes to making the global market more efficient and building partnerships between countries that wish to ameliorate their forms of commerce.

Belarus-In 2005, the railroad logistics center in Kolyadichi was upgraded into dry port, connected by transport infrastructure to the nearby seaports. Today, the Kolyadichi dry port provides processing and transshipment services of cargo to the regions of Belarus, and also the CIS countries, Baltic states and abroad through railways and highways (Belarus news, 2015).

FIGURE 13. KHORGOS - ONE OF THE WORLD'S BIGGEST DRY PORT
Source: Marco Hernandez (2017)

2.4 Summary quantitative statistics

From the above paragraphs, we can distill two important pieces of information that we will use in the quantitative analysis in Chapter4. First, the countries that this analysis should focus on (Section 2.3.2), given the OBOR initiative in general and China-Europe railway express initiative as our special focus. Second, the share of trade

going through the China-Europe railway system as part of total trade. This part is crucial because it is this share that will be affected by dry-port and transport infrastructure investments. The results are summarized in Table 4.

Country	*Total export value (USD million)*	*Total exports via CER (USD million)*	*Share of exports going via CER (%)*	*Total import value (USD million)*	*Total imports via CER (USD million)*	*Share of imports coming via CER (%)*
China	2,273,468	517,314	22.8%	1,679,564	325,458	19.4%
Russia	343,908	46,434	13.5%	182,782	28,190	15.4%
Poland	194,461	20,680	10.6%	189,696	29,365	15.5%
Germany	1,328,549	127,500	9.6%	1,057,616	57,983	5.5%
Spain	278,122	3,729	1.3%	305,266	3,243	1.1%
Sweden	140,001	22,094	15.8%	138,365	5,222	3.8%
Netherlands	473,834	27,046	5.7%	424,851	9,463	2.2%
France	493,941	16,553	3.4%	563,398	13,025	2.3%
Czech Republic	157,194	18,838	12.0%	140,716	27,487	19.5%
Kazakhstan	45,954	10,745	23.4%	30,567	9,264	30.3%
Belarus	26,660	5,101	19.1%	30,291	6,280	20.7%

TABLE 4. COUNTRY SELECTION AND SHARE OF TRADE GOING THROUGH THE CHINA-EUROPE RAILWAY IN 2015.

Source: own elaboration based on various source

Chapter 3 Analysis of Investment effects and Empirics

3.1 Impacts of Investments on cost savings, productivity and effectiveness

The importance of infrastructure for productivity, costs and effectiveness is widely discussed in the literature (Aschauer, 1989; Day and Zou, 1994; Ferreira and Issler, 1995).

3.1.1 The effect of investments on costs

Bougheas, Demetriades and Morgenroth (1999), on the basis of the development of a gravitational model, examined the role of infrastructure in a bilateral trade model with transport costs, which shown that for some relatively high levels of infrastructure, in terms of higher trading volume, the benefits of additional investments outweigh the losses of the final output. Therefore, the construction and improvement of infrastructure could lower transport costs with all trading partners. The benefits of investment are multilateral. Moreover, differences in the quantity and quality of infrastructure may lead to differences in transport costs, leading to variations in competitiveness (Ismail and Mahyideen, 2015). Investment in achieving better transport services and infrastructure could increase trade flows and reduce cost for several parties.

To assess the desirability of an investment project, cost benefit analysis (CBA) is usually utilized by governments and private sectors. Lindfors (2013) assessed the Umeå Luleå (Sweden) railway project and the results are listed in the Table 5 below.

Umeå Luleå Railway Project in Sweden	
The investment cost (US$ million)	*2,633*
The first year of the price-level in the assessment	2010
Cost reduction impacts from the CBA per year in 2020	
Infrastructure maintenance cost savings (US$ million)	11.8
Operational and time cost savings for goods transport operators (US$ million)	32.1
Benefits for passenger transport operators (US$ million)	6

TABLE 5. CBA RESULTS OF THE INVESTMENT OF UMEÅ LULEÅ RAILWAY PROJECT
Source: own elaboration based on data from Lindfors (2013)

The macro econometric models are used to analyze the economic impacts of a main capital investment plan. According to the estimation of the number of truck trips diverted to rail by Florida Department of Transportation (FDOT) (2009), freight rail

improvements achieve economic benefits in two perspectives: lower the cost of shipping by rail and reduce highway congestion. The total estimated investments, the reduction of truck miles travelled in Florida and cost savings for shippers are shown in Table 6 below.

Year	*Project*	*Investment (USD billion)*	*Reduced Truck-miles (millions)*	*Shipping cost savings for Florida businesses (USD million)*
2008/09	Southwest Florida Rail Corridor ROW	3	29.7	167.3
2009/10	Hypoluxo Villa Rica double track	11	30.9	187.7
2010/11	Southwest Florida Rail Corridor	0.863	32.2	273.2
2011/12	Amelia River Bridge Rehab	2.267	68.4	284.7
	Magnolia North Double track	1.662		
	Westlake Lacy Traffic Control	6.228		
	Pineda Causeway Grade Separation	26.160		
Total		**51.18**	**161.2**	**912.9**

TABLE 6. IMPACTS OF FLORIDA'S FREIGHT RAIL PROJECTS INVESTMENT
Source: own elaboration based on data from FDOT (2009)

3.1.2 The effect of investments on productivity and efficiency

There is a lot of economic evidence demonstrating that public investment is an important long-term driving force for productivity growth. The investments in constructions and improvements of transport infrastructure could reduce transport costs as well as lead to a decrease in enterprises' input costs, thereby enhance factor productivity. Decision makers and transport planners are increasingly considering the productivity effects of transport investment in CBA practice (Melo, Graham and Brage-Ardao, 2013). However, the most useful investigations of the economic impact of transport infrastructure is largely dependent on traditional literature reviews techniques (Gillen, 1996; Jiang, 2001). For freight shipment, reducing the time of delivery of goods through infrastructure investment may bring additional benefits and gain economic efficiency. On the other hand, improving the reliability of transport may result in tighter scheduling, thereby increasing productivity (Kernohan and Rognlien 2011).

Based on the meta-analysis results from Melo, Graham and Brage-Ardao (2013), on average, a rise of 10% in public investment in transport infrastructure accompanied

by an increase in output of about 0.5% in productivity. In addition, here are some empirical evidence about impacts of investment in dry port on trade volume.

According to the research studied by Panova and Hilmola (2015), a subsidiary of the Russian Railways can enlarge its share in handling harbor container traffic by utilizing the concept of dry port with US$ 901 million. The study results showed the potential productivity growth is from the present 22% in 2015 and the existing growth rate of 16% to the volumes comparable to road transport (64% and 70%, separately).

In October 2002, Beijing Chaoyang port with the nature of the dry port, as a precedent in China, directly connects with Tianjin port. In the first year of the implementation with estimated investment of US$ 32 million, the volume of containers is doubled to 76,700 TEUs over the previous year. Until 2006, the Container shipments had developed to 93,094 TEU and the cargo-handling capacity had reached to 704,600 tons.

3.1.3 The effect of investments on customs procedures and effectiveness

The trade facilitation is partially defined as the systematic rationalization of customs procedures and documents, which also includes all measures that affect the shipment of cargoes between customers and suppliers of the complete international supply chain (ADB 2009, UNESCAP 2009). The railway and port infrastructure construction discussed in this paper is often referred to as a hard infrastructure or physical infrastructure. the level of customs procedures efficiency and the time of customs clearance are treated as the part of soft infrastructure. Some “hidden” costs (as much as 15% of the value of the goods in some cases) of trade due to the inefficient border procedures have negative impact on governments, businesses, consumers and the whole regional economy. Studies show that-for some countries-the welfare benefits resulted from more effective customs procedures could be as high as those from reducing tariffs (OECD, 2005).

Organization for OECD has developed a series of trade facilitation indicators (TFI) to improve border customs procedures, reduce trade costs, and achieve more trade flows. And then OECD calculated the potential benefits of Trade Facilitation Agreement for three main groups of countries split by economic development, which are Low income countries (LICs), Lower-middle income countries (LMICs), and Upper-middle income countries (UMICs).

Two different scenarios are used to measure the upper and lower limits of the potential trade cost reductions implemented by the agreement - a “full” implementation scenario and a “limited” implementation scenario. OECD TFI data show that the simplification of trade documents; automation of the border customs

process; and streamlining of border procedures appear to have the greatest influence on trade costs, saving cost of 2.4% to 4.2% depending on the various level of development (OECD, 2015). The Overall potential trade cost reductions by three groups are concluded in Table 7.

Different income-level countries	*Overall Trade Costs Reduction (%)*	*Simplification of trade documents (%)*	*Automating customs processes (%)*	*Streamlining of border procedures (%)*
Low income countries (LICs)	12.6-16.5	**4.2**	3.5	2.4
Lower-middle income countries (LMICs)	13.7-17.4	2.8	**3.9**	**3.6**
Upper-middle income countries (UMICs)	12.8-14.6	3.6	2.9	2.8

TABLE 7. THE SUMMARIES OF POTENTIAL TRADE COST REDUCTIONS (%)
Source: own elaboration based on data from OECD (2015)

From 2002 to 2013, approximately US$ 2.3 billion financial assistance has been expanded in aid for trade facilitation. Among this, the commitment for simplifying trade documents and automating customs processes had reached US$ 670 million and US$ 1 billion respectively in 2013. Furthermore, around US$ 630 million disbursement were spent to streamline border procedures until 2013.

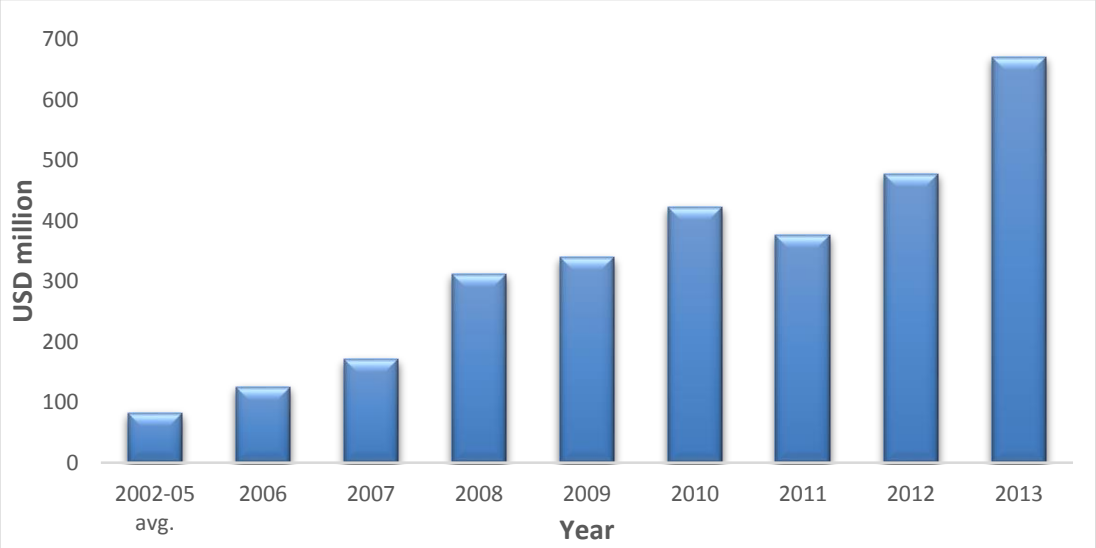

FIGURE 14. TRADE FACILITATION ASSISTANCE COMMITMENTS 2002-2013
Source: OECD-DAC aid activity database (CRS)

3.2 Empirical evidence of Chinese dry port investment

In recent years, China has gradually attached importance to the development of dry ports. On the one hand, most ports in China have fallen into a terrible circumstance which is the cargo and container throughput reduction in 2009 (Wilmsmeier, Bergqvist and Cullinane, 2013). The alternative application of dry port ensures the accessibility to hinterland and attracts more cargo flow because the dry port has the same functions as a seaport, which brings more trade opportunities to inland cities. On another hand, one of the features of the Chinses economy is regional disequilibrium. The coastal areas of the southeastern regions have been economically developed, whereas the economy of northwest inland regions is relatively backward. The dry port is a crucial measure to reduce regional resource differences, cut down geographic distance to markets and eliminate the economic imbalance in China (Wilmsmeier, Bergqvist and Cullinane, 2013).

1. Seaport-based dry ports: Shijiazhuang dry port

Tianjin Port is the largest comprehensive port in northern China, trading with more than 180 countries and regions as well as more than 500 ports.

Shijiazhuang dry port as the largest international logistics area in North China, with ports, international container multimodal transport, transshipment, third-party logistics and other functions, to achieve the extension of the coastal ports and border ports to the hinterland. In 2006, Henan Highway Port Authority and Tianjin Port Group Co., Ltd signed a joint venture project of Shijiazhuang dry port construction; it began operations in 2006. The land area of facilities is 26.2 Ha with a total investment of 268 million Yuan **(US$ 40.12 million)** (SIPC, 2009).

After the completion of the first and second construction phases, its main services contain storage, distribution, cargo consolidation, freight forwarding, export declaration, intermodal transfer, and bonded warehouse. After 2011, improving the accessibility of railways and roads, capacity and ancillary facilities building were the central tasks of the third phase. Simultaneously, the support from both the provincial and municipal governments have laid a solid foundation for the success of this project. The benefits brought by Shijiazhuang dry port are explained as the following aspects.

- **Cost reductions**

It not only can improve the real load rate of the containers from Tianjin port, but also can reduce the transportation and logistics cost for enterprises. According to the report from Shijiazhuang Daily (2007), cost reductions can achieve 300 Yuan per FEU and 200 Yuan per TEU, separately. Furthermore, the Integrated logistics costs fell by 20%.

- **Increase coastal port capacity and productivity (container flows)**

As an extended gateway for Tianjin port, the development of Shijiazhuang dry port has already enabled Tianjin port to increase their export volumes from Huabei province, a main industrial province in China (Beresford et al., 2012).

According to statistics, in 2013, Beijing-Tianjin-Hebei regional container supply has accounted for more than 80% of Tianjin Port. Among them, the dry port for the Tianjin Port brought 282,000 TEUs of goods, an increase of 45% compared to 2012. These dry ports have become the gateway and important platform of regional development.[6]

- **Simplify customs clearance procedures and improve customs efficiency**

In the past, the local enterprises need go to Tianjin Port for customs clearance procedures, or go to Tianjin port for customs clearance after the declaration in Shijiazhuang. No matter through which way, the staff must travel between the two places. Now with the dry port, the enterprise can handle customs clearance nearby and does not need to run back and forth, so that "once declaration, once check, once release", the goods are shipped directly to the port of Tianjin after the departure of goods for the first time on the spot customs clearance, greatly saving time and costs. As a result of the one-stop completion of customs clearance procedures in the Shijiazhuang dry port, the time for tax reimbursement can be decreased from 20 to 7 days (Liping, 2009). The operational data show that the operating hours of the dry port logistics, the central region shortened 1-2 days, the western region shortened 3-4 days.

