ERASMUS UNIVERSITY ROTTERDAM

Erasmus School of Economics

Bachelor Thesis [IBEB]

A review of how the train lines of the Belt and Road Initiative influence trade flows between China and Europe

Name student: Benjamin Gärtner

Student ID number: 475963

Supervisor: Sacha Kapoor

Second assessor: xxx

Date final version: xxx

Abstract:

This thesis investigates the effects of the Belt and Road Initiative's train lines on trade flows between China and Europe. The analysis extends research done by Li, Bolton & Westphal by adding new control variables and removing those thought to be superfluous. In spite of these changes this thesis finds similar results for the effect of a train connection on trade with China. These results imply that the train lines have a significant positive effect on European imports from China but no significant effect on European exports to China.

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1. Introduction

In 2013 the Chinese government unveiled a global development strategy which is now referred to as the Belt and Road Initiative (BRI). The project consists of various investments in different countries to foster relations and help develop better infrastructure in order to increase connectivity. The project is unique in the sense that it has a huge scale, it has been referred to as the largest infrastructure and investment project in history. The project covers more than 70 countries which amount to a third of global domestic product (Campbell, 2017).

China sees its connection to the developed European economic circle as vital for trade and policy objectives (Li, Bolton & Westphal, 2018). China's aim to move back to overland shipping signifies an attempt to revive the ancient silk roads of the past through the harnessing of new technologies. While railways have existed for over a century, they have become faster and more efficient in transporting goods. Arguably this method of transportation has been somewhat neglected when it comes to trade. A reason for this could be that other methods such as ocean or air transport do not need a complex and existing infrastructure to exist. The lack of a unifying track gauge - spacing between tracks- between Europe and the former Soviet Union highlight that existing infrastructure is poor when it comes to international trade via train. However, Railways have clear advantages over other forms of transport. First, when compared to ocean shipping railways are much faster and simultaneously have a lower impact on the environment (Reis, Fabian Meier, Pace & Palacin, 2013). Secondly, whilst air shipping may still be faster it is significantly more expensive than railways. Finally, research has shown that "railway networks are 50 percent more productive in promoting international trade" when compared to road networks (Li, Bolton & Westphal, 2018, p.276).

This thesis aims to replicate and extend upon the paper "The effect of the New Silk Road railways on aggregate trade volumes between China and Europe" by Yuan Li, Kierstin Bolton and Theo Westphal (2018). Their paper focuses on existing Chinese-European train lines, in order to conduct a pilot study to find the effect of railways on trade between Europe and China. Since the Belt and Road Initiative is relatively new the analysis focused on nine railways where the earliest started to operate in 2011 and the latest in 2015. The authors underline that it is "still too early to draw a conclusion" about the effects of the BRI, however they wish their study to be a "starting point" for an evaluation of the BRI's "potential effect on trade between China and Europe" (Li, Bolton & Westphal, 2018, p.276).

Much like the above paper this thesis will make use of the gravity model to investigate the trading patterns between Europe and China and to find out whether the railway connections found in certain countries have a significant effect on the flow of goods. This topic gives rise to the research question:

> *Do the train lines of the Belt and Road Initiative have a significant effect on trade between China and Europe?*

This thesis makes use of the data supplied by Professor Yuan Li and adds further control variables - population, IMF development stage and arable land per person - to add depth to the existing analysis. These control variables are particularly important when it comes to trade and have been omitted in the previous research. Upon analysing the data, this thesis found that the exchange rate variable added by Li et al. contributed little to the research and was thus removed from our research. This thesis will aim to see if similar results can be achieved in spite of the changes in order to find whether the explanatory effect of the train connection in Li, Bolton and Westphal's paper is accurate.

In a globalised age where trade is ever more important research evaluating specific projects such as the BRI is important. This is because it is vital to assess the efficiency and impact of such initiatives to see whether they are worthwhile. The BRI is especially relevant because it is currently still being developed and is one of the largest infrastructure projects of all time. Through this research one can assess how important the trainlines are for trade and what sort of impact they may bear for the future. Whilst the research this thesis is focusing on has been done before it is also important to note that a secondary view may be able to add depth and a different view to the existing findings.

The results of this thesis highlight that the train connections have no significant effect on total exports. The only export goods that are affected significantly are Food and Animals (SITC0). In contrast for the total imports and for the various individual categories of goods a significant positive effect was found.

2. Literature Review

2.1 Introduction to the literature

The most important piece of literature for this thesis is the paper "The effect of the New Silk Road railways on aggregate trade volumes between China and Europe" by Yuan Li, Kierstin Bolton and Theo Westphal (2018). This paper is the keystone of this thesis which aims to specifically build upon their research. The paper utilizes a gravity model to analyse how trade has been influenced along the train lines of the new silk road in order to find whether these train lines will yield a positive effect on trade. Their research concludes that the railway lines have a positive effect on a country's total imports from China (Li, Bolton & Westphal, 2018). For the exports to China only a positive relationship was found for the category of goods food and live animals (Li, Bolton & Westphal, 2018).

Li, Bolton and Westphal's paper can be regarded as unique as it addresses a major gap in the literature, as there are few papers that investigate the relationship between international trade and railway infrastructure. Furthermore, no specific academic papers were found that explored the specific relationship between the BRI railway lines and trade.

One can split similar research into two general fields. One field is the research on the belt and road initiative and the other is research into the impact of infrastructure on trade. Since the belt and road initiative is one of the largest economic projects of its time it has attracted a lot of attention. There exists qualitative research that aims to give an understanding of the motivation and framework of the project such as the research by Yiping Huang. Other research is more specific and empirical such as the analysis of debt implications by Hurley, Morris and Portelance.

2.2 Research specific to BRI

Yiping Huang's paper identifies two key motivations for the BRI, the first being a method to sustain China's economic growth (Huang, 2016). Huang describes how China's growth is slowing down due increasing costs in its export industry which make it less competitive (Huang, 2016). These changes signify that China's old growth model is no longer working. Huang sees the BRI as a Blueprint "to explore cooperation with new economic partners", these new partners are the countries situated between China and Central Europe many of which are underdeveloped (Huang, 2016, p.317). Huang proposes that China sees these countries as

"new growth pillar" which could turn into lucrative exports markets (Huang, 2016, p.317). In the future it will be interesting to also analyse the effect of the railway lines on such countries, however currently the trade between these nations and China is very small. It therefore makes sense that this thesis focuses mainly on Europe which at the moment is Chinas biggest trading partner. The second motivation identified is the eyeing of greater international economic influence. Huang (2016, p.318) states that the initiative can be used "to assert greater influence on international economic governance". Huang (2016) ends his paper with an assessment of the current situation and concludes that it is an ambitious project with a lot of potential. However, he also identifies key barriers such as the "lack of central coordination mechanism, potential clash of different political regimes and beliefs and financial viability of cross-border projects" (Huang, 2016, p.314).

Hurley, Morris and Portelance's paper examines the debt implications of the BRI from a policy perspective. Their paper describes that the BRI aims to deliver "trillions of dollars in infrastructure financing to Asia, Europe and Africa" (Hurley, Morris & Portelance, 2019, p.1). The paper describes that such infrastructure financing often involves lending from Chinese authorities to sovereign borrowers, such actions increase the risk of debt distress (Hurley, Morris & Portelance, 2019). The paper identifies eight countries which are particularly at risk these being; Djibouti, the Maldives, Laos, Montenegro, Mongolia, Tajikistan, Kyrgyzstan and Pakistan. Whilst this thesis will mainly be looking at the benefits of the BRI for trade it is also important to keep in mind the negative consequences that can occur and how China may be exploiting poorer nations for their own benefit.

Whilst an extensive amount has been written about the BRI there has not been much focus on how its infrastructure has influenced trade one reason for this could be that the project is not fully complete, and researchers have not yet regarded the topic as worthwhile. However, for such a large ongoing project it should be of great importance to review how the infrastructure has influenced trade in order judge the projects effectiveness so far as well as identifying weak points and strong points which could be improved upon.

One paper that is rather similar to that of Li, Bolton and Westphal is that of Garcia Herrero and Xu. They analyse whether Europe can expect trade gains from the BRI by using a gravity model to assess the impact of a reduction of transport costs on trade (Garcia-Herrero & Xu, 2016). However rather than analyse existing trade flows they try to simulate how trade would

change in the future due to the expected decrease in costs. Their research concludes that EU countries would be “clear winners” of the BRI as it is expected to create a lot of extra trade (Garcia-Herrero & Xu, 2016, p.11). Their models also highlight the Europe would benefit less if there were to be a free trade agreement for the countries along the BRI (Garcia-Herrero & Xu, 2016). Seeing as these researchers used simulations and also incorporated the sea routes into their analysis it will be interesting to see whether the analysis of this thesis can also find such positive results about the BRI.

The above research papers can be seen as important as they give the reader a good understanding of the Belt and Road initiative and its implications.

2.3 Research on infrastructure and trade

The other field of research is in the area how infrastructure influences trade. Much has been written in this area however primarily there has been a focus on roads and ports rather than railways, as can be seen in the papers of Nordås & Piermartini (2004) and Hummels (2007). The most likely reason for this is that Rail only makes up a very small amount of overall trade. As can be seen in figure 1, sea transport is the most preferred method with about 50% of trade using this method. Air transport is the second most used accounting for about 25%. Following this road accounts for about 15%, whilst rail is only used for around 2%.

Whilst rail is only used for a small percentage of trade this still amounts to huge numbers of goods. Furthermore, looking into the future, the BRI should ensure that a greater percentage of trade in goods utilises rail. In addition, current factors such as climate change also push for more eco-friendly and efficient modes of transporting goods. Railways offer an efficient way to transport goods over land with a low carbon footprint.