2. Border Dry Port: Kunming Dry Port

The Kunming dry port, firstly was operated in 2009, is a section of an Export Processing Area within Kunming National Economic and Technological Development Zone (KETDZ) with a total area of 47.33 Ha and the total investment is around 26 million Yuan **(US$ 3.89 million) (FIL, 2010).** In addition, it is located in Yunnan Province, near Southeast Asia and South Asia (via the Lancang River and Mekong River), bordering Laos, Vietnam and Myanmar. The main services contain domestic trade, material distribution, international distribution, value-added services, cargo loading, storage, tallying and bonded logistics (Beresford et al., 2012).

The project set up branches in the economic development zone through the introduction of ports, docks, shipping companies, freight forwarding and shipping agents, in order to take delivery of goods, return containers, and issue the multimodal transport bill of lading. So that the importers and exporters in Kunming can complete the booking, customs declaration, export tax rebate and other procedures in the local to saving time costs.

[6] http://news.hsdhw.com/175594

The whole operation of the KETDZ is supervised by the government, thus the investment in dry port is directly supported by the government. The dry port ‘s operator is Yugang Logistics Company, which is s a joint venture with the private sector (Beresford et al., 2012). Local governments had tried to attract more private and foreign investment to promote local trade and logistics development and total foreign investment has reached more than 170 million Yuan **(US$ 25.42 million)** in 2010 **(KETDZ, 2010).**

Time and Cost reductions

- For Yunnan Province, through the dry port’s customs clearance, reducing the logistics link, the standard cost per container can be reduced by about 2%.
- It is estimated that since December 27, 2014 opened jointed transportation between sea and railway fast train through Kunming Taohua Village, domestic trade goods delivery time shortened by 50% compared with the traditional logistics model, the reduction of logistics costs is about 9.2%; international trade goods Delivery time reduced by 15%, logistics costs fell by an average of about 2.3%.[7]
- "Multi-point declaration, inspection and cargo release in the port" customs supervision model simplifies the customs procedures, improve the efficiency of customs clearance.
- The efficiency cost savings of 5500 Yuan per TEU can be achieved through better coordination of container shipment after Yugang Logistics Company applied a holistic approach **(Yunnan, 2010).**
- In 2001, the foreign trade turnover in Kunming was more than US$ 12 billion, an increase of 20% compared to the volumes in last year. [8]

3. Other examples of dry ports in China

Shangrao dry port as the first "dry port" project was a significant port logistics platform as well as the result of strategic cooperation between two cities Ningbo and Shangrao. It is located on the north side of the new railway station in Shangrao New District, with a total area of 17.6 Ha and a total investment of 137 million yuan (US$ 20.48 million). Since its first operation in December 2009, Shangrao dry port use the advantages of low cost and high-quality service as the starting point, relying on convenient road and rail transport to solve the bottleneck of import and export cargo transport, to achieve the "inland extension" of coastal port's function. With continuous improvement of Shangrao dry port, it can provide "one-stop" services for Shangrao enterprises to help enterprises save 20-30% of the logistics costs. In 2015, it completed the business volume of 120,126TEU, an increase of 62.05% than 2014 due to an increase of US$ 30.12 million investment; sea-rail combined transportation of 270,18TEU, an increase of 31.12%.[9]

[7] http://www.shisc.net/p/archives/19977
[8] http://www.tieyang.com/about-1-10-24-484-1.aspx
[9] http://www.sohu.com/a/73046485_362103

3.3 Investment flows of key countries involved

3.3.1 Investments in Railway transport

The capital investments on infrastructure have always been a driving force for national economic and trade development (Esipova, 2011; NACO, 2014). For example, in order to stimulate the economic stagnation crisis, the Spanish central government preferably provided financial support and tax incentives on transport-related infrastructure projects and activities. Additionally, the Czech Republic's National Anti-Crisis Program increased the investment in transport infrastructure to mitigate the adverse effects of the global crisis in 2009 (Kuznetsov & Khesin, 2013). In the United States, the immediate reaction to the economic crisis was also an investment in public infrastructure, which aimed at expanding the long-term production capacity of the economy (Heintz, Pollin, & Garrett-Peltier, 2009).

At least since Aschauer (1989), It is very important to realize the scale and significance of the impact of public infrastructure investment on the economic performance of the private sector. Emeritus and Jean Monnet Professor emphasizes the existing interrelationship between infrastructure and economic activity: the economic impact that began at the construction stage and the economic effects that go up in the infrastructure usage phase (Izquierdo 2004). Dr. Jeffrey Delmon, senior infrastructure specialist of The World Bank, indicated in his that, “Poor infrastructure impedes a nation’s economic growth and international competitiveness” (The World Bank 2006). The investment on in infrastructure is one of the major mechanisms to enhance income, employment, productivity and economic competitiveness (Government of Puerto Rico, 2011). The financial support and investment on transportation infrastructure plays a vital role in promoting prosperity, economic growth as well as productivity for the countries and regions along SREB. Previous studies have discovered that trade infrastructure is associated with development, since it narrows income inequality and poverty (Calderón & Servén 2004; Seneviratne & Sun 2013), ameliorates the external trade balance (Celbiş et al. 2014).

Therefore, the cross-border infrastructure investment is the core Chinese project under OBOR. One of the financial support is from the Asian Infrastructure Investment Bank (AIIB), a new development bank proposed by Chinese President Xi Jinping in 2014 to raise the standard of infrastructure construction financing in Asia and enhance economic integration as well as regional connections. Financially, Ning Jizhe, the vice-chairman of NDRC said China Development Bank (CDB) and the Export-Import Bank of China have extended US$ 110 billion in loans for Belt and Road (B&R) projects by the end of 2016 and China has signed currency swap deals with countries along the B&R routes in a total amount of 900 billion yuan (The Economic Times, 2017). Chinese Vice Minister of Transport declared on December 29, 2016 that China plans to invest 3.5 trillion yuan on railways construction during the 13th plan Five-

Year Plan period (2016-2020). As China has recently explained, the goal of the US$ 900 billion scheme is to kindle a "new era of globalization", which will benefit all parties that are involved in this golden age (Bruce-Lockhart, 2017).

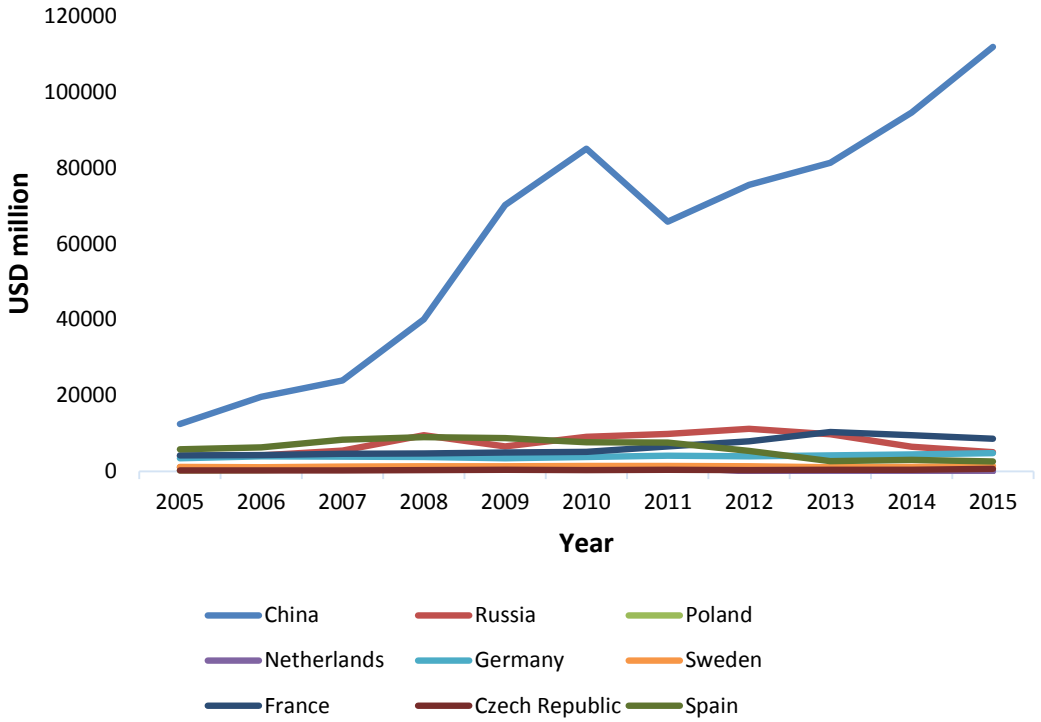

FIGURE 15. NATIONAL INVESTMENT IN RAIL INFRASTRUCTURE, SELECTED COUNTRIES, 2005-2015

Source: own elaboration based on data from OECD (2017), Infrastructure investment (indicator). doi: 10.1787/b06ce3ad-en (Accessed on 19 July 2017)

According to OECD, Figure 15 and 16 show the investment flows (EU € million from 2005 to 2015 in concerned countries.

From the graph above we can see that China invested a much larger amount in railway transportation in the last decade, which was far more than other countries. In addition to a slight fluctuation in 2011, the overall trend was rising and reached around EU € 111,893 million in the end of 2015. Driven by recently positive policies, China will continue to strengthen its investment in railway infrastructure. According to a statement issued by China Railway Corporation (CRC) on Jan 3, 2017, the central government has assigned a budget of 800 billion yuan (US$115 billion) to realize the goals of promoting investment, expanding the network and increasing the amount of scheduled trains (Xinhua, 2017). Fallon (2015) presents that the investments required for infrastructure development will reach US$ 8 trillion by 2020. Until now, 57 countries have signed up as members, including 37 in Asia and 20 non-regional countries (Chen, 2017).

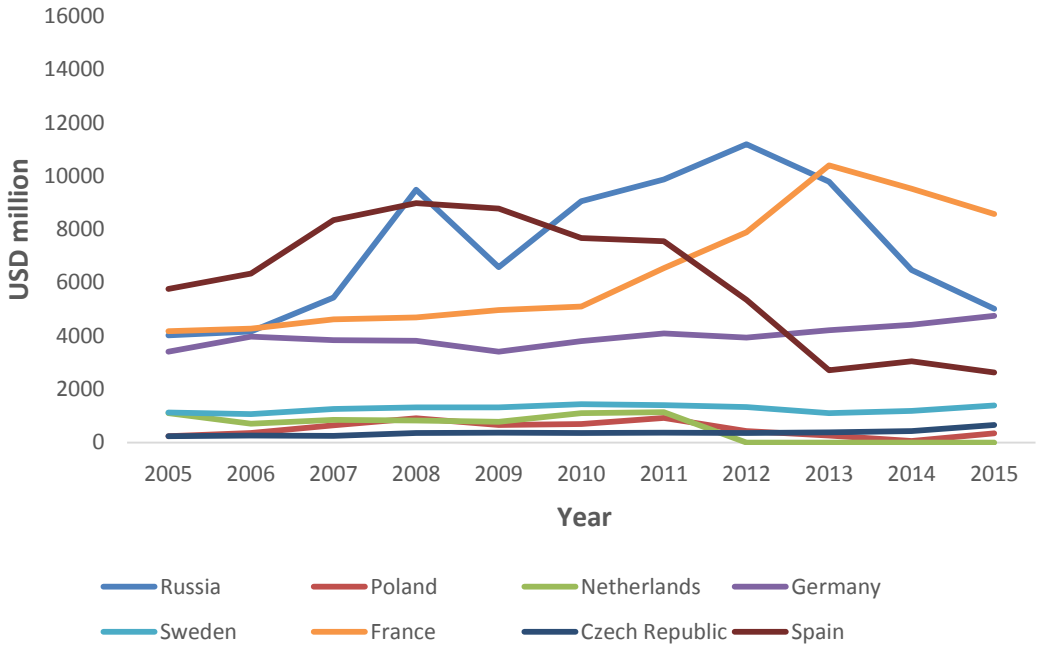

FIGURE 16. NATIONAL INVESTMENT IN RAIL INFRASTRUCTURE, SELECTED COUNTRIES (EXCEPT CHINA), 2005-2015

Source: own elaboration based on data from OECD (2017), Infrastructure investment (indicator). doi: 10.1787/b06ce3ad-en (Accessed on 19 July 2017)

The second group followed China includes Russia, Spain, Germany and France. Among them, Germany's investment trend is relatively stable, while the other three European countries presented significant fluctuations. The investment range is between EU € 2,500 million and EU € 12,000 million every year.

Poland, Sweden, Netherlands and Czech Republic formed the third investment group where the investment fund is below € 2,500 million per year. Between 2005 and 2015, the investment flow in third group was comparatively steady with small disparities within the group.

Additionally, according to Asian Development Bank (ADB) (2017), there are three Railway Investment Projects with an implementation period from 2017 to 2020 in Kazakhstan, which are Electrification of Almaty– Aktogay Railway Section, Electrification of Dostyk– Aktogay Railway Section, and Electrification of Aktogay–Mointy Railway Section, with a total investment of US$ 1,604 million. In April 2013, The European Bank for Reconstruction & Development (EBRD) provided a senior loan with two extensions and the entire amount was around EU€ 26 million (US$ 31 million). Furthermore, in 2014, Stadler had invested EU€ 73 million (US$ 87 million) in Minsk plant in Fanipol (Belarus) to manufacture trains and support the development of modern facilities (Gruntov, 2014).

3.3.2 Investment in dry port related projects

The construction and expansion of dry ports requires substantial financial support. The way in which dry port is owned and managed reveals that it has the potential to be evaluated as new market opportunities and to invest accordingly. The possession and the administration of a dry port can be in form of public, private or a combination of both, like Public – Private Partnerships (PPPs) (Rodrigue and Notteboom, 2012). In most instances, the large private investors will afford a considerable risk because the dry port need a lot of capital investment in their initial stage while the reciprocation is slow.

Prior to the study of Vandervoort, C. and Morgan, M. (1999), the dry port must be part of a multi-party system in which the necessary infrastructure (roads, railways) exists, maintenance is ensured, legislative systems and the regulatory institutions are treated as optimizing the contribution of both the public and private sectors. Many examples around the world indicate that the private sectors are involved in the development of infrastructure (ie, dry ports), through PPPs[10], reducing the negative impact of investment deficits ((Bergqvist et al.,2010; Van den Berg & Langen, 2011; Wilmsmeier, Monios, & Lambert, 2011).

❖ **China**

The major compositions of the dry port investors in China are port authorities, local firms, railways enterprises, local government etc. In some cities far from the seaports, railway companies are also involved in the construction and expansion of the dry port, for example the dry ports in Chengdu, Harbin and Urumchi. Furthermore, a few dry ports' investment funds come directly from the local government, for instance in Xi'an and Luoyang. (MOT, 2017). Until March 2017, the total investment in dry port related projects is around 149 billion yuan (US$ 23 billion).

❖ **Russia**

In Russia, the scheme of PPPs can lighten the investment burden associated with the formation of inland rail infrastructure of seaports. In general, the dry ports are set up along the developed transport corridors. Similar fundamental rail co-location approach should be applied in Russia to establish the required terminal and warehousing infrastructure by using PPPs (Panova and Hilmola, 2015). Russian railway companies involved in the exploitation of dry ports projects can not only to guarantee the assistance of the private enterprises, but also can create profit to the both sides.

At the end of 2013, to develop the dry port at Vorsino, the railway, temporary storage warehouses and container terminal were accomplished at the Kaluga Industrial Park.

[10] A public–private partnership (PPP, 3P or P3) is a long-term cooperative arrangement between two or more public and private parties, for providing a public asset or service.

The investment amount is about EU€ 250 million (US$ 296 million) and the prospective terminal's capacity is around 300,000 TEU every year, while due to the transport connection with Kaluga's airport by the end of 2014, the expected freight volumes will surpass one million TEUs per year (Liuima, 2014).

❖ **Kazakhstan**

In 2014, Xi Jinping signed a $ 30 billion investment deal with Kazakhstan. Karl Gheysen, CEO of Holgos Gateway, recalled: "After 2007/8, Nazarbayev began to advocate the idea of restoring the old route of the Silk Road. A substantial US$ 200 million investment into an inland port followed which became operational in 2015, to interconnect the Chinese and Russian railway system. Close partnerships with China were formed, and in December 2016, the 1,000th block train from China arrived in Europe." (Kuester, 2017).

According to Nikkei Asian Review, China Ocean Shipping (Group) Company (COSCO) spends US$ 38 million to insure the Kazakh facility. On 15 May 2017, COSCO Shipping, Lianyungang Port Holdings Group Co., Ltd. (LPH) and Kazakhstan's national railway operator Kazakhstan Temir Zholy (KTZ) jointly signed the tripartite equity transfer agreement on KTZE-Khorgos Gateway, whereby COSCO Shipping and LPH jointly acquired a 49% equity interest in KTZ originally owned equipment (Louppova, 2017). EBRD (2016) invested EU€ 1080.2 million (US$ 1281 million) in infrastructure projects.

❖ **Belarus**

After a makeover in 2015, the railroad logistics center in Kolyadichi near Minsk cooperates has been transformed into a seaport-based dry port. This is one of the foremost projects for the Belarusian rail transport logistics that brings new opportunities in developing export and import cargo transportation, especially along the Belarusian-Chinese route (Railway PRO, 2015). To attract more customers, it provides direct fast container trains and implements new projects, with an expected investment about US$ 288 million (Rw.by, 2015).

❖ **European countries**

- **Poland**

In accordance with previous practices in Poland, investments in dry port infrastructure are provided by the private sector, whereas the investments in new road and rail track connected with dry port are financed by the public sector. Thus, a synchronous cooperation platform of private and public investors is necessary. Dry port Poznan is a classic example of a distant dry port that supports supplies reaching Polish market from the North European ports and neighboring countries, with an investment of US$ 950 million (Andrzejewski and Fechner, 2012).

- **Germany**

To increase the efficiency of the port of Hamburg, Hamburg Port Authority (HPA) planned to construct a second railway track and a dry port in the inland of Slovenia to relieve capacity pressure on the port of Koper and the existing single line (Biermann and Wedemeier, 2016). More than EU€ 140 million (US$ 166 million) and EU€ 226 (US$ 268 million) had been investment in Koper's port facilities improvement and dry port located at Divača, respectively[11].

- **Spain**

Recently, Spain's leading port operator Noatum Ports confirms a cooperation agreement with Chinese COSCO Shipping Ports Limited for the transfer of 51% of Noatum Ports, which will increase cargo throughputs in the ports as well as improve the service levels to customers in ports of Valencia and Bilbao (Louppova, 2017). The COSCO Shipping Ports obtained a majority stake in the Spanish container and rail terminal operator Noatum Ports for US$ 228 million (Mooney, 2017).

- **Sweden**

The Swedish Transport Administration underlines that intermodal terminals and dry ports are crucial to facilities' future increase of rail freight, while realizing the importance of a stable cooperation between public and private sectors to ensure the efficiency and sustainability (Banverket, 2010; Wilmsmeier, Bergqvist and Cullinane, 2013). It is worth mentioning that the Swedish state freight carrier Green Cargo recently invest more than US$ 560 million in several new services to provide more options for Swedish companies to choose environmentally-friendly railway transportation and dry port services. (Weedy, 2017).

- **Netherlands**

The Dutch port as the Europe's largest gateway focuses more on dry port and inland terminal development to ensure an efficient intermodal container transport network. The direct investment in hinterland Dry Port Emmen-Coevorden from Dutch government is more than US$ 1.6 billion (Bozuwa et al., 2009).

- **France**

In France, the inland Dry Port of Lyon, a partnership initiated between the port of Marseille and the river port Edouard Herriot in Lyon handle a throughput of over 100 000 TEUs annually, with an estimated investment of EU€ 60 million (US$ 71 million) (Brooks, Pallis and Perkins, 2014). Moreover, in 2000, An EU€ 8.2 million (US$ 9.7 million) investment program in Dry Port Dunkerque was undertaken jointly by the PAD with other private investors.

[11] https://www.rvo.nl/sites/default/files/2015/10/Slovenia,%20%20Kansen%20Logistic%20and%20Transport%202015.pdf

Czech Republic- Currently, there is no mature dry port projects in Czech Republic

3.4 Summary of quantitative statistics

Dry ports have far-reaching significance to improve the investment environment of inland hinterland and promote regional economic growth.

The operations of dry ports mitigate congestion and prolonged dwell times for containers as well as solving the crowded problems in terminal due to the sharply increasing container flows. As the inland port has the advantage of creating job opportunities for public and making better use of the regional transport infrastructure, the local government considers it as a project of public benefit. A well-established concept of dry can help determine methods to shift freight volumes from road to more energy-efficient and environmentally friendly way, such as railway transport, reduce traffic congestion in harbor cities, efficiently handle cargoes in seaports and provide beneficial logistics solutions for shippers in the port's hinterland (Roso, Woxenius, & Lumsden, 2009).

However, there are no relevant literatures study the impact of investment in railway infrastructure and dry port by using specifically quantitative analysis. Therefore, we refer to a few of studies about the impact of investment levels on productivity, efficiency and trade costs, which are summarized in Table 8. Besides that, the summary of Chinese dry port's case studies is displayed in Table 9.

Project	Investment (USD billion)	Time (year)	Operational and time costs (USD million)	Shipping cost savings (USD million)	
Umeå Luleå Railway Project	2.63	2008-2009	32.1	-	
Southwest Florida Rail Corridor ROW	3	2009-2010	-	167.3	
Hypoluxo Villa Rica	11	2010-2011	-	187.7	

Project	Investment (USD billion)	Time (year)	Operational and time costs (USD million)	Shipping cost savings (USD million)	
double track					
Southwest Florida Rail Corridor	0.863	2011-2012	-	273.2	
Florida's Freight Rail Projects	51.18	2008-2012	-	912.9	
Project	**Investment (USD million)**	***Overall Trade Costs Reduction (%)***	***Simplification of trade documents (%)***	***Automating customs processes (%)***	***Streamlining of border procedures (%)***
Trade facilitation (OECD)	2,300	12.6-17.4	-	-	-
	670	-	2.8-4.2	-	-
	1,000	-	-	2.9-3.9	-
	630	-	-	-	2.4-3.6
Melo, Graham and Brage-Ardao (2013): a rise of 10% in public investment in transport infrastructure accompanied by an increase in output of about 0.5% in productivity.					

TABLE 8. SUMMARY OF QUANTITATIVE DATA ON PRODUCTIVITY, EFFICIENCY, AND COST REDUCTIONS
Source: own elaboration

Year	*Dry port*	*Investment (USD million)*	*Increase of container shipments (productivity)*	*Logistics cost reductions*	*Simplify customs clearance procedures (time saving)*
2002	Chaoyang	32	21.37%	-	-
2006	Shijiazhuang	40.12	45%	20%	31%
2009	Kunming	29.31	20%	Domestic trade: 9.2%	15%

Year	Dry port	Investment (USD million)	Increase of container shipments (productivity)	Logistics cost reductions	Simplify customs clearance procedures (time saving)
				International trade: 2.3%	
2009	Shangrao	20.48	62.05%	20%-30%	-
2015		30.12	31.12%		-

TABLE 9. SUMMARY OF DRY PORT RELATED EMPIRICS IN CHINA

Source: own elaboration

Additionally, based on data collection in Section 3.3, we concluded the recent investment flows of concerned countries in the Table 10 below.

Countries	Railway investment (USD million) (2015)	Investment in Dry port related projects (USD million)
China	111,893.10	23,000
Russia	5,022.32	296
Poland	340.34	950
Germany	4,750	392
Spain	2,631	228
Sweden	1,387.82	560
Netherlands	1,136	1,600
France	8.569.9	168
Czech Republic	661.24	-
Kazakhstan	1,604	1,318.2
Belarus	118	288

TABLE 10. SUMMARY OF INVESTMENT IN RAILWAY AND DRY PORT RELATED PROJECTS

Source: own elaboration based on various resources

Chapter 4 Methodology Approach

In this Chapter, we work out our quantitative methodological approach. In section 4.1 we select our quantitative model by comparing it to other possible methodologies and choosing the best alternative to answering the research question. In section 4.2, we describe the selected model, the GSIM model in more detail. section 4.3 covers the data collection and data needs. We conclude with section 4.4 in which we develop the scenarios. We will develop different scenarios to simulate different possible future developments.

4.1 Introduction

Many models and methodologies can be chosen to analyse the quantification of the research question. In this section, we discuss three common approaches: the gravity model (Bergeijk & Brakman, 2010), Computable General Equilibrium (CGE) modelling (Partridge & Rickman, 2010) and Global Simulation Model (GSIM) (Francois, 2003).

The gravity model is an econometric model that originates from Newton's Law of Universal Gravitation that any particle in the universe attracts any other particle ((Yotov et al., 2016). Jan Tinbergen (1962) firstly applied the corresponding equation based on the economic size (evaluated by GDP) of two countries and the distance between them to empirically analyze the patterns of bilateral trade flows. To regress the dry port performance on trade flows in our case, we need collect different variables that allow us to look at the productivity, competitiveness, cost base and efficiency of dry ports. However, the collection of this kind of information is limited and the gravity model cannot be used to predict future flows. Therefore, a simulation approach is better for answering our research question.

CGE is also called Applied General Equilibrium (AGE), which has been widely used to analyze policies' economy-wide impact. However, CGE models request a considerable amount of data but have yet to replace other regional models as the standard tool for regional economic development analysis (Partridge & Rickman, 2010). Apart from their complexity, there are some limits appear when research in specific countries or sectors.

In contrast, a partial-equilibrium (PE) model, such as GSIM can capture detailed disaggregated effects as well as short and medium-term effects. In our research, to assess economic and trade impact of investment projects at a combined country and industry level, applied GSIM model could simultaneously estimate trade effects, welfare effects (i.e. producer surplus, consumer surplus) and output effects. Furthermore, we choose GSIM because in combination with literatures this is already

ambitious for a thesis given the time we have; and because in CGE the results will likely be too small to move well outside the error margin of the model.

4.2 GSIM model

To avoid the complexity of global general equilibrium models when modeling trade policy at an industry level, GSIM model utilize a global set of equilibrium prices and a non-linear representation of import demand, combined with generic export-supply equations (See Francois and Hall 2003, 1997). The basic assumption of GSIM model is national product differentiation, which means that imports are imperfect substitutes for each other (Francois and Hall, 2009).

4.2.1 Import demand

Formally, we will specify import demand as the following function:

$$M_{(i,v),r} = f(P_{(i,v),r}, P_{(i,v)s\neq r}, Y_{i,v}) \qquad \text{Equation 1}$$

Where:
$\boldsymbol{M(i,v),r}$ = demand for product i from country r in country v
$\boldsymbol{y(i,v)}$ = total expenditure on imports of i in country v
$\boldsymbol{P(i,v),r}$ = internal price for goods from region r within country v
$\boldsymbol{P(i,v),S\neq r}$ = price of other varieties

Equation 1 describes the import demand M of commodity i in country v from country r. In demand theory, this results from the assumption of weak separability. We presume that Equation 1 follows from CES (Armington) demand for imports. Then, based on the first-order conditions for CES demand functions, we get the following:

$$M\_((i,v),r) = g\_((i,v),r)\text{^}\sigma\ (P\_((i,v),r)/P\_v\ )\text{^}(-\sigma)\ E\_V\ P\_v\text{^}(-1) \qquad \text{Equation 2}$$

Where:
α = the CES expenditure weight
E = the expenditure
P = the CES composite price
σ =is the composite demand elasticity

By applying the Slutsky decomposition of partial demand and taking advantage of the zero-homogeneity property of Hicksian demand, Francois and Hall (2003) derive Equation 3 and 4 by differentiating Equation 1.

$$N_{(i,v),(r,s)} = \theta_{(i,v)s}(E_m + E_s) \qquad \text{Equation 3}$$

$$N_{(i,v),(r,r)} = \theta_{(i,v),r} E_m - \sum_{s \neq r} \theta_{(i,v),s} E_s = \theta_{(i,v),r} E_m - (1 - \theta_{(i,v),r}) E_s \qquad \text{Equation 4}$$

Equation 3 and Equation 4 defines the cross-price elasticity and the own- price demand elasticity, respectively, where $\boldsymbol{E_s}$ is elasticity if substitution and $\boldsymbol{E_m}$ is the elasticity of aggregate import demand in country ***v.***

4.2.2 Individual Demand and Supply Conditions

Next, we need to define composite demand for national product varieties. National supply functions are required to specify full market clearing, where $P_{i,r}$ * is the export price received by exporter *r* on world markets, and $P_{(i,v),r}$ is the internal price for the same good. We use Equation 5 below to link these two prices.

$$P_{(i,v),r} = (1 + t_{(i,v),r}) P_{i,r}^* = T_{(i,v),r} P_{i,r}^* \qquad \text{Equation 5}$$

In Equation 5, T =1+ t is the power of the tariff (the proportional price markup achieved by the tariff t.). The model defines export supply to world markets as being a function of the world price P* (Equation 6).

$$X_{i,r} = f(P_{i,r}^*) \qquad \text{Equation 6}$$

Differentiating Equations 1, 5 and 6, and manipulating the results, Equation 7, 8 and 9 are derived where ^ denotes a proportional change, so that $\hat{x} = \frac{dx}{x}$.

$$\hat{P}_{(i,v),r} = \hat{P}_{i,r}^* + \hat{T}_{(i,v),r} \qquad \text{Equation 7}$$

$$\hat{X}_{i,r} = E_{x(i,r)} \hat{P}_{i,r}^* \qquad \text{Equation 8}$$

$$\hat{M}_{(i,v),r} = N_{(i,v),(r,r)} \hat{P}_{(i,v),r} + \sum_{s \neq r} N_{(i,v),(r,s)} \hat{P}_{(i,v),s} \qquad \text{Equation 9}$$