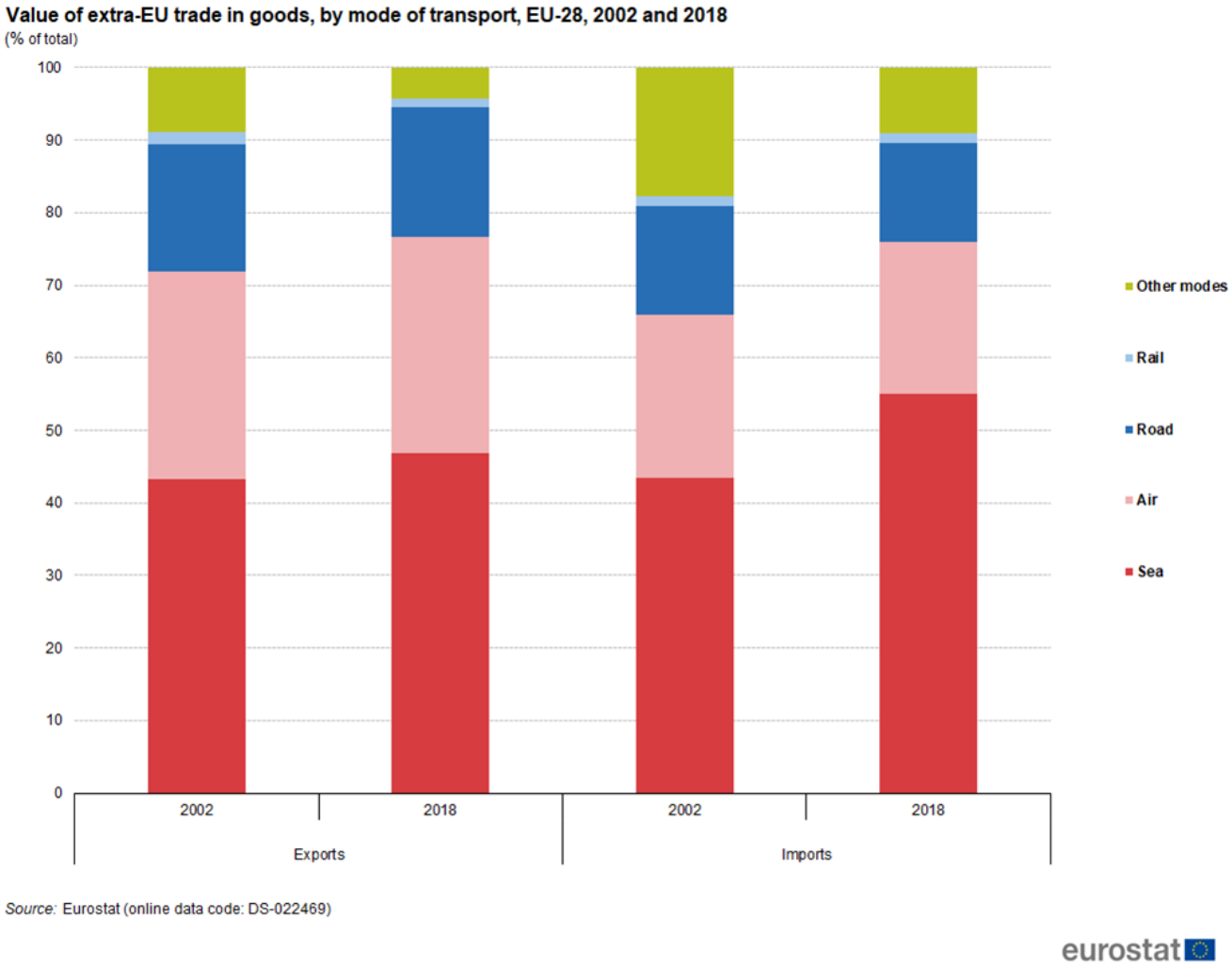


Figure 1: Data source: https://ec.europa.eu/eurostat/statistics-explained/index.php/International_trade_in_goods_by_mode_of_transport

Nordas and Piermartini's paper focuses on the link between the quality of infrastructure and a country's trade performance using a gravity model (Nordås & Piermartini, 2004). In their infrastructure analysis they include roads, airports, ports, telecommunications and the time required for customs clearance (Nordås & Piermartini, 2004). They conclude that the quality of infrastructure is an important determinant for trade performance with port efficiency having the largest positive impact on trade.

Hummels' paper investigates the effect of transportation costs on international trade with a focus on the second era of Globalization (Hummels, 2007). His paper concludes that both advances in technology and declining costs for air shipping were vital for the increase in trade (Hummels, 2007). He specifically highlights that air shipping grew from "an insignificant share of trade to a third of US imports by value" during the period 1955 to 2004 (Hummels, 2007,

p.152). For ocean shipping Hummels (2007) found that the overall costs did not change much and thus it did not have a significant impact during the second era of globalisation. Hummels (2007) ends his paper with the idea that telecommunication and internet may lead to a third era of globalization. The research of this thesis suggests that there may be another unidentified factor that could also lead to such a third era. This being the revolution in train transport that the BRI could cause.

Existing papers that do focus on railway infrastructure are more historic and pertain to times shortly after the invention of rail transport. Since technologies have changed since then one cannot be sure whether their results apply to today. Yet the findings may still have relevance to this analysis as they demonstrate existing effects that railways have had on trade. Furthermore, there are few modern-day large railway projects that the BRI can be compared to thus one must look into the past.

The first key paper in this field is that of Dave Donaldson which investigates the effects of colonial India's railroads. The analysis makes use of a general equilibrium trade model and finds that railroads "decreased trade costs and interregional price gaps" (Donaldson, 2018, p.899). Furthermore, results highlighted an increase in "interregional and international trade", as well as an increase in "real income levels" (Donaldson, 2018, p.899). This paper bears significance due to the fact that there is some similarity to the BRI. The British investment in railroads in India where a massive undertaking at the time. The railroads-built span over vast distances and connecting all of India as well as neighbouring countries such as Bangladesh and Pakistan. If these railroads where able to create such significant effects on trade it is likely that those of the BRI will also have such positive effects. Arguably due to the greater scale and advances in technology there should be a larger impact.

A further paper that investigates railroads is that of Robert William Fogel. He investigates the effect of railroads on economic growth. His paper highlights how railroads crowded out the use of canals and how there was a great increase in trade within the United states during this time (Fogel, 1962). Many economists have contributed this increase to the rail roads. However, Fogel's paper underlines that this is not necessarily a causal effect (Fogel, 1962). His analysis demonstrates that substitutes of the railway such as canals were simply abandoned due to slightly higher costs (Fogel, 1962). The analysis in the paper shows that the absence of railways would have only resulted in marginally higher costs (Fogel, 1962). The paper thus

concludes that railroads were not as vital for economic growth as some would think (Fogel, 1962). Such a conclusion is interesting as it suggests that the railway may not have a very large competitive advantage over other modes of transport. However, Fogel's analysis only represents 19th century America. There are no waterways or canals that would be able to connect China to Europe. Neither is there road infrastructure. Thus, it is likely that in the case of the BRI railroads have more importance.

Another paper investigating the effect of railways is that of B.R. Mitchell. His paper evaluates the extent to which the introduction of the railway contributed to United Kingdom economic growth (Mitchell, 1964). The paper describes how the take-off in UK growth "already occurred before the invention of the locomotive" the result of this is that railways are not seen as important as in other countries such as the US (Mitchell, 1964, p.315). The paper much like that of Fogel concludes that railways did not have a significant impact on the economy, they did however have an impact for a short time during their construction which created employment and stimulated "the iron and engineering industries" (Mitchell, 1964, p.333).

As can be seen from the literature review there is a clear gap in academic writing when it comes to the niche of the railways of the BRI. The existing literature on the BRI suggests this is a huge infrastructure project worthy of attention. Though since the initiative is still in its early stages not a lot of economic analysis has been done. The research is often more qualitative focusing on describing the projects undertakings and the political consequences. Of the more quantitative papers one focused on the niche of debt implications and the other is based on simulations to predict future effects rather than analysing the existing relationships. When investigating papers on the effect of infrastructure on trade it also became clear that train lines were mainly investigated in the past. In up to date research train lines in particular are often neglected and if they are included in the analysis, they are only a minor part. To an extent this makes sense as train lines are only used for a small fraction of trade. However, one must not fall trap to the bias that this volume of trade does not matter because it makes up a small percentage. Indeed, trains still transport huge amounts of goods and therefore are worthy of analysis.

3. Theoretical Framework

3.1 EU-China trade

The EU and China are both some of the biggest traders in the world. They trade a lot with each other which is shown by the fact that “China is the EU's biggest source of imports and its second-biggest export market” ("China - Trade - European Commission", 2020). In spite of the fact that they depend on each other so much for trade their relationship cannot necessarily be described as positive. Issues such as dumping, a lack of transparency and the disregard for intellectual property rights by China has been met with criticism from the EU. In an attempt to improve relations and have more stable trade the EU-China 2020 Strategic Agenda for Cooperation has been drawn up. A major part of this agenda is the aim for an investment agreement which would create investment rights to protect both Chinese and European investors from discrimination ("China - Trade - European Commission", 2020). Furthermore, the agreement would “improve transparency, licensing and authorisation procedures” in order to make investments easier and safer ("China - Trade - European Commission", 2020). Cementing an investment agreement would be a great way to further improve relations and also to prevent many of the issues currently surrounding trade between the partners. Whilst the agreement can be seen as more important for the EU in order to protect them from dubious actions by the Chinese it is also important for China to be able to establish themselves as respectable trading partners.

An analysis of the trade between China and the EU highlights that the EU mainly imports industrial and consumer goods, machinery and equipment, footwear and clothing from China ("China - Trade - European Commission", 2020). In contrast the EU mainly exports machinery and equipment, motor vehicles, aircraft, and chemicals to China ("China - Trade - European Commission", 2020). It is also important to note that the EU exports a greater number of services to China than it imports. This in addition to the type of goods traded demonstrates that the EU is a more developed block which is able to specialise in more high-end goods and services. In contrast China can be seen as more of a developing country which supplies basic goods and parts that the EU firms need in their production. Whilst it is currently the case that China still has a lot of manufacturing; they have slowly moved away from the image of producers of cheap low quality. The BRI can be seen as one method how China wants to improve its trading possibilities and relations in order to achieve such an aim.

The figure below highlights how trade between Europe and China has developed in recent years. European exports to China seem to have more than doubled whilst imports from China have seen an increase of about 70% from the years 2006-2016.