4.2.3 Global Equilibrium Conditions

From the system of equations above, we are able to solve for equilibrium price. Particularly, we further substitute Equations 3, 4, and 7 into 9, and sum over import markets. For any set of R trading countries, Equation 10 can be used to define S≤R global market clearing conditions where we have R exporters. If we model domestic production, we will have R=S market clearing conditions.

$$\hat{M}_{i,r} = \hat{X}_{i,r} \Rightarrow \quad E_{X(i,r)}\hat{P}_{i,r} = \sum_{v} N_{(i,v),(r,r)}\hat{P}_{(i,v),r} + \sum_{v}\sum_{s\neq r} N_{(i,v),(r,s)}\hat{P}_{(i,v),s}$$
$$= \sum_{v} N_{(i,v),(r,r)}[P_r^* + \hat{T}_{(i,v),r}] + \sum_{v}\sum_{s\neq r} N_{(i,v),(r,s)}[\hat{P}_s^* + \hat{T}_{(i,v),s}] \qquad \text{Equation 10}$$

Where:

$\hat{P}_{i,r}^*$= internal price for goods from country r

E_x = elasticity of export supply

To calculate national welfare and revenue effects, the basic solution set of prices is applied. Conceptually, producer surplus is represented by Equation 11 below where R($\boldsymbol{i}$,$\boldsymbol{r}$) represents benchmark export revenues valued at world prices.

$$\Delta PS_{(i,v)} = R^0_{(i,r)} \cdot \hat{P}_{i,r}^* + {}^1\!/_2 \cdot R^0_{(i,r)} \cdot \hat{P}_{i,r}^* \cdot \hat{X}_{i,r}$$
$$= \left(R^0_{(i,r)} \cdot \hat{P}_{i,r}^*\right) \cdot \left(1 + \frac{E_{X,(i,r)} \cdot \hat{P}_{i,r}^*}{2}\right) \qquad \text{Equation 11}$$

The change in consumer surplus is formalized in Equation 12, measured with respect to the composite import demand curve.

$$\Delta CS_{(i,v)} = \left(\sum R^0_{(i,v),r} \cdot T^0_{(i,V),r}\right) + \left({}^1\!/_2\, E_{M,(i,v)} \hat{P}^2_{(i,v)} \cdot sign\left(\hat{P}_{(i,v)}\right) - \hat{P}_{(i,v)}\right)$$
$$\text{where } \hat{P}_{(i,v)} = \sum \theta_{(i,v),r}\, \hat{P}_{(i,v)} + \hat{T}_{(i,v),r}$$

In Equation 11, $P_{(i,v)}$ represents the price for composite imports and $R^0_{(i,v),r} \cdot T^0_{(i,v)r}$ represents expenditure at internal prices (the price of the composite good is set to be 1 in the benchmark equilibrium). The GSIM model combines the changes in producer surplus, consumer surplus and import tariff revenues to estimate welfare changes.

4.3 Data description

In order to run GSIM models, large amounts of relevant data are required. First, we selected 11 countries involved in the China-Europe railway strategy based on the analysis of nine major railway lines (Section 2.2.2). Second, the bilateral trade flows between selected countries were retrieved from the UN Comtrade (United Nations Comtrade Database) and split into those parts that are traded via rail (the CR express) and the rest. Third, the initial bilateral import tariffs were collected according to MFN simple average (%) which has been derived from the World Integrated Trade System

database (WITS) developed by the World Bank. Specifically, due to the establishment of the Customs Union on 1 July 1968, the bilateral import tariffs between EU Member States is equal 1 and their external tariffs vis-à-vis third parties are the same. Additionally, according to Francois (2003) as well as Ma (2016), a demand elasticity of -2.0 has been used. Regarding supply and substitution elasticities, we take 1.75 and 10 as has been common in the literature (Berden, 2016; Francois, 2003; Ma, 2016; Berden et al, 2009).

In this study, the last component of the GSIM model requirement is quite significant and complicated. To fill in NTMs matrix, we calculate the trade cost equivalent (TCE) in reference to the effect of investment on productivity, transportation cost, and customs efficiency. Therefore, Investments and quantitative effects are needed for scenarios. The investments in railway infrastructure over time are gathered from Infrastructure investment indicator via OECD. Some of the missing data comes from the National Railway Administration's report or related news. Nevertheless, dry port related investments are collected from various source, such as national port authority's websites or latest published news, because CR Express is an ambiguous strategy and the dry port's concept is relatively new, limited details are released so far. We use related research literature and previous case studies to estimate the coefficients (the impact) of investments on productivity, reduction of costs and improvement of customs efficiency in the past. From Van Elswijk (2012) we take the information that transport costs constitute 21% of total trade costs – in order to focus the investment effects on dry-ports and infrastructure on the transport share only.

4.4: Scenario development

In order to answer the research question, we develop three different scenarios:

- The first scenario is one where China focuses modest (Scenario 1A) investments into dry-ports only and ambitious (Scenario 1B) investments into dry-ports and infrastructure, improving their productivity and efficiency.
- In Scenario 2, we assume that all countries on the CE express invest modestly (Scenario 2A) in dry-ports or ambitiously (Scenario 2B) in dry-port and infrastructure productivity.
- Scenario 3 is the same as Scenario 2B but on top of that China signs Free Trade Agreements with the countries on the CE express roads in order to facilitate trade further.

The way these scenarios look in detail is presented in Table 11 below.

Scenario	*Modest (A)*	*Ambitious (B)*
1: Chinese investments in dry-ports (A) or dry-ports and infrastructure (B)	Based on Van Elswijk (2012) and our literature review of investments: a 10% NTM reduction for China and its neighbours and 2% for other countries	Based on Van Elswijk (2012) and our literature review of investments: a 15% NTM reduction for China and its neighbours and 5% for other countries
2: All CR-express countries invest in dry-ports (A) or dry-ports and infrastructure to neighbours (B)	Based on Van Elswijk (2012) and our literature review of investments: a 10% NTM reduction for the country itself, 5% reduction for its direct neighbours and 2% for all other countries	Based on Van Elswijk (2012) and our literature review of investments: a 25% NTM reduction for the country itself, 15% reduction for its direct neighbours and 5% for all other countries
3: All CR-express countries invest in dry-ports and infrastructure to neighbours AND China signs an FTA with them	Based on Van Elswijk (2012) and our literature review of investments: • A 25% NTM reduction for the country itself, 15% reduction for its direct neighbours and 5% for all other countries. • For all countries, bilateral FTAs with China: ➢ For Russia, Kazakhstan and Belarus: 75% tariff reduction and 4% NTM reduction; ➢ For the EU Member States: 25% tariff reduction and 2% NTM reduction; ➢ No effect for ROW	

TABLE 11. DRY-PORT AND INFRASTRUCTURE INVESTMENT SCENARIOS
Source: own elaboration

These scenarios allow us to dig deeper into the different possible futures that are relevant for our research question. In particular:

- They allow us to distinguish between whether it remains a China-only driven initiative (simulated in Scenario 1) or whether China manages to get all CR-express countries on board to commit and invest also (Scenario 2);
- They allow us to distinguish between modest and really committed (ambitious) levels of investment from the CR-express countries; in dry-ports only or also in broader infrastructure (sub-scenarios A or B);
- They allow us to see what would be the effect if the CR-express railway initiative is solidly embedded in the broader OBOR strategy – that includes signing FTAs with countries along the OBOR routes (Scenario 3).

As mentioned before, for each of these scenarios, we look at economic and trade effects. The economic effects we define as welfare and production effects. The trade effects are reported in value terms, where we also show the displacement of trade by CR-express trade, which is a novel feature of this research.

Chapter 5 Results and analysis

In this Chapter, we present the results and analysis. As explained in the previous Chapter, we look at three scenarios: a China-centred CR-express scenario (modest and ambitious); a broadly supported CR-express scenario (modest and ambitious) and a broadly supported CR-express scenario supported by being embedded into SREB-OBOR via Free Trade Agreements (FTAs).

5.1 China-centred CR-express scenario

Impact on welfare

When we look at the results, presented in Figure 17 for the modest (A) scenario. We see that China is expected to gain significantly in terms of total welfare (with USD 512 mln). The benefits are equally divided over producers (USD 223 mln) and consumers (USD 289 mln). Russia also gains a lot because it is a neighbouring country to China and Kazakhstan that also benefits in relative terms. However, for Russia the main gains accrue to consumers via cheaper prices for products because Russia imports more from China than it exports to it.

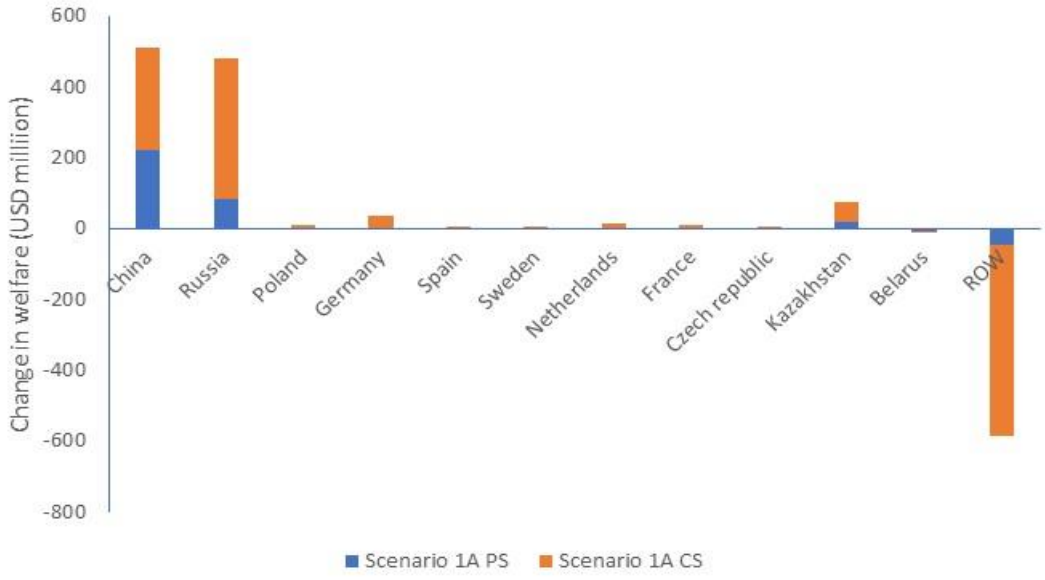

FIGURE 17. WELFARE EFFECTS OF SCENARIO 1A (SPLIT INTO PS AND CS)
Source: Authors own calculations

In Figure 18 we depict the welfare changes within the countries between non-CR-express and CR-express trade. We see that because of investments in infrastructure and dry-ports, the welfare gains we report in Figure 17 come from the CR-express trade flows. In all cases, but with China and Russian showing this particularly strongly: there is substitution between the CR trade and other trade.

For Scenario B, these effects are the same in relative terms but larger in magnitude. China stands to gain USD 942 mln in welfare, and Russia USD 793 mln.

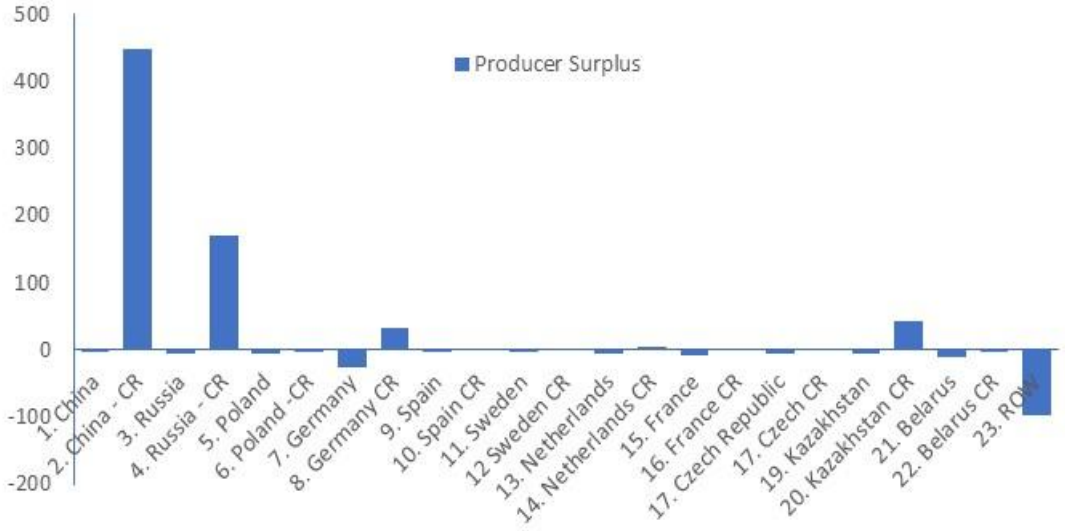

FIGURE 18. CR- AND NON-CR-PARTS OF PRODUCER SURPLUS
Source: Authors own calculations

Impact on output

When we look at what investments in dry-ports (and infrastructure in Scenario 1B) do for GDP, in the China centred scenario, we find that China's GDP stands to gain (by 0,04%) but not as much as Kazakhstan's (0.23%) or Russia's (0.12%). This is shown in Figure 19. The reason for this result is that Russia and Kazakhstan as China's neighbours benefit most from China's investments in the CR-express – which leads to lower prices of imports for these two countries, which drives the GDP gains (see the importance of consumer surplus in our welfare analysis).

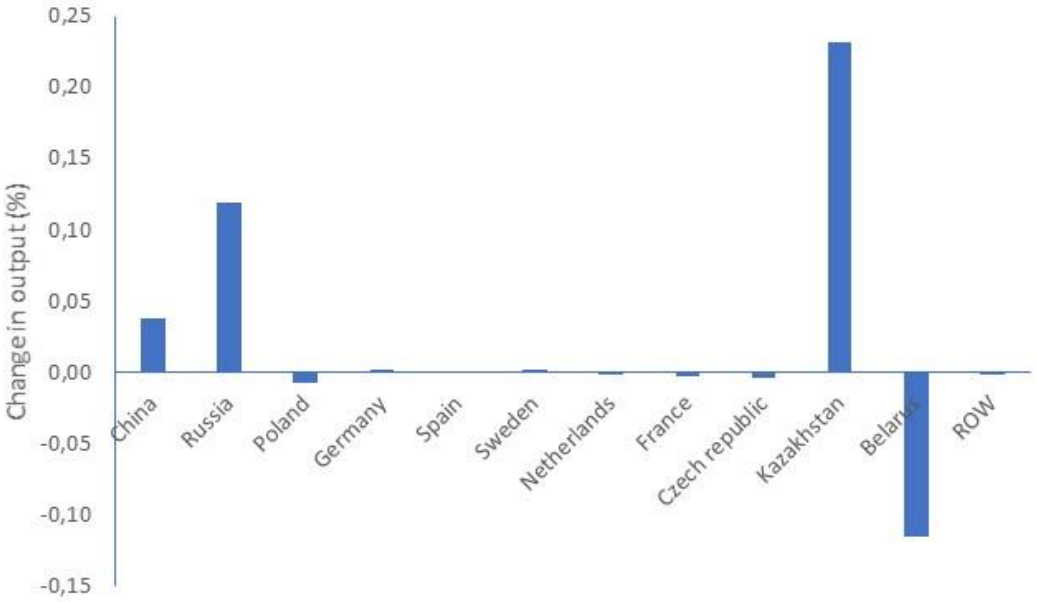

FIGURE 19. CHANGES IN OUTPUT IN SCENARIO 1B
Source: Authors own calculations

Impact on trade

The bilateral trade impacts are very elegantly presented in Figure 20 for the ambitious China-centred scenario.

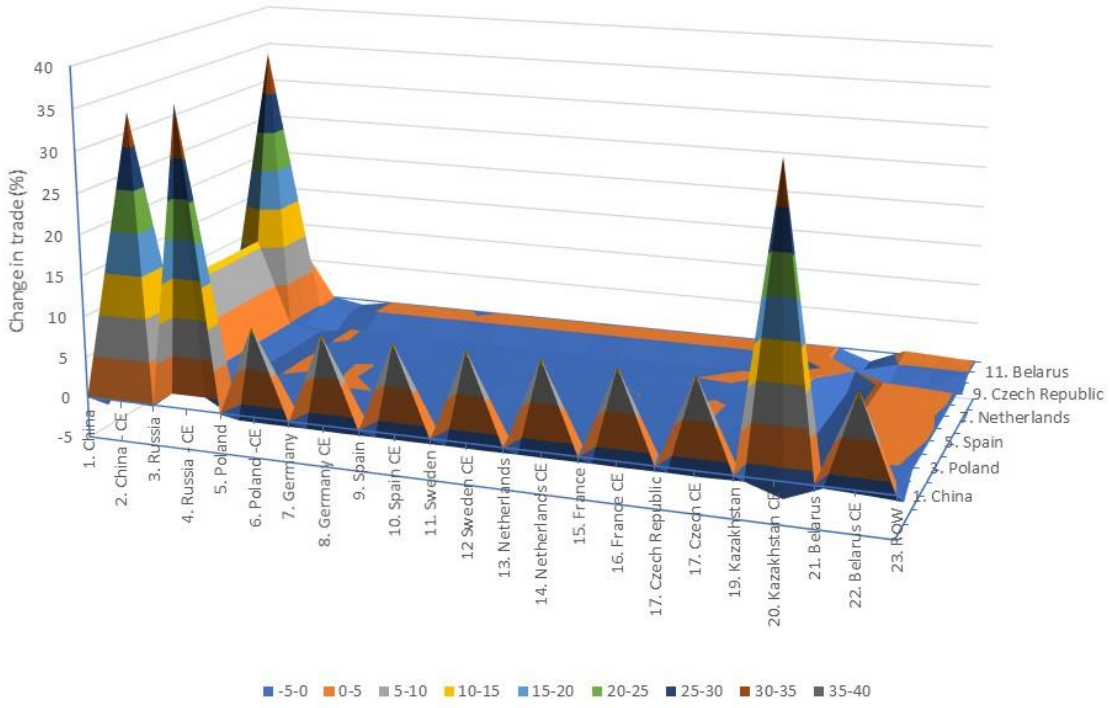

FIGURE 20. BILATERAL TRADE CHANGES (%) FOR SCENARIO 1B
Source: Authors own calculations

It is not surprising that we see Chinese exports increase significantly and also imports increase to some extent (but less). For Russia and Kazakhstan, the two closest countries affected by Chinese investments in the CR-express, imports from China go up a lot (explaining both the GDP and welfare effects explained before).

5.2 Overall CR-express scenario

When we turn to Scenario 2, we move from a China-centred CR-express to one where all the countries on the CR-express line engage and commit to making the CR express a success. That is Scenario 2. Also for this scenario, we define two sub-scenarios: a modest one where investments are made by all CR-express countries but are limited in nature. And a scenario where countries ambitiously engage and make much deeper investments resulting in improved levels of productivity along the entire CR-express lines. As in Section 5.1, we first present the welfare effects, and then the production (output) and trade effects.

Impact on welfare

In Figure 21 we show the welfare effects of the Overall CR-express scenario. We see that in the ambitious scenario, the effects for all CR-express countries are more positive than in the modest scenario. This is an economic argument to encourage the countries to be serious and ambitious about the CR-express – for their own benefit.

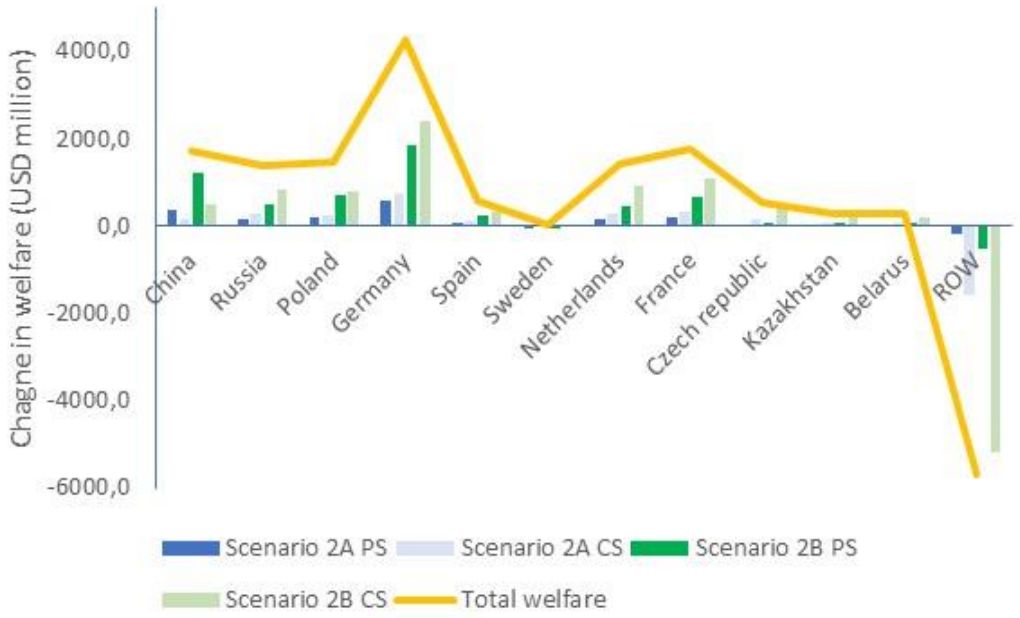

FIGURE 21. WELFARE CHANGES IN THE OVERALL CR-EXPRESS SCENARIO
Source: Authors own calculations

The region that loses out significantly (in the order of magnitude of USD 5.7 billion) is the Rest of World. We also note that when the Scenario gets more ambitious, Germany gains relatively more and more (USD 4.3 billion in Scenario 2B). This is because the effect of investments in dry-ports and infrastructure along the entire CR-express line, benefits the country that is most centrally located and has a large economy (i.e. trade flows that can benefit) to begin with: Germany. The second largest benefactor remains China with potential welfare gains of USD 1.7 billion. We also see that in China producers gain relatively more than producers while in Germany this is the other way around. The other sign of the coin of Germany's success is the fact that Sweden – only marginally integrated in the CR-express – is benefiting least from the investments in dry-ports and infrastructure by others.

Impact on Output

With regard to changes in output, we see a similar picture as with welfare: because of the concentration of EU Member States ambitiously investing in the CR-express, a very strong infrastructure productivity boost is given in the EU to its existing infrastructure in this Scenario. That means that EU Member States benefit more (except for Sweden), and China relatively less. We need to note, however, that we report here GDP changes in relative terms. Given the size of the Chinese economy the 0.1% increase in output is still considerable in absolute terms. The output results for both modest and ambitious scenarios are presented in Figure 22.

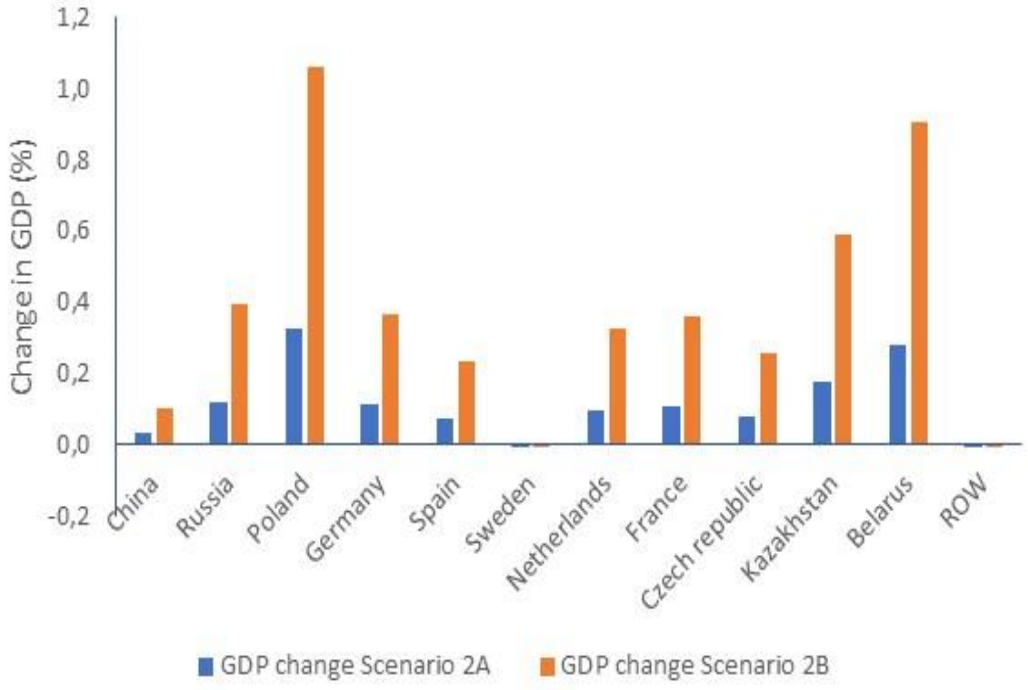

FIGURE 22 CHANGES IN OUTPUT UNDER THE OVERALL CR-EXPRESS SCENARIO (%)
Source: Authors own calculations

Impact on trade

With respect to the impact of the CR-express overall scenario on trade, there are two main points we would like to report and analyse. First, as shown in Table 12, it becomes very clear that when we look at Chinese imports or Dutch exports, in principle, the share of the CR-express is becoming more important as percentage of total trade, while other types of trade (i.e. maritime trade, pipelines) become less important. In orange, we report declines and in (dark) green, we report (large) increases in bilateral trade – for a subset of the countries, in order to focus on the message (for the other countries this effect is the same, except for Rest of World).

Origin countries / flows	China	Russia	Poland	Germany	Spain	Sweden	The Netherlands
1. China		-3,2	-2,8	-1,6	-0,8	-0,2	-1,5
2. China – CR		32,4	7,3	67,7	9,6	10,2	8,7
3. Russia	0,2		-2,5	-1,2	-0,4	0,2	-1,2
4. Russia - CR	33,9		30,3	6,5	7,4	8,1	6,6
5. Poland	0,3	-2,7		-1,1	-0,2	0,4	-1,0
6. Poland -CR	3,8	24,8		26,9	3,2	3,9	2,4
7. Germany	0,1	-3,0	-2,6		-0,5	0,1	-1,3
8. Germany CR	8,3	5,0	30,7		7,7	8,3	32,4
9. Spain	0,1	-2,9	-2,5	-1,3		0,1	-1,2
10. Spain CR	9,1	5,7	6,2	7,5		9,1	7,6
11. Sweden	0,1	-3,0	-2,6	-1,3	-0,5		-1,3
12 Sweden CR	10,6	7,3	7,7	9,1	10,0		9,1
13. Netherlands	0,2	-2,8	-2,4	-1,2	-0,3	0,2	
14. Netherlands CR	8,4	5,1	5,5	32,5	7,8	8,4	

TABLE 12. CHANGES IN BILATERAL TRADE FLOWS BECAUSE OF THE OVERALL CR-EXPRESS SCENARIO (% CHANGE)

Source: Authors own calculations

The second point is that when we look at changes of trade along the CR-express as is depicted in Figure 23, we see that compared to Figure 20 bilateral trade effects are much more spread.

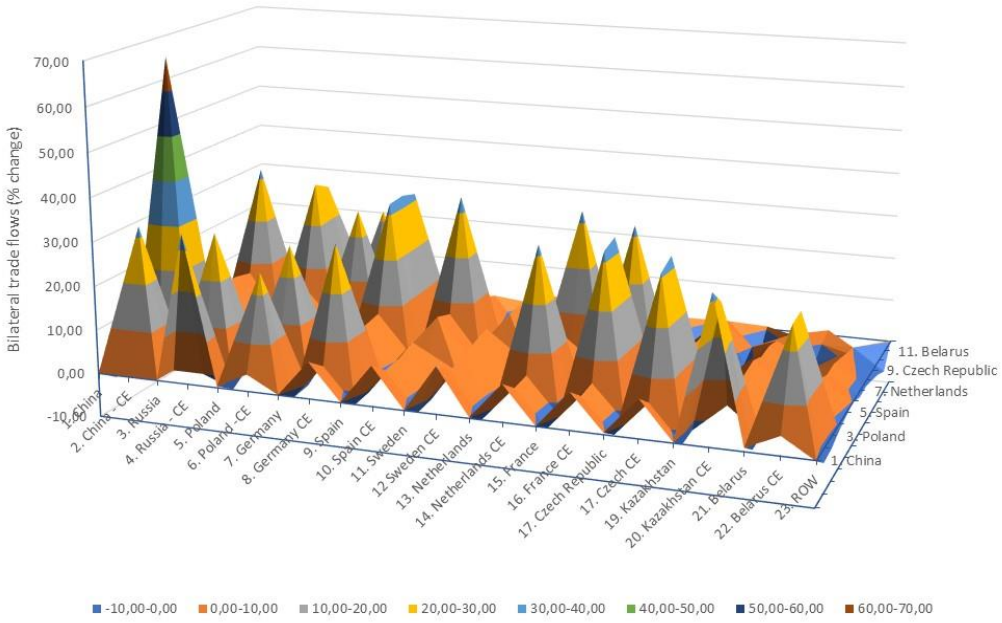

FIGURE 23. BILATERAL TRADE LANDSCAPE (% CHANGE) FOR SCENARIO 2B
Source: Authors own calculations

Whereas in Figure 20, intra-EU trade was flat in this Figure, clearly trade increases among the various CR-express countries. The largest change in trade flow (i.e. the highest peak) is Chinese exports to Germany via the CR-express.