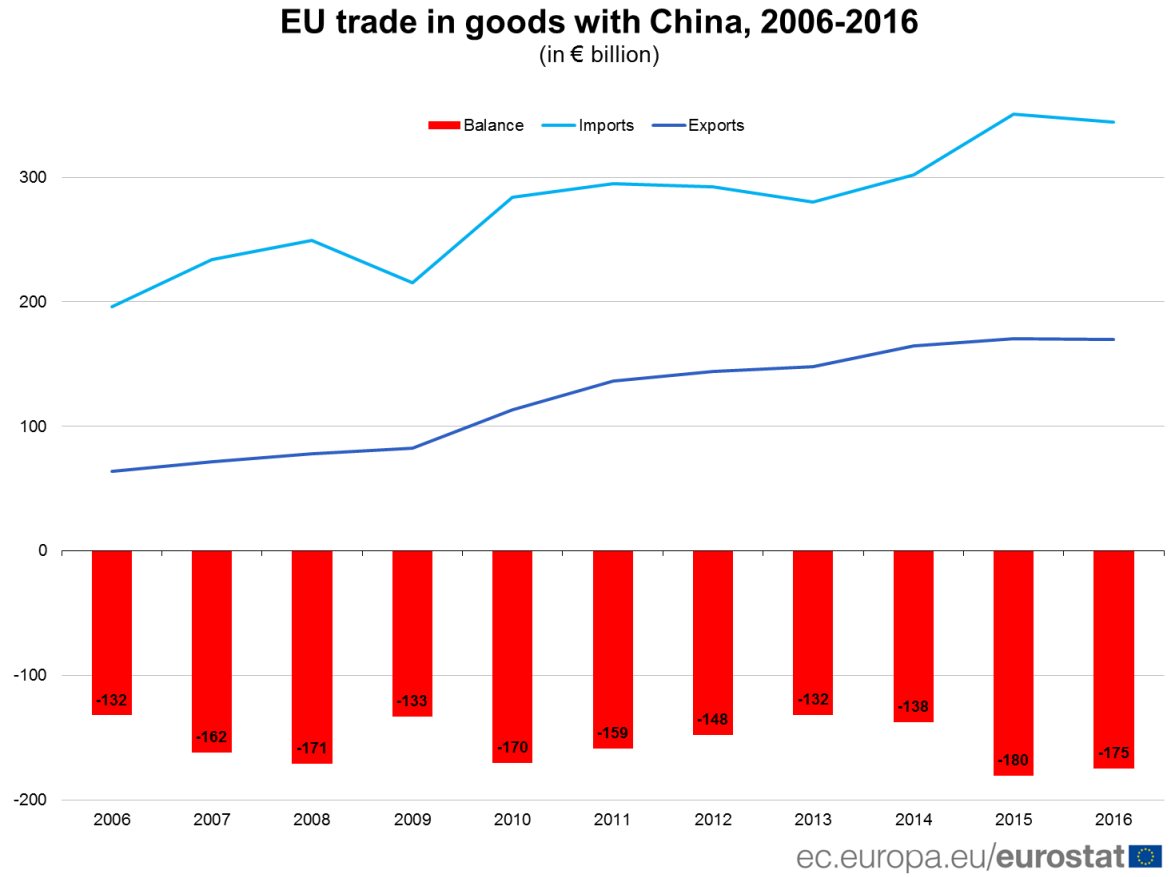


Figure 2: Data source: https://ec.europa.eu/eurostat/web/products-eurostat-news/-/EDN-20170601-1?inheritRedirect=true

3.2 Description of the belt and road initiative

The BRI is an infrastructure project that aims "to connect Asia with Africa and Europe via land and maritime networks along six corridors with the aim of improving regional integration, increasing trade and stimulating economic growth." ("Belt and Road Initiative (BRI)", 2020). The project can be split into two major parts, the first being the Silk Road Economic Belt which aims to connect China with the rest of Asia, Russia and Europe by land. The second part is the 21st century Maritime silk road which is a sea route connecting China to Asia, the south pacific, the middle east and eastern Africa and finally Europe ("Belt and Road Initiative (BRI)", 2020).

The project has five main objectives:

- policy coordination;
- infrastructure connectivity;
- unimpeded trade;
- financial integration;
- and connecting people.

It has been estimated that the initiative will cost over 1 trillion US$ in investments, whereby most of the money is directed towards infrastructure, power plants and telecommunication networks ("Belt and Road Initiative (BRI)", 2020). Moreover, the project has a wide range, it currently covers more than seventy countries which amount to 65% of the world's population and 1/3 of the world's GDP ("Belt and Road Initiative (BRI)", 2020).

3.3 Description of the train lines

This thesis focuses on the effect of a train connection on total trade with China. This section aims to give an overview of the different lines that exist by showing where they start and finish, what type of goods are transported and how often the trains run. The number of train lines and the various destinations should help outline the huge scale that this part of the BRI encompasses.

Between the years 2011 and 2015 nine railway lines connecting China to Europe started to operate (Li, Bolton & Westphal, 2018). The main railway line is named Yuxinou, it started operations in 2011 and starts in Chongqing and ends in Duisburg, Germany. This train line is seen as vital as Chongqing is a major production hub that specialises in laptop manufacturing (Li, Bolton & Westphal, 2018). According to Deng (2015) laptop computers account for almost half of the cargo shipped by this railway line. Duisburg is also of strategic importance as it is located in the heart of Europe and also has the largest inland port in the world. From Duisburg goods can be transported over the Rhine to a variety of destinations. The Yuxinou railway line operates on a fixed timetable which increases efficiency by making it easier for firms to ship their goods on schedule (Li, Bolton & Westphal, 2018).

Hanxinou is a further important line that originates in Wuhan and reaches its final destination in the Czech Republic. This line mainly transfers Foxconn – a large electronics manufacturer-

products as well as cars and building supplies (Li, Bolton & Westphal, 2018). The line also transports automobile parts from Europe to China on a weekly basis (Li, Bolton & Westphal, 2018).

The Sumanou railway begins in Suzhou – a city in south east China - and ends in Warsaw. It is considered one of the longest railway lines in the world (Li, Bolton & Westphal, 2018). It mainly transports electronics, machinery, clothing and household items (Li, Bolton & Westphal, 2018). The Rongou line also ends in Poland however it starts in Chengdu. The line transports electronic products, machinery, auto parts, and clothing (Li, Bolton & Westphal, 2018).

The Zhengou line originates in Zhengzhou and ends in Hamburg. This line was built to circumvent the old transport route that consisted of having goods from the Henan province transported to Qingdao and then to Europe via the sea (Li, Bolton & Westphal, 2018). The Hexinou line starts from Hefei and also ends in Hamburg. The journey takes around 15 days and covers approximately 11,000 kilometres (Li, Bolton & Westphal, 2018). The main goods transported are electronic and household appliances as well as textiles (Li, Bolton & Westphal, 2018).

The Xiangou line is unique in the way that it has 3 final destinations, these being Duisburg, Moscow and Tashkent in Uzbekistan (Li, Bolton & Westphal, 2018). The line mainly transports tea, porcelain, and automobile parts (Li, Bolton & Westphal, 2018).

Yixinou is a line that connects Yiwu to Spain, it has one of the greatest track lengths in the BRI (Li, Bolton & Westphal, 2018). According to Li et al. (2018, p.278) Yiwu “is a city famous for its small commodities” thus, the line transports miscellaneous goods to Spain. The train also transports popular Spanish products such as wine, cured ham and olive oil back to China (Li, Bolton & Westphal, 2018). Since this train line only began operations in 2014 the final Countries – Ukraine, France and Spain - who had not yet been connected are not considered in this study (Li, Bolton & Westphal, 2018).

Haou is one of the newest lines built only having begun operations in the summer of 2015 (Li, Bolton & Westphal, 2018). It originates in Harbin and ends in Hamburg. Much like with other lines its shipping contents include clothing, electronic components, and automobile parts (Li, Bolton & Westphal, 2018).

While this paper only analyses train lines up to the year 2014, it is still important to note that there have been a number of developments since then. The image below highlights the main trainlines from China to Europe, showing the individual cities where the lines end. As can be seen from the image since 2014 successful connections have been made to Finland, the United Kingdom, the Netherlands, Latvia, Hungary, Belarus and Spain. These new connections are numerous so this paper will only focus on the United Kingdom and the Netherlands as these can be seen as the most strategically important.

Figure 3: Data source: https://www.dsv.com/en/insights/expert-opinions/rail-freight-between-europe-and-china

The Yiwu-London railway line was opened in January 2017 (Josephs, 2020). The line spans a distance of 12,000 kilometres and the journey takes 15 days (Josephs, 2020). The line can be seen as strategically important as the UK is one of the largest economic players within Europe and the world. A number of UK firms such as Brand Avenue have stated that they see the potential of utilising such a rail connection as it is "quicker than sea and cheaper than air" freight services (Josephs, 2020). The Chengdu-Tilburg-Rotterdam express started operations in June 2017 (GVT, 2017). What is unique about this line is that it is also heavily utilised in the direction west to east which cannot be said for some of the other lines. Goods shipped to China include; cars, medicine, beer and machinery (GVT, 2017). A further distinguishing feature is the 'Get Ahead in Europe' initiative by the partners Logistiek Midden-Brabant and the Port of Rotterdam Authority, which aims to promote the advantages of funnelling trade through the Netherlands (GVT, 2017).

In table 1 below one can find an up to date overview of the Train lines discussed in the previous paragraph. The basis was taken from Li et al. (2018) and updated data on the frequency and duration was taken from DHL ("DHL", 2020).

Route	Distance (km)	Duration (days)	Connection start	Train frequency
Chongqing-Duisburg	**11,179**	**13-16**	**July 2011**	**Daily**
Wuhan-Melnik (CZ)/Pardubice (CZ)Turkmenistan	**10,863**	**16**	**October 2012**	**2-3x/week**
Suzhou-Warsaw	**11,200**	**18**	**November 2012**	**6-8x/week**
Chengdu-Lodz	**9,826**	**10.5**	**April 2013**	**6x/week**
Zhengzhou-Hamburg	**10,214**	**19-20**	**July 2013**	**4x/week**
Yiwu-Madrid	**13,052**	**21**	**November 2014**	**Irregular schedule**
Hefei-Germany	**11,000**	**15**	**June 2014**	**1x/week**
Changsha-Duisburg/Moscow/Tashkent	**11,808**	**18**	**October 2014**	**Every 10 days**
Harbin-Hamburg	**9,820**	**15**	**June 2015**	**1x/week**
Yiwu-London	**12,000**	**15**	**January 2017**	**1x/week**
Chengdu-Tilburg-Rotterdam	**10,947**	**15**	**June 2017**	**3x/week**

Table 1: Overview of the trainlines of the BRI, showing distance, transport duration, start of trainline and train frequency

3.4 The Gravity Model

The gravity model is an international Trade model that analyses bilateral trade flows based on the size and distance between two economies. The model was developed by Jan Tinbergen, it takes inspiration from Newtons law of gravity and hence suggests that trade increases if the distance between trading partners is smaller or when the trading partners are larger in economic size (Chaney, 2018). This is quite intuitive as it makes sense that economically larger countries would trade more for another. Furthermore, distance is a good control variable as with greater distance come more transportation costs, which are likely to reduce the amount of trade.

The equation for the basic model is: $$F_{ij} = G * \frac{M_i * M_j}{D_{ij}}$$

Where F is the trade flow between country i and j, G is a constant, M stands for the respective economic sizes of each country and D is the distance between the two countries. The constant G captures all other variables that influence trade flows.

The gravity model is relevant for this specific research on the BRI as we are investigating bilateral trade flows in order to find the effect of a rail connection to China has on trade. In order to control for the trade volumes between China and the respective European countries a gravity analysis works well. The method controls for both the distance and economic sizes of the trading partners. Furthermore, one can add additional control variables in order to achieve greater accuracy.