5.3 Overall CR-express scenario flanked by FTAs

As mentioned in Chapter 2, the CR-express is an important part of the SREB-OBOR strategy. It is, however, not the only part. That is why we also look at Scenario 3: an ambitious investment programme into dry-ports and other infrastructure projects carried by all CR-express countries (i.e. Scenario 2B) with, in addition, bilateral FTAs between China and the countries on the CR-express railroad. We believe that it is easier for China to sign a deep FTA with countries like Russia, Kazakhstan and Belarus than with the EU and its EU Member States. The depth of the FTAs reflects this reality check. The results are presented in the sections below.

Impact on Welfare

When we look at the welfare effects of Scenario 3 (Scenario 2B + FTAs), we see that the welfare picture changes drastically compared to Scenario 2B. Chinese welfare is by far the highest – nearing USD 20 billion, followed by a distance by Germany and Russia. All countries experience some degree of losses in tariff revenues, but – with the exception of ROW – all countries participating in the CR-express and FTAs with China gain in welfare terms.

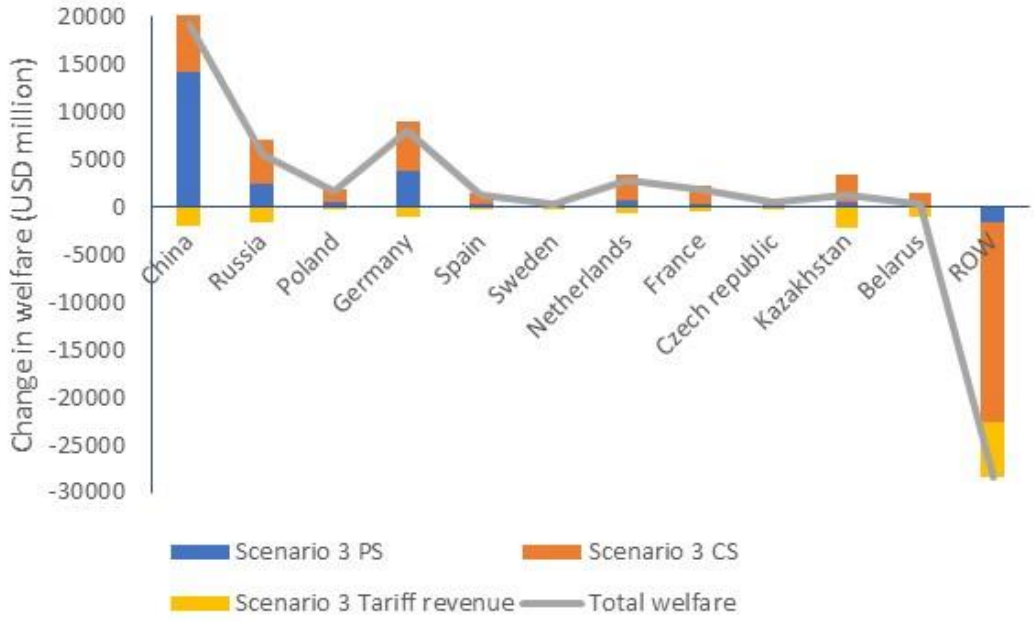

FIGURE 24. EFFECT OF SCENARIO 3 ON WELFARE
Source: Authors own calculations

We also see that the driver for the gains in China are the producers, while the loss for ROW as well as the gains for Germany and Russia come from lower prices for their consumers. This is depicted in Figure 24.

Impact on Output

In Figure 25, in blue, we show the expected changes in output under Scenario 3. We see that China, Russia, Kazakhstan and Belarus gain a lot (they are assumed to sign the most ambitious FTAs), but also other countries gain. Only Poland has a higher GDP increase in Scenario 2B, compared to Scenario 3. The Polish could therefore try to convince the EU not to engage in an FTA with China, not even a shallow one. However, because the other EU Member States, especially Germany, benefit from an EU-China FTA, the EU's economics and politics may still favour closer economic ties with China. What is also very clear from this Figure – a recommendation for China – is that China needs to implement the entire SREB-OBOR strategy, not only the CR-express part if it wants to benefit significantly.

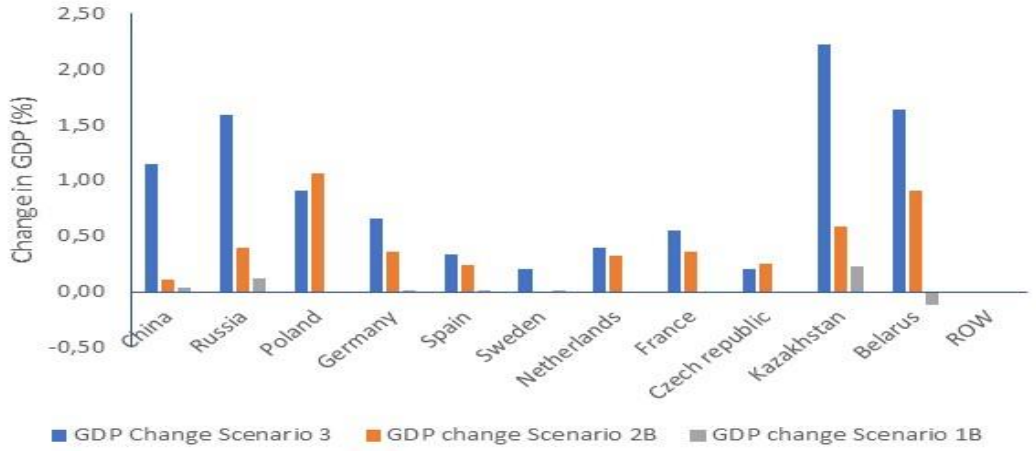

FIGURE 25. CHANGES IN OUTPUT (%)
Source: Authors own calculations

Impact on Trade

Finally, the impact on trade is very large in Scenario 3. When we compare the scale of the axis between Figure 23 in Section 5.2 (70% maximum) to the value in Figure 26 below (350%), it is clear that for most bilateral pairs, trade increases significantly. It also becomes clear – in conjunction with the output data analysed above, that the optimal strategy for China to maximise its benefits from SREB-OBOR is to 1) Be ambitious about the CR-express in terms of investments; 2) Convince the other CR-express countries to also be ambitious; and 3) To flank the investments in dry-ports and infrastructure with FTAs with countries on the CR-express.

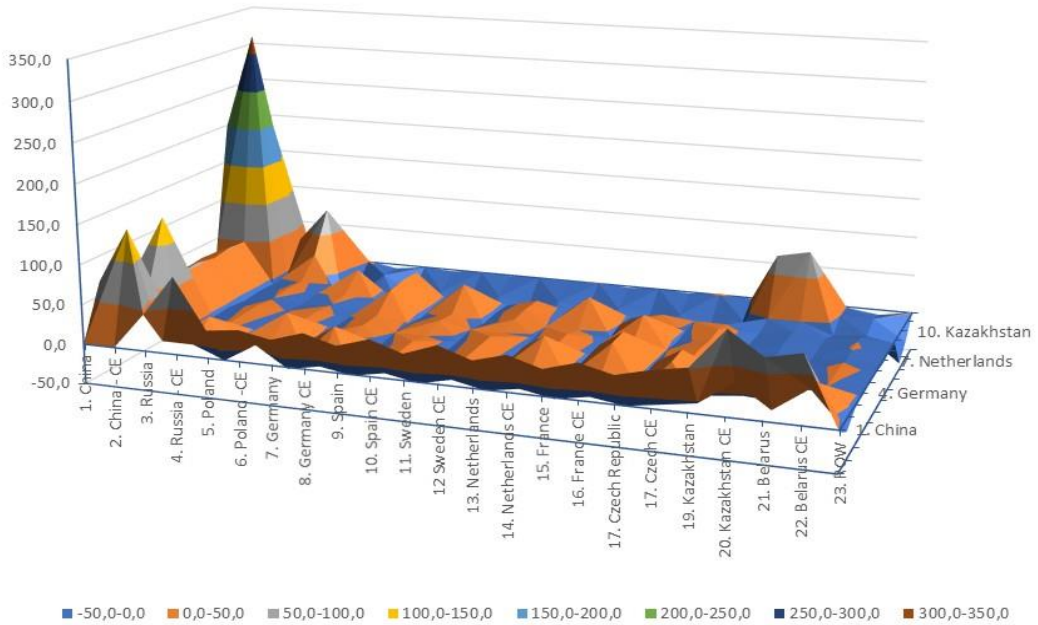

FIGURE 26. CHANGES IN BILATERAL TRADE UNDER SCENARIO 3 (%)
Source: Authors own calculations

Chapter 6 Conclusion

In this last chapter, we summarize the main findings and their significance. In addition, limitations of our research and recommendations for future work will be discussed.

6.1 Methodological approach

The aim of the present research was to assess the economic and trade impact of investments in developing dry ports and transport infrastructure in the context of SREB, especially along the CR Express. Therefore, we studied a lot of prior research and case studies to look at the effect of investment on productivity, cost reduction and efficiency. Based on the analysis of the main nine railway lines' layout and trade flows, we selected eleven concerned countries with respect to the CR express, which are China, Russia, Poland, Germany, Spain, Sweden, Netherlands, France, Czech Republic, Kazakhstan, Belarus.

After comparing three models (the Gravity model, CGE and GSIM), we chose the GSIM model which allows us to quantify the expected impacts of investment projects in terms of economic (welfare, output) and trade effects – as is the focus of our research question. We adopted three scenarios that have set different levels of policy instruments to promote the development of CR Express and dry ports. The first scenario simulates a future where China is driving the CR express idea, linking Chinese dry ports up to its neighbouring countries, but the rest of the countries along the CR express do not commit. The second scenario simulates that all countries along the CR express invest in dry ports (modest) and also general infrastructure (ambitious); not just China alone. The third scenario, looks at a future where the investments in dry ports and infrastructure along the CR express are flanking by another SREB-OBOR element: signing FTAs with CR-express countries.

6.2 Key Conclusions

In this section, we highlight the main takeaways from this study.

When we look at the CR Express, it is clear that this is one of the key pillars of China's SREB-OBOR strategy. Its success depends to a large extent on whether China manages to engage other countries into the OBOR strategy in genera and CR express in particular. The difference in scenarios 1 and 2 highlights this: the welfare, GDP and trade effects are much higher in the overall CR express scenario (Scenario 2) than in the China-driven CR express strategy (Scenario 1).

We also find that China and Russia are expected to gain significantly in terms of total welfare if China focuses investment into dry ports (modest). Especially when China expands investment to infrastructure (ambitious), the total welfare of China and Russia is USD 942 mln and USD 793 mln respectively. The main importers of Chinese goods via rail are Russia and Kazakhstan and they benefit a lot from lower prices of imports (increase of CS) from China, which results in the welfare and GDP gains for those countries.

One of the more significant findings to emerge from this study is that if all CR-express countries intend to invest, they can obtain more benefits with the increase in depth of investment. So: it makes more sense for countries like Germany, the Netherlands and Poland to invest deeply into dry ports and infrastructure linking up to China than to invest only marginally – in their self-interest. In terms of welfare and output, due to the concentration of EU Member States, ambitiously investing in the CR-express, means that EU Member States benefit relatively more (except for Sweden), and China relatively less (but it also benefits). It is interesting to see that when the Scenario gets more ambitious, Germany gains relatively more and more (USD 4.3 billion in the Overall Ambitious CR-express scenario) because of its central location and the large economy, while Sweden benefits least because it is integrated to only a limited degree in the CR-express. In the trade field, distinguished with other types of trade, the share of the CR-express is becoming more crucial as percentage of total trade (see clearly see a displacement of 'other' trade by CR express rail trade if the latter benefits from investments in infrastructure and dry ports. And the trade flows increase among the various CR-express countries due to the investment from all parties. It is very interesting, but not surprising given the sizes of these economies, that the largest change in trade flow is Chinese exports to Germany via the CR-express in Overall CR-express scenario.

Furthermore, this research also shows that if China flanks its CR express strategy with bilateral FTAs between China and the countries on the CR-express railroad – as is the plan in the SREB-OBOR strategy – total welfare gains for China are massive. Producers and consumers gain in participating countries even if there is some loss in tariff revenues. Also, GDP benefits from these trade agreements. Based on the expected changes in output under Overall Ambitious CR-express + FTAs scenario, most of countries (except Poland) gain a lot compared with the situation of no FTAs. In terms of trade impact, trade increases significantly for most bilateral pairs.

In general, most of concerned countries will benefit from the investment in dry port and infrastructure, especially with the FTAs, while the Rest of World loses out significantly in all the scenarios – as expected because they are not part of the CR express initiative. These findings have significant implications for the understanding of how China implements the CR-express in the context of SREB-OBOR strategy. To conclude, with a focus on China: the optimal strategy for China is to increase

investment in dry ports and other infrastructure, to convince the other CR-Express countries to also invest heavily, and to flank the CR express strategy with an FTA strategy: signing FTAs with countries on the CR-Express.

6.3 Limitations of the research and areas for further study

Although we worked hard for pushing research methodologies to the limit to obtain reliable and plausible results, we still met some limitations in our research.

First of all, this study was limited by the available level of detail database information about the CR Express and dry ports investment. For example, if there is no directly available data on effects of investment effects in dry ports. This meant we had to calculate it by ourselves, which was an approximation. However, we based our work on qualified websites. We expect more information will be available over time.

Although we believe the GSIM model has been a correct choice to assess investment effect on economic and trade, an additional uncontrolled factors is still a limitation in the GSIM model. For instance, the GSIM model cannot look at both overall effects and sectoral effects simultaneously. Therefore, when we analyse the impact of the investment in the railway sector, the GSIM model does not generate sector-specific changes that would allow us to get information regarding changes in trade values (at sector level) to be transferred into trade volumes.

Lastly, the focus of this paper is to study the trade and economic impact of investment in dry ports and infrastructure under the CR Express initiative. We assumed in Scenarios 2 and 3 that the countries along the CR Express railroad are currently willing to invest. However, the proposal and completion of other trade agreements may affect their investment decisions. Moreover, when other countries outside the CR express realize the opportunities behind it, they may also try to get involved into this strategy. Consequently, it would be interesting to look into the potential of the CR express cooperating with other parties. Further investigation and experimentation into modelling similar strategies is strongly recommended.