4. Methodology

4.1 Data and Data sources

Most of the data used stems from Yuan Li, who kindly provided the data set used in his paper. It is panel data made up of 28 countries from the year 2005-2014. The timeframe allows for a distinction between the time before the railway connections started operations and after (Li, Bolton & Westphal, 2018).

Li et al. (2018) reduce the number of EU countries by 3, due to the fact that Croatia, Bulgaria and Romania only joined the EU after 2007. Li et al. (2018) also add 3 countries namely Belarus, Kazakhstan and Russia due to the fact that they are important way points for the belt and road initiative. Most of the railways analysed pass through these countries.

The trade data in the set was taken from the WITS databank and is the Standard International Trade Classification (SITC) revision 3 (Li, Bolton & Westphal, 2018). These trade volume data are divided into 10 categories such as crude materials, manufactured goods or food and animal products (See table 2 forreference). The trade data includes exports from the countries to China and the imports received from China. The data is in gross format, meaning re-imports and re-exports are taken into account (Li, Bolton & Westphal, 2018). These export and import figures are the dependent variables of the analysis.

Sitc Classification	Description
SITC0	**Food and live animals**
SITC 1	**Beverages and tobacco**
SITC 2	**Crude materials, inedible, except fuels**
SITC 3	**Mineral fuels, lubricants and related materials**
SITC 4	**Animal and vegetable oils, fats and waxes**
SITC 5	**Chemicals and related products**
SITC6	**Manufactured goods**
SITC7	**Machinery and transport equipment**
SITC8	**Miscellaneous manufactured articles**
SITC9	**Commodities and transactions**

Table 2: SITC categories explained

Li et al. (2018) also include the weighted tariff average in their data, this is done to “reflect the average numeric more realistically” (Li, Bolton & Westphal, 2018, p.282). The advantage of the weighted average tariff over a simple average is that it makes distinctions between

products and takes into account the amount these goods are exported and imported (Li, Bolton & Westphal, 2018).

Li et al. (2018) state that google maps was used to calculate the direct distance between the capitals of the various 28 countries and Beijing. Furthermore, a dummy was added where landlocked countries were assigned a “1” and those with access to the sea were assigned a “0” (Li, Bolton & Westphal, 2018). Important to note is that Li et al. (2018) regarded the Caspian Sea as being unimportant for international trade and therefore recorded Kazakhstan as landlocked.

A dummy variable was also used to signify whether a country had a railway connection to China in that specific year. Here a “1” signified a railway connection and a “0” no railway connection. Li et al. (2018) collected GDP data from the IMF World economic outlook database. Furthermore, official exchange rate data was collected from the World Bank (Li, Bolton & Westphal, 2018). However due to the fact that the exchange rate is largely fixed and that we believed it to add little value to the analysis this variable was omitted in the research done by this thesis.

To add to Li’s data three control variables were chosen that were thought to likely have a significant effect on the volume of trade. The first of these variables is population. Population is likely to influence trade because the amount of people also effects the amount consumed and produced. Thus, it is likely that a country with a higher population imports and exports more. Though, it is likely that population will affect the imports of a country more. The population data was collected from the World Bank data base for the years 2005-2014. The second variable that was added was the development stage of the country, this is a dummy variable that takes the value 1 if the country is developed and 0 if the country is not developed. The data for this was taken from the IMF developing countries list. This variable was included because ‘Developed Countries’ are often more economically active and therefore trade more. Finally, the third variable that was added was the hectares per person. The idea behind this was that countries with more space per person are likely able to produce more themselves and thus will export more and import less than countries with less hectares per person. This data was also retrieved from the world bank database.

4.2 Gravity Model applied

This paper will make use of the empirical model used in Li, Bolton and Westphal's paper, which is described by the equation:

$y_{it} = \beta\ railcon_{it} + \gamma\ X_{it} + \varepsilon_{it}$

Where y_{it} is a dependent variable, made up of the import/export data of various countries trade with China. Regression models will also be run for each subcategory denoted by the SITC codes to see whether there are any differences for specific types of goods. Railcon is a dummy variable indicating whether the country has a railway connection with China. The β is the coefficient of the dummy and should have a positive sign if the hypothesis of Li, Bolton and Westphal's paper holds (Hypothesis: Railway connection will increase the connected country's imports/exports with China). The variable X can be defined as a set of control variables that influence trade with China. The control variables taken from Li, Bolton and Westphal's analysis include the weighted tariff average, distance, whether the country is landlocked, GDP and Chinese GDP. Furthermore, the variables population, stage of development and arable land were added for further depth.

In order to interpret the estimates of this equation causally one needs to make a number of assumptions. First, we are in a natural setting and thus there is no randomisation which would ensure that we would find the casual effect of our treatment (railway connection). Due to this we have to control for observable factors that influence the value of trade between countries. The disadvantages of doing this is that there are many factors that influence this, and it is difficult to distinguish the most important ones. The analysis of this thesis has done its best to include the most important factors influencing trade however it is possible that some influencing factors are missing. In addition, there are also unobservable factors which cannot be controlled for.

A further important assumption of multiple regression is that there is no major correlation between the independent variables. This can easily be tested by creating a correlation matrix as seen in table 3.

	Rail connection	Distance (km)	yuan-usd exchange rate	yuan-euro exchange rate	Landlocked	Country GDP	China GDP	Population	Arable land	IMF Development
Rail connection	1									
Distance (km)	-0.2852	1								
yuan-usd exchange rate	-0.2794	-0.0056	1							
yuan-euro exchange rate	-0.316	-0.0062	0.8588	1						
Landlocked	0.138	-0.2001	-0.0026	0.0029	1					
Country GDP	0.149	0.2066	-0.0696	-0.0587	-0.3165	1				
China GDP	0.3213	0.0081	-0.9422	0.9404	0.0037	0.0657	1			
Population	0.2319	-0.0247	0.0102	0.0122	-0.2715	0.7907	-0.017	1		
Arable land	0.2586	-0.8138	0.0067	0.0045	0.26	-0.1797	-0.0083	0.0905	1	
IMF Development	-0.2491	0.5833	-0.1112	-0.1172	-0.252	0.2578	0.1198	-0.0762	-0.6396	1

Table 3: Correlation between independent variables

The most important variable in this diagram is the rail connection as it is the variable of interest. The correlation between the rail connection and the other control variables is very low meaning one can interpret the rail connection without any problems with respect to correlation. The table also highlights that the exchange rate variables have very high correlation with each other and with the Chinese GDP due to this and the fact that omitting them had little effect on the regression outcome they were removed from the analysis. Whilst the correlation between population and country GDP was also relatively high the regression analysis signified that omitting one of these variables would have had a noticeable effect on the regression outcome. This resulted in both variables being kept for the later regression analysis.

Another assumption of regression analysis is that there must be homoscedasticity of the error terms. This can be tested by doing the Breusch-Pagan test. The test resulted in a p-value of 0.000, meaning one must reject the null hypothesis of constant variance. This means we have heteroscedasticity, a solution to this problem is using robust errors, which was done in this analyis.

4.3 Hypothesis

Having read Li, Bolton and Westphal's paper and other surrounding literature this thesis' first hypothesis is: "The rail connection will have little to no impact on the value of exports". This hypothesis was formed due the fact that the surrounding literature such as Li et al. (2018)

highlighted that the BRI is mainly used from direction east to west. This means that trains are mainly utilised by the Chinese for transporting goods to Europe. Since European countries do not utilise the train lines enough many trains return to China empty. The result of this is that the train connection will have little effect on the exports to China as these exports will mainly still be using air and sea freight. Our second hypothesis is: "the rail connection will have a significant positive effect on the value of imports". Since the train lines are heavily utilised by China to transport goods to Europe it can be expected that their introduction will have a positive effect on trade.

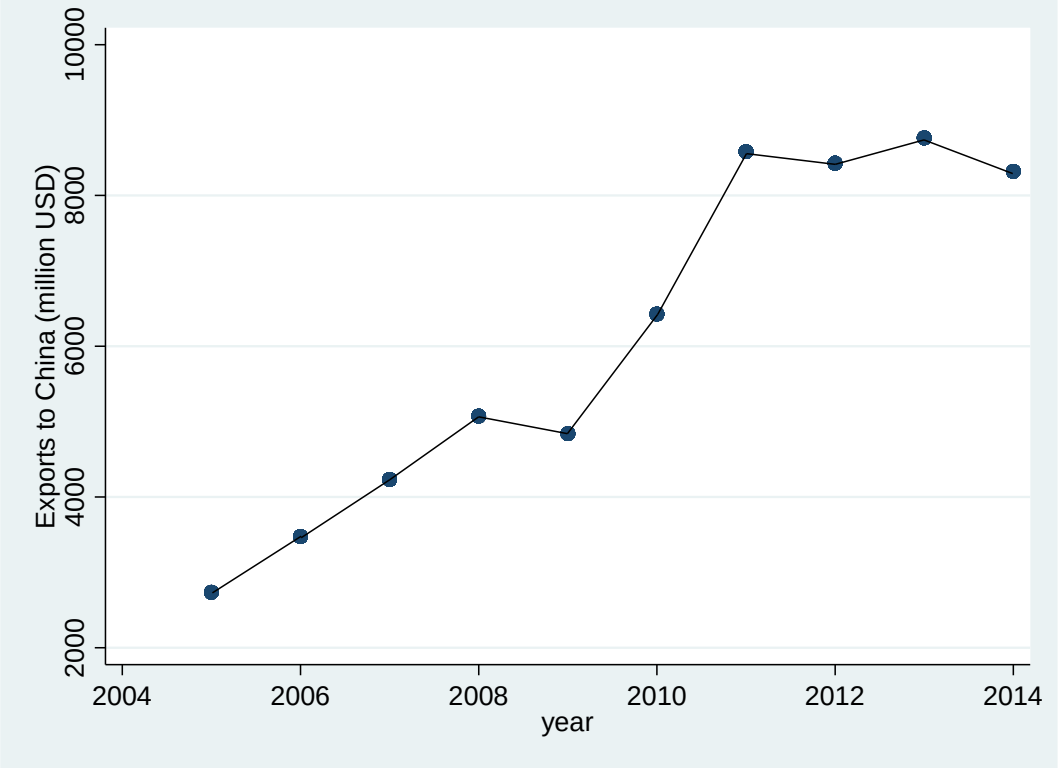
Since this thesis adds new control variables to the analysis there will also be a short discussion on their expected effects. We expect there to be higher exports with more arable land per person and also less imports. Yet we believe this will mainly hold for the category of food and livestock because more arable land is especially useful in agriculture. For the IMF development we believe that there should be a significant positive effect for countries that are developed as these can be expected to trade more. Finally, we propose that for the population there should be a higher effect for the imports than the exports, but both should be positive. This deduction come from the fact that a country with a high population likely needs to import a lot in order to meet the demands of the many consumers. Conversely a country with many people is also likely to produce more and thus export greater amounts. Yet, due to the fact that production in many developed countries is driven by technology and machinery it is likely that the effect on exports will not be very large.

5. Results

5.1 Basic relationships

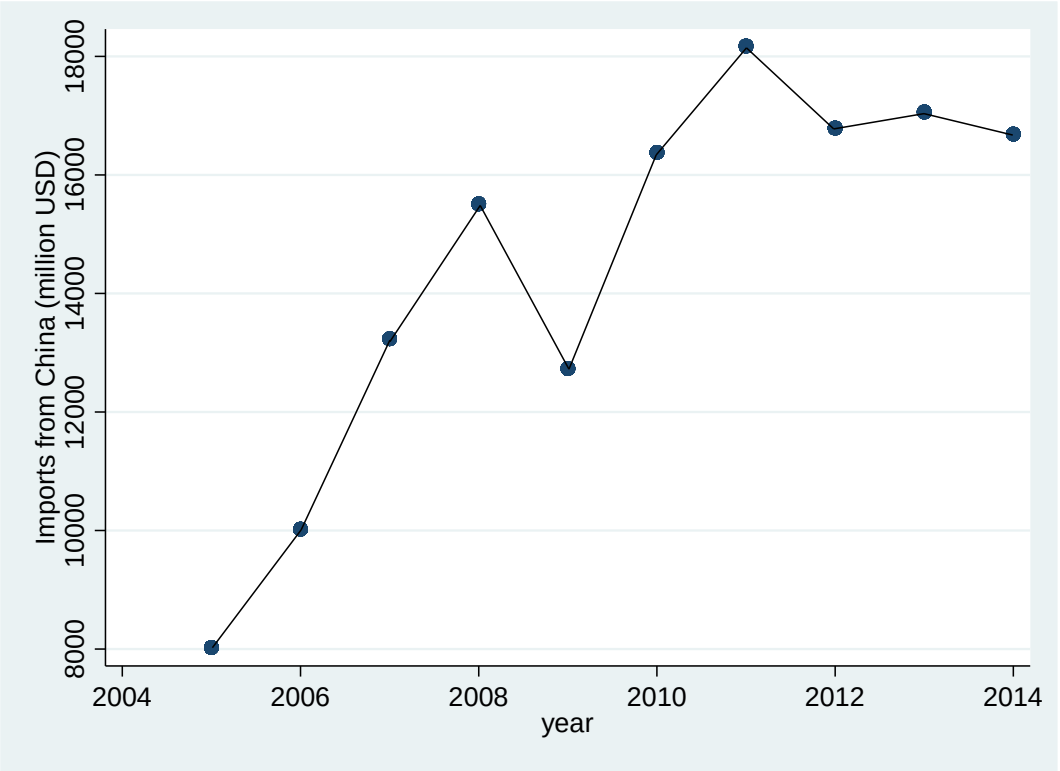
Before diving into the regression results, this paper will investigate some basic relationships between the variables found. First it is interesting to see how trade between Europe and China has developed over the years. In order to see this relationship a scatterplot of the mean total exports and import in millions of USD were plotted against time. Graph 1 highlights how the exports to China from Europe developed from 2005 to 2014. The data highlights that the mean volume of trade for Europe tripled during this time period. This significant increase is due to China opening up to more trade and also needing goods from Europe for production.

Furthermore, it is likely that China's large increase in population necessitated a greater influx of goods from Europe. The graph highlights that the financial crisis of 2008 had a slight negative impact on trade shown by the decrease in 2009. However, the graph demonstrates that exports quickly picked up 2010.



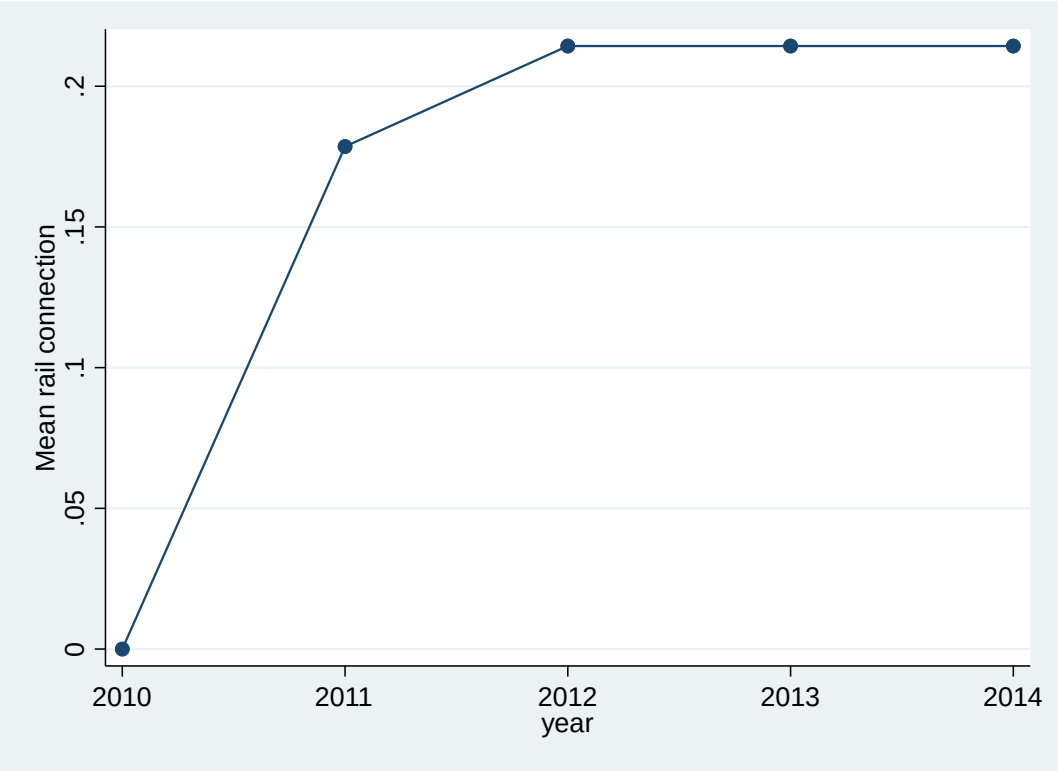
Graph 1: Plot of mean exports (million USD) to China over time

The graph 2 shows the mean value of European imports from China. Looking at the mean total value it is clear that this is much higher for the imports. A reason for this is that China during this time especially was a manufacturing powerhouse meaning that many goods consumers demanded came from China. Another stark difference to the graph above is the decrease during the financial crisis which is much more pronounced. However, much like with the previous graph there is a bounce back in 2010 that continues the overall upward trend until 2011 after which both graphs level out.



Graph 2: Plot of mean imports (million USD) from China over time

Another important relationship to analyse is that of how the train lines are completed over the years. This can be done by looking at the average of the dummy variable which signifies whether a country has a rail connection to China or not. Graph 3 below signifies that until 2010 no country within Europe had a rail connection. Then in 2011 there was a stark increase which suggests that a couple countries received a connection at once. Following this in 2012 an additional number of countries got connected albeit fewer than in the previous year. From 2012 to 2014 no new connections were made, though in the years -not part of the dataset- following these numerous countries received connections. Whilst the graph does not convey much detail one can glean that the Chinese are building the railway connections quickly and in stages. It seems as though China likes to complete numerous connections at once before moving to the next stage. Evidence such as the fact that both the Line to London and Tilburg-Rotterdam were completed in 2017 suggests this pattern continues.



Graph 3: Plot of mean rail connection over time

The next stage of the analysis focuses on how the regression changes as control variables are added.

5.2 Adding controls to the regression model

Before moving to the final models, this thesis investigated the effect adding control variables had on the outcome. For both exports and imports four models were run. The first was a model with only the rail connection as independent variable. The second model is a simple gravity analysis, it only includes distance, Chinese GDP and country GDP as control variables. The third model includes all final control variables chosen. The fourth model adds country and year dummies for greater accuracy.

Table 4 and 5 below highlight that with each model the R^2 increases, which suggests the later models fit the data better. A further interesting note is that adding country and year dummies had a greater effect on the train connection variable for imports than exports. Additional observation tells us that using only the gravity model specifications in model 2 already yielded a consistent result for the train connection. This is because after adding multiple control

variables in model 3 the coefficient for the train connection did not change by much. This observation holds for both exports and imports.

Variables	1- Log total exports	2- Log total exports	3- Log total exports	4- Log total exports (With Country + Year dummies)
Rail connection	0.733***	-0.0679	-0.0381	-0.0825
	(5.48)	(-0.69)	(-0.40)	(-0.93)
Distance (km)		-0.000181	-0.000116	-0.00189***
		(-0.71)	(-0.54)	(-4.97)
Country GDP (billion USD)		0.000590***	0.000494**	0.000141
		(3.56)	(3.05)	(0.87)
China's GDP (billion USD)		0.000136***	0.000122***	0.000164***
		(15.91)	(14.48)	(15.51)
Tariff			-0.00317	-0.0241
			(-0.15)	(-1.25)
Landlocked			0.902*	-14.76***
			(2.06)	(-6.68)
Arable land (hectares per person)			0.529	-1.378*
			(1.01)	(-2.18)
IMF development			0.639***	0.473***
			(5.68)	(4.78)
Log Population			0.885***	-5.184***
			(6.13)	(-5.90)
Constant	7.007***	7.200***	-8.170**	118.1***
	(18.17)	(3.81)	(-2.89)	(6.37)
N	279	279	279	279
R^2	0.057	0.47	0.81	0.99

t statistics in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 4: Shows how the regression model for total exports changes as control variables are added

Variables	1- Log total imports	2- Log total imports	3- Log total imports	4- Log total imports (With Country + Year dummies)
Rail connection	0.678***	0.178	0.183*	0.319***
	(6.92)	(1.95)	(2.00)	(4.13)
Distance (km)		0.0000533	-0.0000689	0.000864**
		(0.26)	(-0.50)	(2.70)
Country GDP (billion USD)		0.000736***	0.000395**	0.000189
		(5.05)	(3.01)	(1.34)
China's GDP (billion USD)		0.0000667***	0.0000680***	0.000103***
		(8.50)	(7.54)	(10.81)
Tariff			0.0186	0.0760***
			(0.90)	(3.94)
Landlocked			0.406	2.575
			(1.67)	(1.39)
Arable land (hectares per person)			-0.473	1.150*
			(-1.17)	(2.16)
IMF development			0.424***	0.376***
			(4.13)	(4.51)
Log Population			0.891***	1.524*
			(9.51)	(2.07)
Constant	8.369***	7.141***	-6.326***	-26.27
	(25.88)	(4.81)	(-3.67)	(-1.69)
N	279	279	279	279
R^2	0.045	0.56	0.86	0.99

t statistics in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 5: Shows how the regression model for total imports changes as control variables are added

5.3 Regression Results exports

Finally, we will analyse the regression results. The regression tables show the models with the most noteworthy results (full table containing results for all sitc goods classifications can be found in the appendix). Mainly models with a significant result for the rail connection were chosen as this is the focus of the thesis. First, we will be looking at the regression results for the exports (table 6).