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Appendix

Annex 1. Scenario 1A: China invests modestly in dry ports

SUMMARY OF GLOBAL RESULTS

	Produce Prices, Quantities, and Revenues -- change					Producer Surplus		Tax Revenue Effects			Downstream/Final Consumer Effects			Total Welfare	Employment			
	A	B	C	D	E	F	G	H	I	J	K	L	M	N = F+G+H+I+J+K	O	P	Q	R
	% change in OUTPUT	% change in PRODUCER PRICE	% change in FOB (or ex-factory) PRICE	% change in producer revenues	value of change in producer revenues	part 1, change in producer surplus	part 2, rents from under-takings	change in output taxes	change in export taxes	change in import taxes	change in consumer surplus	consumer prices, % change	total consumption, % change	Net welfare effects	Protected base employment, thousands	Change in protected employment, thousands	Downstream base employment, thousands	Change in downstream employment, thousands
1. China	0.00	0.00	0.00	0.00	-9.9	-3.6	0.0	0.0	0.0	0.0	288.9	-0.02	0.05	285.3	100	0	100	0
2. China - CE	0.04	0.02	0.02	0.06	1,236.6	449.7	0.0	0.0	0.0	0.0	399.4	-0.22	0.66	849.0	100	0	100	1
3. Russia	0.00	0.00	0.00	-0.01	-16.3	-5.9	0.0	0.0	0.0	0.0	9.3	0.00	0.01	3.4	100	0	100	0
4. Russia - CE	0.12	0.07	0.07	0.19	467.6	170.0	0.0	0.0	0.0	0.0	35.3	0.00	0.01	205.3	100	0	100	0
5. Poland	-0.01	0.00	0.00	-0.01	-16.0	-5.8	0.0	0.0	0.0	0.0	4.2	0.00	0.00	-1.6	100	0	100	0
6. Poland -CE	0.00	0.00	0.00	0.00	-2.1	-0.8	0.0	0.0	0.0	0.0	1.9	0.00	0.00	1.2	100	0	100	0
7. Germany	0.00	0.00	0.00	-0.01	-73.7	-26.8	0.0	0.0	0.0	0.0	13.2	0.00	0.01	-13.6	100	0	100	0
8. Germany CE	0.01	0.00	0.00	0.01	87.8	31.9	0.0	0.0	0.0	0.0	9.9	0.00	0.01	41.8	100	0	100	0
9. Spain	0.00	0.00	0.00	0.00	-5.1	-1.8	0.0	0.0	0.0	0.0	2.6	0.00	0.01	0.8	100	0	100	0
10. Spain CE	0.00	0.00	0.00	0.00	6.9	2.5	0.0	0.0	0.0	0.0	56.4	-0.14	0.42	58.9	100	0	100	1
11. Sweden	0.00	0.00	0.00	0.00	-5.4	-2.0	0.0	0.0	0.0	0.0	-3.5	0.01	-0.03	-5.4	100	0	100	0
12 Sweden CE	0.00	0.00	0.00	0.01	5.8	2.1	0.0	0.0	0.0	0.0	-537.1	0.00	-0.01	-535.0	100	0	100	0
13. Netherlands	0.00	0.00	0.00	0.00	-17.3	-6.3	0.0	0.0	0.0	0.0	0.0	0.00	-100.00	-6.3	100	0	100	-153
14. Netherlands CE	0.00	0.00	0.00	0.00	9.7	3.5	0.0	0.0	0.0	0.0	0.0	0.00	-100.00	3.5	100	0	100	-153
15. France	0.00	0.00	0.00	0.00	-19.6	-7.1	0.0	0.0	0.0	0.0	0.0	0.00	-100.00	-7.1	100	0	100	-153
16. France CE	0.00	0.00	0.00	0.00	13.9	0.0	0.0	0.0	0.0	0.0	0.0	0.00	-100.00	0.0	100	0	100	-153
17. Czech Republic	0.00	0.00	0.00	-0.01	-11.7	-4.2	0.0	0.0	0.0	0.0	0.0	0.00	-100.00	-4.2	100	0	100	-153
17. Czech CE	0.00	0.00	0.00	0.00	1.5	0.5	0.0	0.0	0.0	0.0	0.0	0.00	-100.00	0.1	100	0	100	-153
19. Kazakhstan	-0.02	-0.01	-0.01	-0.03	-11.8	-4.3	0.0	0.0	0.0	0.0	0.0	0.00	-100.00	-4.3	100	0	100	-153
20. Kazakhstan CE	0.25	0.14	0.14	0.39	115.9	42.1	0.0	0.0	0.0	0.0	0.0	0.00	-100.00	-14.0	100	0	100	-153
21. Belarus	-0.07	-0.04	-0.04	-0.12	-26.6	-9.7	0.0	0.0	0.0	0.0	0.0	0.00	-100.00	-9.7	100	0	100	-153
22. Belarus CE	-0.04	-0.02	-0.02	-0.07	-10.1	-3.7	0.0	0.0	0.0	0.0	0.0	0.00	-100.00	-4.0	100	0	100	-153
23. ROW	0.00	0.00	0.00	0.00	-265.5	-96.6	0.0	0.0	0.0	0.0	0.0	0.00	-100.00	-96.6	100	0	100	-153
0	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	-100.00	0.0	100	0	100	-153
0	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	-100.00	0.0	100	0	100	-153
0	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	-100.00	0.0	100	0	100	-153
0	0.00	-0.01	-0.01	0.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	-100.00	0.0	100	0	100	-153
0	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	-100.00	0.0	100	0	100	-153
0	0.00	-0.01	-0.01	0.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	-100.00	0.0	100	0	100	-153
0	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	-100.00	0.0	100	0	100	-153
0	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	-100.00	0.0	100	0	100	-153
0	0.00	-0.01	-0.01	0.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	-100.00	0.0	100	0	100	-153
0	0.00	0.01	0.01	0.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	-100.00	0.0	100	0	100	-153
0	0.00	-0.05	-0.05	0.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	-100.00	0.0	100	0	100	-153
0	0.00	0.71	0.71	0.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	-100.00	0.0	100	0	100	-153

Annex 2. Scenario 1B: China invests ambitiously in dry ports

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SUMMARY OF GLOBAL RESULTS

	Produce Prices, Quantities, and Revenues -- change					Producer Surplus		Tax Revenue Effects			Downstream/Final Consumer Effects			Total Welfare	Employment			
	A	B	C	D	E	F	G	H	I	J	K	L	M	N = F+G+H+I+J+K	O	P	Q	R
	% change in OUTPUT	% change in PRODUCER PRICE	% change in FOB (or ex-factory) PRICE	% change in producer revenues	value of change in producer revenues	part 1, change in producer surplus	part 2, rents from under-takings	change in output taxes	change in export taxes	change in import taxes	change in consumer surplus	consumer prices, % change	total consumption, % change	Net welfare effects	Protected base employment, thousands	Change in protected employment, thousands	Downstream base employment, thousands	Change in downstream employment, thousands
1. China	0.00	0.00	0.00	0.00	-9.9	-3.6	0.0	0.0	0.0	0.0	495.9	-0.03	0.09	492.3	100	0	100	0
2. China - CE	0.04	0.02	0.02	0.06	1,236.6	449.7	0.0	0.0	0.0	0.0	628.5	-0.35	1.04	1,078.2	100	0	100	2
3. Russia	0.00	0.00	0.00	-0.01	-16.3	-5.9	0.0	0.0	0.0	0.0	23.8	-0.01	0.04	17.9	100	0	100	0
4. Russia - CE	0.12	0.07	0.07	0.19	467.6	170.0	0.0	0.0	0.0	0.0	82.1	-0.01	0.02	252.1	100	0	100	0
5. Poland	-0.01	0.00	0.00	-0.01	-16.0	-5.8	0.0	0.0	0.0	0.0	7.2	0.00	0.01	1.4	100	0	100	0
6. Poland -CE	0.00	0.00	0.00	0.00	-2.1	-0.8	0.0	0.0	0.0	0.0	2.9	0.00	0.01	2.1	100	0	100	0
7. Germany	0.00	0.00	0.00	-0.01	-73.7	-26.8	0.0	0.0	0.0	0.0	33.4	-0.01	0.02	6.6	100	0	100	0
8. Germany CE	0.01	0.00	0.00	0.01	87.8	31.9	0.0	0.0	0.0	0.0	19.0	0.00	0.01	50.9	100	0	100	0
9. Spain	0.00	0.00	0.00	0.00	-5.1	-1.8	0.0	0.0	0.0	0.0	5.4	0.00	0.01	3.6	100	0	100	0
10. Spain CE	0.00	0.00	0.00	0.00	6.9	2.5	0.0	0.0	0.0	0.0	90.2	-0.22	0.67	92.7	100	0	100	1
11. Sweden	0.00	0.00	0.00	0.00	-5.4	-2.0	0.0	0.0	0.0	0.0	-2.5	0.01	-0.02	-4.4	100	0	100	0
12 Sweden CE	0.00	0.00	0.00	0.01	5.8	2.1	0.0	0.0	0.0	0.0	-537.1	0.00	-0.01	-535.0	100	0	100	0
13. Netherlands	0.00	0.00	0.00	0.00	-17.3	-6.3	0.0	0.0	0.0	0.0	0.0	0.00	-100.00	-6.3	100	0	100	-153
14. Netherlands CE	0.00	0.00	0.00	0.00	9.7	3.5	0.0	0.0	0.0	0.0	0.0	0.00	-100.00	3.5	100	0	100	-153
15. France	0.00	0.00	0.00	0.00	-19.6	-7.1	0.0	0.0	0.0	0.0	0.0	0.00	-100.00	-7.1	100	0	100	-153
16. France CE	0.00	0.00	0.00	0.00	13.9	0.0	0.0	0.0	0.0	0.0	0.0	0.00	-100.00	0.0	100	0	100	-153
17. Czech Republic	0.00	0.00	0.00	-0.01	-11.7	-4.2	0.0	0.0	0.0	0.0	0.0	0.00	-100.00	-4.2	100	0	100	-153
17. Czech CE	0.00	0.00	0.00	0.00	1.5	0.5	0.0	0.0	0.0	0.0	0.0	0.00	-100.00	-0.5	100	0	100	-153
19. Kazakhstan	-0.02	-0.01	-0.01	-0.03	-11.8	-4.3	0.0	0.0	0.0	0.0	0.0	0.00	-100.00	-4.3	100	0	100	-153
20. Kazakhstan CE	0.25	0.14	0.14	0.39	115.9	42.1	0.0	0.0	0.0	0.0	0.0	0.00	-100.00	-51.6	100	0	100	-153
21. Belarus	-0.07	-0.04	-0.04	-0.12	-26.6	-9.7	0.0	0.0	0.0	0.0	0.0	0.00	-100.00	-9.7	100	0	100	-153
22. Belarus CE	-0.04	-0.02	-0.02	-0.07	-10.1	-3.7	0.0	0.0	0.0	0.0	0.0	0.00	-100.00	-4.6	100	0	100	-153
23. ROW	0.00	0.00	0.00	0.00	-265.5	-96.6	0.0	0.0	0.0	0.0	0.0	0.00	-100.00	-96.6	100	0	100	-153
0	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	-100.00	0.0	100	0	100	-153
0	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	-100.00	0.0	100	0	100	-153
0	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	-100.00	0.0	100	0	100	-153
0	0.00	-0.01	-0.01	0.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	-100.00	0.0	100	0	100	-153
0	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	-100.00	0.0	100	0	100	-153
0	0.00	-0.01	-0.01	0.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	-100.00	0.0	100	0	100	-153
0	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	-100.00	0.0	100	0	100	-153
0	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	-100.00	0.0	100	0	100	-153
0	0.00	-0.01	-0.01	0.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	-100.00	0.0	100	0	100	-153
0	0.00	0.01	0.01	0.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	-100.00	0.0	100	0	100	-153
0	0.00	-0.05	-0.05	0.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	-100.00	0.0	100	0	100	-153
0	0.00	0.71	0.71	0.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	-100.00	0.0	100	0	100	-153

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Annex 3. Scenario 2A: China and all other countries invest modestly in the CR express

SUMMARY OF GLOBAL RESULTS

	Produce Prices, Quantities, and Revenues -- change					Producer Surplus		Tax Revenue Effects			Downstream/Final Consumer Effects			Total Welfare	Employment			
	A	B	C	D	E	F	G	H	I	J	K	L	M	N = F+G+H+I+J+K	O	P	Q	R
	% change in OUTPUT	% change in PRODUCER PRICE	% change in FOB (or ex-factory) PRICE	% change in producer revenues	value of change in producer revenues	part 1, change in producer surplus	part 2, rents from under-takings	change in output taxes	change in export taxes	change in import taxes	change in consumer surplus	consumer prices, % change	total consumption, % change	Net welfare effects	Protected base employment, thousands	Change in protected employment, thousands	Downstream base employment, thousands	Change in downstream employment, thousands
1. China	0.00	0.00	0.00	0.00	-56.4	-20.5	0.0	0.0	0.0	0.0	169.3	-0.01	0.03	148.8	100	0	100	0
2. China - CE	0.03	0.02	0.02	0.05	1,121.9	408.0	0.0	0.0	0.0	0.0	269.0	-0.15	0.44	677.0	100	0	100	1
3. Russia	-0.02	-0.01	-0.01	-0.03	-103.3	-37.6	0.0	0.0	0.0	0.0	245.0	-0.13	0.39	207.4	100	0	100	1
4. Russia - CE	0.14	0.08	0.08	0.22	547.3	199.0	0.0	0.0	0.0	0.0	770.5	-0.07	0.22	969.6	100	0	100	0
5. Poland	-0.03	-0.02	-0.02	-0.05	-80.0	-29.1	0.0	0.0	0.0	0.0	111.3	-0.04	0.11	82.2	100	0	100	0
6. Poland -CE	0.36	0.20	0.20	0.56	670.6	243.9	0.0	0.0	0.0	0.0	13.7	-0.01	0.03	257.6	100	1	100	0
7. Germany	-0.02	-0.01	-0.01	-0.02	-310.6	-113.0	0.0	0.0	0.0	0.0	298.4	-0.07	0.21	185.4	100	0	100	0
8. Germany CE	0.13	0.07	0.07	0.20	1,883.7	685.0	0.0	0.0	0.0	0.0	342.4	-0.06	0.18	1,027.4	100	0	100	0
9. Spain	-0.02	-0.01	-0.01	-0.03	-76.4	-27.8	0.0	0.0	0.0	0.0	145.9	-0.10	0.31	118.1	100	0	100	0
10. Spain CE	0.09	0.05	0.05	0.14	276.4	100.5	0.0	0.0	0.0	0.0	60.8	-0.15	0.45	161.3	100	0	100	1
11. Sweden	-0.02	-0.01	-0.01	-0.03	-35.9	-13.0	0.0	0.0	0.0	0.0	69.8	-0.23	0.70	56.8	100	0	100	1
12 Sweden CE	0.02	0.01	0.01	0.02	23.7	8.6	0.0	0.0	0.0	0.0	-1,587.3	0.01	-0.02	-1,578.6	100	0	100	0
13. Netherlands	-0.02	-0.01	-0.01	-0.04	-172.5	-62.7	0.0	0.0	0.0	0.0	0.0	0.00	-100.00	-62.7	100	0	100	-153
14. Netherlands CE	0.12	0.07	0.07	0.19	564.6	205.3	0.0	0.0	0.0	0.0	0.0	0.00	-100.00	205.3	100	0	100	-153
15. France	-0.02	-0.01	-0.01	-0.03	-120.1	-43.7	0.0	0.0	0.0	0.0	0.0	0.00	-100.00	-43.7	100	0	100	-153
16. France CE	0.00	0.07	0.07	0.20	670.4	0.0	0.0	0.0	0.0	0.0	0.0	0.00	-100.00	0.0	100	0	100	-153
17. Czech Republic	-0.04	-0.02	-0.02	-0.06	-86.3	-31.4	0.0	0.0	0.0	0.0	0.0	0.00	-100.00	-31.4	100	0	100	-153
17. Czech CE	0.12	0.07	0.07	0.18	146.9	53.4	0.0	0.0	0.0	0.0	0.0	0.00	-100.00	-13.2	100	0	100	-153
19. Kazakhstan	-0.03	-0.01	-0.01	-0.04	-16.5	-6.0	0.0	0.0	0.0	0.0	0.0	0.00	-100.00	-6.0	100	0	100	-153
20. Kazakhstan CE	0.20	0.12	0.12	0.32	94.0	34.2	0.0	0.0	0.0	0.0	0.0	0.00	-100.00	-8.3	100	0	100	-153
21. Belarus	-0.06	-0.03	-0.03	-0.09	-20.9	-7.6	0.0	0.0	0.0	0.0	0.0	0.00	-100.00	-7.6	100	0	100	-153
22. Belarus CE	0.34	0.19	0.19	0.53	82.4	30.0	0.0	0.0	0.0	0.0	0.0	0.00	-100.00	-9.8	100	1	100	-153
23. ROW	0.00	0.00	0.00	0.00	-497.2	-180.8	0.0	0.0	0.0	0.0	0.0	0.00	-100.00	-180.8	100	0	100	-153
0	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	-100.00	0.0	100	0	100	-153
0	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	-100.00	0.0	100	0	100	-153
0	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	-100.00	0.0	100	0	100	-153
0	0.00	-0.01	-0.01	0.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	-100.00	0.0	100	0	100	-153
0	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	-100.00	0.0	100	0	100	-153
0	0.00	-0.01	-0.01	0.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	-100.00	0.0	100	0	100	-153
0	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	-100.00	0.0	100	0	100	-153
0	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	-100.00	0.0	100	0	100	-153
0	0.00	-0.01	-0.01	0.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	-100.00	0.0	100	0	100	-153
0	0.00	0.01	0.01	0.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	-100.00	0.0	100	0	100	-153
0	0.00	-0.05	-0.05	0.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	-100.00	0.0	100	0	100	-153
0	0.00	0.71	0.71	0.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	-100.00	0.0	100	0	100	-153