The interpretation of a log-level regression coefficient is as follows:

1. $\frac{\Delta totaltrade}{total\ trade} = \Delta railconnection \times \beta_1$

2. $100 \times \frac{\Delta totaltrade}{total\ trade} = 100 \times \Delta railconnection \times \beta_1$

3. $\%\Delta totaltrade = 100 \times \Delta railconnection \times \beta_1$

In the first step one differentiates to get rid of the logarithm, one ends up with the change in total trade divided by total trade being equal to the change in rail connection times by the coefficient β_1. One then multiplies both sides by 100, in order to get the percent change in total trade. Finally, one can interpret the coefficient in step 3 as the fact that $\beta_1 \times 100$ is the percentage effect the rail connection has on total trade. It is also important to note that the coefficient has to be statistically significant so that one can reliably interpret the results.

The first model (see table 6 below) has log of total trade as a dependent variable, one can see that the coefficient is not significant thus one can conclude there is no clear effect of a rail connection on the total exports of a country to China. This is in line with our first hypothesis. There are however coefficients of variables that are significant. The first being distance, here the coefficient is small but negative. The coefficient can be interpreted as the fact that the increase in distance of 1-kilometre causes exports to be reduced by 0.189 percent ceteris paribus (Model 1 table 6). This is in line with the gravity model theory that suggests greater distance reduces trade flows. The variable landlocked is also negative which makes sense as countries with no connection to the sea may be able to trade less with China because they can't ship their goods directly using sea freight. However, the coefficient of landlocked is extremely high suggesting that being landlocked decreases trade flows by an immense amount, thus this result needs to be regarded with caution. Chinese GDP is a further variable that is significant. The coefficient implies that when Chinese GDP increases by 1 billion US$ then trade will increase by 0.0141 percent. The IMF development stage is also significant the variable suggests that a developed country will have 47.3% more trade than a developing country. This result is in line with our hypothesis for this variable. The coefficient for arable

land is only significant when the year dummies are added in. The coefficient suggests that the more arable land a country has the less it exports, this goes against our proposed hypothesis. Finally, the logarithm of population is significant. The interpretation of this coefficient is that when population is increased by 1% this will cause exports to go down by 5.184%. This goes against the theory proposed by this thesis which suggested a greater population would result in more trade.

Next, we will look at the SITC categories 0 and 3 (models 2 and 3 in table 6). SITC 0 is the trade of food and live animals. For this specific area of exports one can see a high coefficient of around 1 this suggests that having a rail connection increase the trade in this category by about 100.5%. The only other variable that is significant is that of Chinese GDP which has a similar affect as with total trade. For SITC 3 which is trade in Mineral fuels, lubricants and related materials, a rail connection seems to significantly reduce trade. The coefficient suggests that trade is reduced by 150% due to the rail connection. There seems to be no rational explanation why this could be the case as it does not make sense that a simple rail connection would have such a negative impact on exports of sitc3 category goods. This abnormal result could suggest problems with our analysis. The only other significant variable in model 3 is Chinese GDP which has almost the same effect as on the SITC0 goods.

Variables	1- Log total exports (With Country + Year dummies)	2 - Log sitc0 exports (With Country + Year dummies)	3- Log sitc3 exports (With Country + Year dummies)
Rail connection	-0.0825	1.005**	-1.510*
	(-0.93)	(2.80)	(-2.57)
Tariff	-0.0241	-0.0314	-0.193
	(-1.25)	(-0.39)	(-1.50)
Distance (km)	-0.00189***	-0.000469	0.000350
	(-4.97)	(-0.31)	(0.14)
Landlocked	-14.76***	-8.979	7.313
	(-6.68)	(-1.00)	(0.51)
Country GDP (billion USD)	0.000141	-0.000452	0.00142
	(0.87)	(-0.69)	(1.37)
China's GDP (billion USD)	0.000164***	0.000278***	0.000264***
	(15.51)	(6.51)	(3.85)
Arable land (hectares per person)	-1.378*	-1.461	4.925
	(-2.18)	(-0.58)	(1.25)
IMF development	0.473***	-0.00284	0.742
	(4.78)	(-0.01)	(1.04)
Log Population	-5.184***	-1.652	4.890
	(-5.90)	(-0.46)	(0.85)
Constant	118.1***	39.97	-91.85
	(6.37)	(0.53)	(-0.76)
N	279	270	241
R^2	0.99	0.92	0.88

t statistics in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 6: Regression Models showing results for total exports, sitc0 exports and sitc3 exports to China

5.4 regression results imports

The results for the total value of imports (see table 7 below) highlight that a rail connection did have a significant effect. The coefficient implies that countries with a rail connection have

31.9% more imports. This is in line with our second hypothesis. Furthermore, opposing theory tariffs were found to have a positive effect on trade, if tariffs increase by 1 percent then imports increase by 7%. A reason for these findings could be reverse causality, meaning that tariffs are higher because trade is higher. Distance was also found to have a positive effect which goes against the gravity model theory. The coefficient suggests that an increase in distance of one-kilometre increases trade by 0.0864%. In addition, a significant effect was also found for Chinese GDP, like with exports it had a positive effect. An increase of Chinese GDP of 1 billion US$ will cause imports to increase by 0.01%. Furthermore, if a country is classified as developed it will have 37.6% more trade. Finally, the results describe that a 1% increase in population will cause a 1.524% increase in trade, unlike with the results for exports this conforms to theory. These results also conform to our hypothesis that there will be a greater positive effect of population for the imports when compared to exports.

Whilst total imports were affected by the train connections an interesting find was that this did not hold for all categories of goods. For the SITC5 goods which are chemicals and related products no significant results were found for a train connection, however the rest of the coefficients were in close proximity to that of total imports. The SITC6 category which is manufactured goods had a slightly lower coefficient of 0.231 for the train connection. This suggests whilst the train lines did have a positive effect it was not as much as for other good classifications. Finally, for both the SITC goods 7 and 8 the coefficients highlight a significant effect upwards of 30% on imports. Also, the effect of population was slightly higher for both these good classifications. For both a 1% increase in population caused a more than 2% increase in trade.

Variables	1- Log total imports (With Country + Year dummies)	2- Log sitc5 imports (With Country + Year dummies)	3- Log sitc6 imports (With Country + Year dummies)	4- Log sitc7 imports (With Country + Year dummies)	5- Log sitc8 imports (With Country + Year dummies)
Rail connection	0.319***	0.0574	0.231**	0.334**	0.394***
	(4.13)	(0.89)	(3.00)	(3.13)	(4.30)
Tariff	0.0760***	0.0571***	0.0811***	0.0706**	0.0896***
	(3.94)	(3.52)	(4.21)	(2.64)	(3.91)
Distance (km)	0.000864**	0.000694**	-0.000297	0.00109*	0.00120**
	(2.70)	(2.58)	(-0.93)	(2.47)	(3.16)
Landlocked	2.575	0.514	-4.100*	4.120	4.450*
	(1.39)	(0.33)	(-2.21)	(1.61)	(2.02)
Country GDP (billion USD)	0.000189	0.0000288	0.000288*	0.000189	0.000227
	(1.34)	(0.24)	(2.05)	(0.97)	(1.36)
China's GDP (billion USD)	0.000103***	0.000169***	0.000117***	0.000104***	0.0000908***
	(10.81)	(21.09)	(12.31)	(7.89)	(8.00)
Arable land (hectares per person)	1.150*	1.261**	0.0720	1.512*	0.898
	(2.16)	(2.82)	(0.14)	(2.06)	(1.42)
IMF development	0.376***	0.0473	0.250**	0.466***	0.206*
	(4.51)	(0.68)	(3.02)	(4.05)	(2.08)
Log Population	1.524*	0.789	-1.246	2.213*	2.218*
	(2.07)	(1.28)	(-1.70)	(2.18)	(2.54)
Constant	-26.27	-14.35	31.13*	-41.49	-42.54*
	(-1.69)	(-1.10)	(2.01)	(-1.93)	(-2.30)
N	279	279	279	279	279
R^2	0.99	0.99	0.99	0.98	0.98

t statistics in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 7: Regression Models showing results for total, sitc5, sitc6, sitc7 and sitc8 imports from China

5.5 Discussion of results

When comparing the regression results of this thesis with those achieved by Li, Bolton and Westphal no significant difference was found when it came to the railway connection. For total exports this thesis likewise found no significant effect. We also found the significant effect of around 100% for the SITC0 categorised goods. However, this paper did find a significant negative result of about 150% for the rail connection on SITC3 goods exports. These results were not mentioned by Li, Bolton and Westphal, a reason for this could be that they go against their proposed hypothesis. For the imports all results for the train connection were also similar suggesting that the added control variables did not take away any of the explanatory effect.

One of the most interesting findings of this study is the fact that there is such a large disparity between the exports and imports when it comes to the effect of the rail connection. Li et al. (2018) explain this by the idea that many trains take cargo from China to Europe but drive back empty. They suggest that the only significant effect for exports which is found for food and animals is due to the fact that these are most easily transported by train. For food Li et al. (2018) offer the explanation that the shorter travel time allows for the export of perishable goods. Yet these could also be transported by air. Instead it is more likely that it is the animals driving this increased use of trains as long sea journeys are difficult for animals and air freight often does not allow their transportation.

For imports generally a positive significant effect was found for the rail connections, with the SITC 8 goods profiting the most. One reason for the increased use of trains from China to Europe is the fact that the BRI is a Chinese project and is thus heavily promoted. Furthermore, it could be that the types of products that China exports are more suited towards train transport. Since a lot of manufacturing such as clothing is cheap but also needs to be delivered quickly due to changing trends it makes sense to use train transport. In contrast excusive goods transported from Europe to China may be better suited for air freight. Also, goods that do not require a quick delivery time can be transported by sea.

5.6 Discussion on causality and the limitations of the analysis

As stated earlier in section 4.2, regression is subject to a number of assumptions in order to be able to interpret results as causal. Whilst regression is good for identifying relationships between variables it is difficult to conclude a causal relationship. Factors such as possible omitted variable bias, reverse causality and the fact that the heteroscedasticity assumption was violated are clear problems. Thus, one cannot interpret the results of this paper as indicative that the train lines definitely cause greater trade for imports from China.

As already stated by Li et al. (2018) the results of this research need to be interpreted with caution as there are also many limitations to be found. For one the BRI is in its early stages meaning that we do not have a wide range of data for the train connections. Another limitation is that this study does not use a random sample but rather a “convenience sample, including the countries, which were connected by railway and the EU-25 countries as a control group” (Li, Bolton & Westphal, 2018, p.287). Therefore, the analysis can be classified as a semi-natural experiment whereby the rail connection between China and a given country is the

main independent factor, which explains the outcome variable (trade values) (Li, Bolton & Westphal, 2018). A further limitation brought up by Li et al. (2018, p.287) is the fact that the effects of the rail connection could be "caused by some confounding variable". Since this thesis identified further control variables that did not change the effect of the rail connection by much it can be concluded that such a variable could not be identified. Further research could come up with additional variables to add to the study to see if such a confounding variable can be found. Finally, a further limitation was found that was not mentioned by Li et al. When looking at the data sources it was found that the export and import figures had great differences depending on who was the reporter. Li et al. used the reporting's of the various European countries however, an analysis using figures reported by the Chinese could very well yield different results. Though one must note that the values reported by the European countries are more likely closer to the 'true value' as China has been known to manipulate its data. In spite of these limitations we agree with Li et al. (2018) that the results found in this study can be used as approximations for the effect of the railways as the analysis is statistically and logically sound. The fact that changing the data yielded similar results for the coefficients of the train connection support this idea.

6. Conclusion

The Belt and Road Initiative is an ambitious project which aims to improve China's trading abilities through the creation of new infrastructure and partnerships. The railways connect the east to the west much like the silk roads of ancient times and are a key pillar of the BRI. It has been proposed that these train lines could give birth to a new transport revolution, thus giving rise to increased trade. This thesis has added further control variables and personal insights to an existing analysis of the train connections to find out what effect these connections have had on trade so far.

The regression analysis undertaken by this thesis has highlighted that the train connections have no effect on total exports. In fact, the only export goods that are affected significantly are Food and Animals (SITC0). In contrast for the total imports and for the various individual categories of goods a significant positive effect was found for the train connections which can be explained by the fact that as a Chinese project the BRI is mainly utilised by Chinese firms. Since the project is still in its early days it is likely that the train connections will cause greater increases in trade. Furthermore, as there is increased use of this transportation method it is

likely that European firms will realise the value and start utilising the train connections for exports to China. Whilst it is still too early to say with the train lines will cause a proper transport revolution this analysis has demonstrated that the trainlines can have a major impact on trade. This is highlighted by positive trade effects of up to 100% caused by the train lines.

This thesis in combination with that of Li et al. can be seen as a first step towards analysing the effect of the rail connections on trade. As more countries receive connections and the frequency of train deliveries increase further analysis is needed to investigate how the effect of these connections develop. It would be interesting to see whether the effect of the train lines increases with time as they are used more effectively or whether the effect captured in this early analysis already captures the positive benefits of the train connections. Other aspects of the BRI can also be investigated such as the marine trading routes to see what effect these have on trade.

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Appendix

	No rail connection			Rail connection		
Variable	Observations	Mean	Std. Dev.	Observations	Mean	Std. Dev.
Tariff	257.00	2.79	1.57	22.00	4.20	2.68
Distance (km)	257.00	7403.58	1069.17	22.00	6202.48	1337.57
Landlocked dummy	257.00	0.27	0.44	22.00	0.50	0.51
GDP	257.00	609.52	865.37	22.00	1119.33	1384.37
China GDP	257.00	5704.85	2617.95	22.00	8885.64	1127.14
Log population	257.00	15.89	1.47	22.00	17.20	1.01
Arable land (hectare/person)	257.00	0.31	0.31	22.00	0.64	0.58
IMF development	257.00	0.74	0.44	22.00	0.32	0.48
Exports logsitc0	257.00	3.95	1.87	22.00	5.57	1.45
Exports logsitc1	256.00	-0.13	2.43	22.00	2.37	1.60
Exports logsitc2	257.00	3.28	1.95	22.00	4.43	1.72
Exports logsitc3	253.00	0.42	3.07	22.00	2.10	3.47
Exports logsitc4	251.00	-1.17	2.51	22.00	0.13	1.99
Exports logsitc5	257.00	5.01	1.70	22.00	6.66	1.15
Exports logsitc6	257.00	6.32	1.64	22.00	7.68	1.22
Exports logsitc7	257.00	7.51	1.80	22.00	9.07	1.41
Exports logsitc8	257.00	7.02	1.85	22.00	8.10	1.60
Exports logsitc9	225.00	0.49	4.12	21.00	0.27	3.70
Log Total exports	257.00	8.31	1.74	22.00	9.68	1.38
Imports logsitc0	257.00	3.95	1.87	22.00	5.57	1.45
Imports logsitc1	256.00	-0.13	2.43	22.00	2.37	1.60
Imports logsitc2	257.00	3.28	1.95	22.00	4.43	1.72
Imports logsitc3	253.00	0.42	3.07	22.00	2.10	3.47
Imports logsitc4	251.00	-1.17	2.51	22.00	0.13	1.99
Imports logsitc5	257.00	5.01	1.70	22.00	6.66	1.15
Imports logsitc6	257.00	6.32	1.64	22.00	7.68	1.22
Imports logsitc7	257.00	7.51	1.80	22.00	9.07	1.41
Imports logsitc8	257.00	7.02	1.85	22.00	8.10	1.60
Imports logsitc9	225.00	0.49	4.12	21.00	0.27	3.70
Log Total Imports	257.00	8.31	1.74	22.00	9.68	1.38

Appendix 1: Descriptive Statistics

Variables	(Country Dummy) Log total exports	(Country + Year dummies) Log total exports	(Country Dummy) logsitc1 exports	(Country + Year dummies) logsitc1 exports	(Country Dummy) logsitc2 exports	(Country + Year dummies) logsitc2 exports	(Country Dummy) logsitc3 exports	(Country + Year dummies) logsitc3 exports	(Country Dummy) logsitc4 exports	(Country + Year dummies) logsitc4 exports	(Country Dummy) logsitc5 exports	(Country + Year dummies) logsitc5 exports	(Country Dummy) logsitc6 exports	(Country + Year dummies) logsitc6 exports	(Country Dummy) logsitc7 exports	(Country + Year dummies) logsitc7 exports	(Country Dummy) logsitc8 exports	(Country + Year dummies) logsitc8 exports	(Country Dummy) logsitc9 exports	(Country + Year dummies) logsitc9 exports
Rail connection	-0.110	-0.0825	-0.373	-0.233	-0.441	-0.452	-1.602**	-1.510*	1.365	0.927	-0.384*	-0.308	-0.137	-0.0105	0.119	0.141	0.0187	0.164	-0.668	-0.331
	(-1.17)	(-0.93)	(-0.77)	(-0.47)	(-1.54)	(-1.52)	(-2.83)	(-2.57)	(1.76)	(1.14)	(-2.39)	(-1.90)	(-0.78)	(-0.06)	(0.72)	(0.83)	(0.10)	(0.84)	(-0.77)	(-0.36)
Tariff	-0.00783	-0.0241	-0.207	-0.229*	0.0321	0.00988	-0.159	-0.193	0.133	0.112	0.0564	0.0432	-0.0434	-0.0520	0.0132	-0.000580	0.0591	0.0499	-0.0781	-0.0694
	(-0.37)	(-1.25)	(-1.83)	(-2.00)	(0.50)	(0.15)	(-1.26)	(-1.50)	(0.84)	(0.70)	(1.58)	(1.22)	(-1.11)	(-1.32)	(0.36)	(-0.02)	(1.41)	(1.18)	(-0.45)	(-0.39)
Distance (km)	-0.00186***	-0.00189***	0.00305	0.00316	-0.0111***	-0.0112***	0.000465	0.000350	0.000534	0.00121	-0.000573	-0.000499	-0.00258***	-0.00241**	-0.0000849	-0.0000802	0.000755	0.000946	-0.000396	0.000253
	(-4.45)	(-4.97)	(1.46)	(1.52)	(-8.75)	(-8.81)	(0.19)	(0.14)	(0.13)	(0.29)	(-0.80)	(-0.72)	(-3.29)	(-3.10)	(-0.12)	(-0.11)	(0.90)	(1.13)	(-0.11)	(0.07)
Landlocked	-13.89***	-14.76***	-24.00	-24.63*	-75.22***	-76.17***	9.735	7.313	-16.19	-10.08	0.379	-0.538	-20.24***	-20.82***	-17.07***	-17.68***	-19.54***	-20.07***	-39.68	-41.33
	(-5.68)	(-6.68)	(-1.96)	(-2.03)	(-10.13)	(-10.26)	(0.68)	(0.51)	(-0.59)	(-0.36)	(0.09)	(-0.13)	(-4.43)	(-4.60)	(-3.97)	(-4.17)	(-4.01)	(-4.13)	(-1.47)	(-1.51)
Country GDP (billion USD)	0.000356*	0.000141	-0.00147	-0.00197*	0.000805	0.000622	0.00185	0.00142	0.00153	0.00182	-0.000275	-0.000552	-0.000644*	-0.000934**	0.000211	0.0000352	-0.000678	-0.000913*	0.00316	0.00234
	(2.05)	(0.87)	(-1.71)	(-2.21)	(1.53)	(1.14)	(1.85)	(1.37)	(1.24)	(1.35)	(-0.93)	(-1.86)	(-1.99)	(-2.82)	(0.69)	(0.11)	(-1.96)	(-2.56)	(1.88)	(1.33)
China's GDP (billion USD)	0.000151***	-0.0000570	0.000495***	0.000171	0.000185***	-0.000372	0.000238***	-0.000309	0.000346***	-0.00359*	0.000205***	0.0000178	0.000132***	0.000244	0.000121***	-0.000170	0.000225***	0.000460	-0.000127	-0.00145
	(16.51)	(-0.27)	(10.75)	(0.15)	(6.64)	(-0.53)	(4.50)	(-0.23)	(4.28)	(-2.18)	(13.13)	(0.05)	(7.74)	(0.57)	(7.55)	(-0.42)	(12.34)	(1.00)	(-1.36)	(-0.74)
Arable land (hectares per person)	-1.320	-1.378*	8.518*	8.684*	-11.41***	-11.63***	5.113	4.925	7.522	7.478	-0.998	-0.852	-1.740	-1.412	-0.666	-0.662	1.415	1.781	2.999	4.424
	(-1.90)	(-2.18)	(2.42)	(2.47)	(-5.39)	(-5.47)	(1.30)	(1.25)	(1.03)	(1.02)	(-0.84)	(-0.74)	(-1.34)	(-1.09)	(-0.54)	(-0.54)	(1.02)	(1.28)	(0.48)	(0.69)
IMF development	0.486***	0.473***	1.710**	1.864**	0.142	0.136	0.824	0.742	2.458	0.893	0.212	0.159	0.278	0.264	0.543**	0.544**	0.431*	0.383	0.424	0.325
	(4.45)	(4.78)	(2.97)	(3.24)	(0.43)	(0.41)	(1.15)	(1.04)	(0.85)	(0.30)	(1.14)	(0.88)	(1.36)	(1.30)	(2.83)	(2.86)	(1.98)	(1.76)	(0.45)	(0.34)
Log Population	-4.917***	-5.184***	-7.523	-7.523	-28.78***	-29.09***	5.707	4.890	-6.234	-4.327	1.195	0.936	-7.504***	-7.606***	-5.978***	-6.149***	-6.564***	-6.676***	-15.91	-16.22
	(-5.06)	(-5.90)	(-1.54)	(-1.56)	(-9.75)	(-9.87)	(0.99)	(0.85)	(-0.59)	(-0.40)	(0.72)	(0.58)	(-4.14)	(-4.23)	(-3.50)	(-3.65)	(-3.39)	(-3.46)	(-1.49)	(-1.49)
Constant	112.8***	125.1***	117.2	127.0	620.3***	642.5***	-108.0	-74.98	98.51	152.4	-11.37	-0.565	164.5***	163.4***	119.1***	130.1***	121.9**	117.3**	299.7	335.9
	(5.50)	(6.53)	(1.14)	(1.21)	(9.95)	(9.99)	(-0.89)	(-0.60)	(0.45)	(0.68)	(-0.33)	(-0.02)	(4.29)	(4.17)	(3.31)	(3.54)	(2.98)	(2.78)	(1.38)	(1.51)
N	279	279	265	265	279	279	241	241	183	183	279	279	279	279	279	279	279	279	221	221