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Annex 4. Scenario 2B: China and all other countries invest ambitiously in the CR express

SUMMARY OF GLOBAL RESULTS

	Produce Prices, Quantities, and Revenues -- change					Producer Surplus		Tax Revenue Effects			Downstream/Final Consumer Effects			Total Welfare	Employment			
	A	B	C	D	E	F	G	H	I	J	K	L	M	N = F+G+H+I+J+K	O	P	Q	R
	% change in OUTPUT	% change in PRODUCER PRICE	% change in FOB (or ex-factory) PRICE	% change in producer revenues	value of change in producer revenues	part 1, change in producer surplus	part 2, rents from under-takings	change in output taxes	change in export taxes	change in import taxes	change in consumer surplus	consumer prices, % change	total consumption, % change	Net welfare effects	Protected base employment, thousands	Change in protected employment, thousands	Downstream base employment, thousands	Change in downstream employment, thousands
1. China	0.00	0.00	0.00	-0.01	-154.8	-56.3	0.0	0.0	0.0	0.0	518.5	-0.03	0.09	462.2	100	0	100	0
2. China - CE	0.11	0.06	0.06	0.17	3,527.5	1,282.7	0.0	0.0	0.0	0.0	854.1	-0.47	1.43	2,136.9	100	0	100	2
3. Russia	-0.06	-0.04	-0.04	-0.10	-323.8	-117.8	0.0	0.0	0.0	0.0	779.1	-0.41	1.25	661.3	100	0	100	2
4. Russia - CE	0.46	0.26	0.26	0.72	1,759.0	639.7	0.0	0.0	0.0	0.0	2,421.9	-0.23	0.69	3,061.6	100	1	100	1
5. Poland	-0.10	-0.06	-0.06	-0.15	-251.4	-91.4	0.0	0.0	0.0	0.0	340.1	-0.11	0.34	248.7	100	0	100	1
6. Poland -CE	1.16	0.66	0.66	1.83	2,180.7	793.0	0.0	0.0	0.0	0.0	37.5	-0.03	0.08	830.5	100	2	100	0
7. Germany	-0.05	-0.03	-0.03	-0.08	-974.6	-354.4	0.0	0.0	0.0	0.0	941.5	-0.22	0.67	587.1	100	0	100	1
8. Germany CE	0.41	0.24	0.24	0.65	6,118.3	2,224.9	0.0	0.0	0.0	0.0	1,105.8	-0.20	0.59	3,330.7	100	1	100	1
9. Spain	-0.06	-0.03	-0.03	-0.09	-240.8	-87.6	0.0	0.0	0.0	0.0	464.9	-0.33	1.00	377.4	100	0	100	2
10. Spain CE	0.29	0.17	0.17	0.46	884.8	321.7	0.0	0.0	0.0	0.0	196.3	-0.49	1.48	518.0	100	0	100	2
11. Sweden	-0.05	-0.03	-0.03	-0.08	-112.1	-40.8	0.0	0.0	0.0	0.0	221.2	-0.74	2.25	180.5	100	0	100	3
12 Sweden CE	0.04	0.02	0.02	0.07	67.2	24.4	0.0	0.0	0.0	0.0	-5,172.6	0.02	-0.06	-5,148.2	100	0	100	0
13. Netherlands	-0.08	-0.04	-0.04	-0.12	-541.3	-196.8	0.0	0.0	0.0	0.0	0.0	0.00	-100.00	-196.8	100	0	100	-153
14. Netherlands CE	0.40	0.23	0.23	0.63	1,851.8	673.4	0.0	0.0	0.0	0.0	0.0	0.00	-100.00	673.4	100	1	100	-153
15. France	-0.05	-0.03	-0.03	-0.08	-372.0	-135.3	0.0	0.0	0.0	0.0	0.0	0.00	-100.00	-135.3	100	0	100	-153
16. France CE	0.00	0.24	0.24	0.65	2,221.7	0.0	0.0	0.0	0.0	0.0	0.0	0.00	-100.00	0.0	100	1	100	-153
17. Czech Republic	-0.12	-0.07	-0.07	-0.18	-271.1	-98.6	0.0	0.0	0.0	0.0	0.0	0.00	-100.00	-98.6	100	0	100	-153
17. Czech CE	0.37	0.21	0.21	0.58	468.9	170.5	0.0	0.0	0.0	0.0	0.0	0.00	-100.00	-59.3	100	1	100	-153
19. Kazakhstan	-0.08	-0.04	-0.04	-0.12	-52.0	-18.9	0.0	0.0	0.0	0.0	0.0	0.00	-100.00	-18.9	100	0	100	-153
20. Kazakhstan CE	0.67	0.38	0.38	1.05	309.6	112.6	0.0	0.0	0.0	0.0	0.0	0.00	-100.00	-38.5	100	1	100	-153
21. Belarus	-0.18	-0.10	-0.10	-0.29	-66.3	-24.1	0.0	0.0	0.0	0.0	0.0	0.00	-100.00	-24.1	100	0	100	-153
22. Belarus CE	1.09	0.62	0.62	1.72	266.9	97.1	0.0	0.0	0.0	0.0	0.0	0.00	-100.00	-40.7	100	2	100	-153
23. ROW	0.00	0.00	0.00	-0.01	-1,363.5	-495.8	0.0	0.0	0.0	0.0	0.0	0.00	-100.00	-495.8	100	0	100	-153
0	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	-100.00	0.0	100	0	100	-153
0	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	-100.00	0.0	100	0	100	-153
0	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	-100.00	0.0	100	0	100	-153
0	0.00	-0.01	-0.01	0.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	-100.00	0.0	100	0	100	-153
0	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	-100.00	0.0	100	0	100	-153
0	0.00	-0.01	-0.01	0.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	-100.00	0.0	100	0	100	-153
0	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	-100.00	0.0	100	0	100	-153
0	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	-100.00	0.0	100	0	100	-153
0	0.00	-0.01	-0.01	0.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	-100.00	0.0	100	0	100	-153
0	0.00	0.01	0.01	0.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	-100.00	0.0	100	0	100	-153
0	0.00	-0.05	-0.05	0.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	-100.00	0.0	100	0	100	-153
0	0.00	0.71	0.71	0.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	-100.00	0.0	100	0	100	-153

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Annex 5. Scenario 3: China and all other countries invest ambitiously in the CR express and China signs FTAs with all countries on the CR express

SUMMARY OF GLOBAL RESULTS

	Produce Prices, Quantities, and Revenues -- change					Producer Surplus		Tax Revenue Effects			Downstream/Final Consumer Effects			Total Welfare	Employment			
	A	B	C	D	E	F	G	H	I	J	K	L	M	N = F+G+H+I+J+K	O	P	Q	R
	% change in OUTPUT	% change in PRODUCER PRICE	% change in FOB (or ex-factory) PRICE	% change in producer revenues	value of change in producer revenues	part 1, change in producer surplus	part 2, rents from under-takings	change in output taxes	change in export taxes	change in import taxes	change in consumer surplus	consumer prices, % change	total consumption, % change	Net welfare effects	Protected base employment, thousands	Change in protected employment, thousands	Downstream base employment, thousands	Change in downstream employment, thousands
1. China	0.72	0.41	0.41	1.14	25,489.1	9,268.8	0.0	0.0	0.0	-2,021.9	6,907.2	-0.40	1.20	14,154.1	100	1	100	2
2. China - CE	0.43	0.24	0.24	0.67	13,755.4	5,002.0	0.0	0.0	0.0	-1,534.0	4,580.8	-2.54	8.02	8,048.7	100	1	100	12
3. Russia	0.51	0.29	0.29	0.80	2,525.7	918.4	0.0	0.0	0.0	-180.2	1,211.0	-0.63	1.90	1,949.3	100	1	100	3
4. Russia - CE	1.09	0.62	0.62	1.72	4,181.9	1,520.7	0.0	0.0	0.0	-957.8	5,120.1	-0.47	1.42	5,683.0	100	2	100	2
5. Poland	-0.18	-0.10	-0.10	-0.28	-462.0	-168.0	0.0	0.0	0.0	-241.9	1,075.6	-0.34	1.03	665.6	100	0	100	2
6. Poland -CE	1.09	0.62	0.62	1.72	2,053.5	746.7	0.0	0.0	0.0	-55.2	268.1	-0.19	0.56	959.7	100	2	100	1
7. Germany	0.18	0.10	0.10	0.29	3,587.9	1,304.7	0.0	0.0	0.0	-700.1	2,864.8	-0.65	1.99	3,469.4	100	0	100	3
8. Germany CE	0.48	0.27	0.27	0.76	7,089.3	2,577.9	0.0	0.0	0.0	-421.2	1,966.2	-0.34	1.02	4,122.9	100	1	100	2
9. Spain	0.00	0.00	0.00	-0.01	-13.6	-4.9	0.0	0.0	0.0	-134.1	719.6	-0.50	1.51	580.6	100	0	100	2
10. Spain CE	0.34	0.19	0.19	0.53	1,024.5	372.5	0.0	0.0	0.0	-2,134.7	2,999.6	-7.50	26.35	1,237.4	100	1	100	40
11. Sweden	0.09	0.05	0.05	0.13	186.7	67.9	0.0	0.0	0.0	-1,048.7	1,286.6	-4.20	13.73	305.8	100	0	100	21
12 Sweden CE	0.12	0.07	0.07	0.18	184.1	66.9	0.0	0.0	0.0	-5,779.3	-20,900.7	0.08	-0.25	-26,613.1	100	0	100	0
13. Netherlands	-0.04	-0.02	-0.02	-0.06	-278.5	-101.3	0.0	0.0	0.0	0.0	0.0	0.00	-100.00	-101.3	100	0	100	-153
14. Netherlands CE	0.44	0.25	0.25	0.69	2,022.7	735.5	0.0	0.0	0.0	0.0	0.0	0.00	-100.00	735.5	100	1	100	-153
15. France	0.10	0.06	0.06	0.15	707.1	257.1	0.0	0.0	0.0	0.0	0.0	0.00	-100.00	257.1	100	0	100	-153
16. France CE	0.00	0.26	0.26	0.71	2,430.6	0.0	0.0	0.0	0.0	0.0	0.0	0.00	-100.00	0.0	100	1	100	-153
17. Czech Republic	-0.19	-0.11	-0.11	-0.30	-442.6	-161.0	0.0	0.0	0.0	0.0	0.0	0.00	-100.00	-161.0	100	0	100	-153
17. Czech CE	0.40	0.23	0.23	0.62	500.2	181.9	0.0	0.0	0.0	0.0	0.0	0.00	-100.00	-46.2	100	1	100	-153
19. Kazakhstan	0.61	0.35	0.35	0.96	403.2	146.6	0.0	0.0	0.0	0.0	0.0	0.00	-100.00	-54.5	100	1	100	-153
20. Kazakhstan CE	1.61	0.92	0.92	2.55	752.0	273.4	0.0	0.0	0.0	0.0	0.0	0.00	-100.00	-103.1	100	2	100	-153
21. Belarus	0.31	0.18	0.18	0.49	113.2	41.2	0.0	0.0	0.0	0.0	0.0	0.00	-100.00	-7.6	100	0	100	-153
22. Belarus CE	1.33	0.76	0.76	2.10	325.1	118.2	0.0	0.0	0.0	0.0	0.0	0.00	-100.00	-28.8	100	2	100	-153
23. ROW	-0.02	-0.01	-0.01	-0.02	-4,632.1	-1,684.4	0.0	0.0	0.0	0.0	0.0	0.00	-100.00	-1,684.4	100	0	100	-153
0	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	-100.00	0.0	100	0	100	-153
0	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	-100.00	0.0	100	0	100	-153
0	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	-100.00	0.0	100	0	100	-153
0	0.00	-0.01	-0.01	0.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	-100.00	0.0	100	0	100	-153
0	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	-100.00	0.0	100	0	100	-153
0	0.00	-0.01	-0.01	0.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	-100.00	0.0	100	0	100	-153
0	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	-100.00	0.0	100	0	100	-153
0	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	-100.00	0.0	100	0	100	-153
0	0.00	-0.01	-0.01	0.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	-100.00	0.0	100	0	100	-153
0	0.00	0.01	0.01	0.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	-100.00	0.0	100	0	100	-153
0	0.00	-0.05	-0.05	0.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	-100.00	0.0	100	0	100	-153
0	0.00	0.71	0.71	0.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	-100.00	0.0	100	0	100	-153

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