t statistics in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Appendix 2: All Export Regressions

Variables	(Country Dummy)	(Country + Year dummies)	(Country Dummy)	(Country + Year dummies)	(Country Dummy)	(Country + Year dummies)	(Country Dummy)	(Country + Year dummies)	(Country Dummy)	(Country + Year dummies)	(Country Dummy)	(Country + Year dummies)	(Country Dummy)	(Country + Year dummies)	(Country Dummy)	(Country + Year dummies)	(Country Dummy)	(Country + Year dummies)	(Country Dummy)	(Country + Year dummies)
	Log total imports	Log total imports	logsitc1 imports	logsitc1 imports	logsitc2 imports	logsitc2 imports	logsitc3 imports	logsitc3 imports	logsitc4 imports	logsitc4 imports	logsitc5 imports	logsitc5 imports	logsitc6 imports	logsitc6 imports	logsitc7 imports	logsitc7 imports	logsitc8 imports	logsitc8 imports	logsitc9 imports	logsitc9 imports
Rail connection	0.212*	0.319***	0.0893	0.228	0.00651	-0.0216	0.240	0.0132	0.519	0.707*	-0.00124	0.0574	0.128	0.231**	0.228	0.334**	0.287**	0.394***	-0.327	-0.0511
	(2.20)	(4.13)	(0.31)	(0.76)	(0.06)	(-0.19)	(0.56)	(0.03)	(1.57)	(2.04)	(-0.02)	(0.89)	(1.16)	(3.00)	(1.94)	(3.13)	(2.74)	(4.30)	(-0.45)	(-0.07)
Tariff	0.0351	0.0760***	-0.0236	-0.00196	-0.00580	0.0343	-0.0534	0.151	-0.121	-0.132	0.0182	0.0571***	0.0273	0.0811***	0.0376	0.0706**	0.0405	0.0896***	-0.144	-0.164
	(1.69)	(3.94)	(-0.38)	(-0.03)	(-0.23)	(1.20)	(-0.57)	(1.35)	(-1.68)	(-1.52)	(1.04)	(3.52)	(1.15)	(4.21)	(1.48)	(2.64)	(1.78)	(3.91)	(-0.90)	(-0.83)
Distance (km)	0.000659	0.000864**	-0.00214	-0.00196	-0.000130	-0.0000887	-0.00336	-0.00298	0.00130	0.00152	0.000556	0.000694**	-0.000536	-0.000297	0.000925	0.00109*	0.000966*	0.00120**	0.00837*	0.00892*
	(1.57)	(2.70)	(-1.71)	(-1.59)	(-0.26)	(-0.19)	(-1.68)	(-1.51)	(0.85)	(1.00)	(1.58)	(2.58)	(-1.12)	(-0.93)	(1.81)	(2.47)	(2.11)	(3.16)	(2.35)	(2.44)
Landlocked	3.427	2.575	-15.29*	-16.44*	-4.404	-4.666	11.23	12.54	7.987	7.213	1.218	0.514	-3.153	-4.100*	5.046	4.120	5.204	4.450*	12.94	14.68
	(1.40)	(1.39)	(-2.09)	(-2.29)	(-1.50)	(-1.70)	(0.93)	(1.06)	(0.87)	(0.79)	(0.59)	(0.33)	(-1.13)	(-2.21)	(1.69)	(1.61)	(1.95)	(2.02)	(0.58)	(0.64)
Country GDP (billion USD)	0.000543**	0.000189	0.000484	0.0000529	0.000458*	0.000346	-0.000312	-0.0000761	-0.000294	-0.000725	0.000298*	0.0000288	0.000711***	0.000288*	0.000544*	0.000189	0.000548**	0.000227	0.00496***	0.00433**
	(3.05)	(1.34)	(0.91)	(0.10)	(2.14)	(1.66)	(-0.39)	(-0.09)	(-0.48)	(-1.14)	(1.98)	(0.24)	(3.50)	(2.05)	(2.50)	(0.97)	(2.82)	(1.36)	(3.69)	(2.99)
China's GDP (billion USD)	0.0000649***	-0.0000715	0.0000823**	-0.000173	0.0000287*	0.000136	-0.000149***	0.000376	0.0000521	-0.000724	0.000139***	0.0000544	0.0000619***	-0.000109	0.0000708***	-0.000103	0.0000570***	-0.000150	-0.0000750	-0.000318
	(6.51)	(-0.41)	(2.76)	(-0.25)	(2.39)	(0.52)	(-3.36)	(0.37)	(1.52)	(-0.92)	(16.58)	(0.37)	(5.45)	(-0.62)	(5.82)	(-0.42)	(5.25)	(-0.72)	(-0.96)	(-0.18)
Arable land (hectares per person)	0.722	1.150*	-3.248	-2.885	-0.560	-0.480	-7.569*	-6.921*	1.419	1.891	0.972	1.261**	-0.430	0.0720	1.156	1.512*	0.426	0.898	16.14**	16.77**
	(1.04)	(2.16)	(-1.56)	(-1.40)	(-0.67)	(-0.61)	(-2.37)	(-2.19)	(0.58)	(0.77)	(1.66)	(2.82)	(-0.54)	(0.14)	(1.36)	(2.06)	(0.56)	(1.42)	(2.68)	(2.72)
IMF development	0.372***	0.376***	-0.256	-0.321	0.290*	0.329**	0.206	0.351	0.334	0.360	0.0427	0.0473	0.218	0.250**	0.467***	0.466***	0.211	0.206*	-0.801	-0.933
	(3.41)	(4.51)	(-0.79)	(-1.00)	(2.21)	(2.67)	(0.42)	(0.73)	(0.89)	(0.97)	(0.47)	(0.68)	(1.75)	(3.02)	(3.51)	(4.05)	(1.78)	(2.08)	(-0.89)	(-1.00)
Log Population	1.772	1.524*	-5.150	-5.462	-1.310	-1.428	5.850	5.920	4.243	4.166	1.015	0.789	-0.978	-1.246	2.478*	2.213*	2.460*	2.218*	2.379	3.380
	(1.83)	(2.07)	(-1.78)	(-1.92)	(-1.13)	(-1.31)	(1.22)	(1.25)	(1.15)	(1.15)	(1.24)	(1.28)	(-0.88)	(-1.70)	(2.09)	(2.18)	(2.33)	(2.54)	(0.27)	(0.37)
Constant	-29.00	-20.37	114.6	127.6*	30.08	31.07	-77.53	-96.79	-86.76	-66.23	-17.18	-9.955	28.44	38.44*	-44.91	-34.51	-44.90*	-35.27	-112.2	-126.9
	(-1.42)	(-1.27)	(1.87)	(2.06)	(1.22)	(1.31)	(-0.76)	(-0.95)	(-1.12)	(-0.84)	(-1.00)	(-0.74)	(1.22)	(2.40)	(-1.80)	(-1.56)	(-2.01)	(-1.85)	(-0.61)	(-0.66)
N	279	279	278	278	279	279	275	275	273	273	279	279	279	279	279	279	279	279	246	246

t statistics in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Appendix 3: All import Regressions

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(Country Dummy)	(Country + Year Dummy)
	Log total exports	Log total exports	Log total exports	Log total exports	Log total exports	Log total exports	Log total exports	Log total exports	Log total exports	Log total exports	Log total exports
Rail connection	0.733***	0.737***	0.736***	0.735***	0.313*	-0.0748	-0.0333	-0.0635	-0.0381	-0.110	-0.0825
	(5.48)	(5.51)	(5.50)	(5.49)	(2.34)	(-0.75)	(-0.33)	(-0.65)	(-0.40)	(-1.17)	(-0.93)
Tariff		0.0349	0.0351	0.0347	0.0316	0.00955	0.0113	0.00195	-0.00317	-0.00783	-0.0241
		(1.02)	(1.02)	(1.00)	(1.02)	(0.42)	(0.49)	(0.09)	(-0.15)	(-0.37)	(-1.25)
Distance (km)			-0.0000455	-0.0000395	-0.000260	-0.000153	0.0000936	-0.000123	-0.000116	-0.00186***	-0.00189***
			(-0.13)	(-0.11)	(-1.08)	(-0.61)	(0.32)	(-0.45)	(-0.54)	(-4.45)	(-4.97)
Landlocked				0.0749	1.091	0.551	0.454	0.662	0.902*	-13.89***	-14.76***
				(0.08)	(1.77)	(0.86)	(0.70)	(1.11)	(2.06)	(-5.68)	(-6.68)
Country GDP (billion USD)					0.00167***	0.000646***	0.000620***	0.000752***	0.000494**	0.000356*	0.000141
					(8.61)	(3.87)	(3.72)	(4.70)	(3.05)	(2.05)	(0.87)
China's GDP (billion USD)						0.000135***	0.000134***	0.000120***	0.000122***	0.000151***	0.000164***
						(15.59)	(15.53)	(13.96)	(14.48)	(16.51)	(15.51)
Arable land (hectares per person)							1.000	0.707	0.529	-1.320	-1.378*
							(1.67)	(1.23)	(1.01)	(-1.90)	(-2.18)
IMF development								0.602***	0.639***	0.486***	0.473***
								(5.21)	(5.68)	(4.45)	(4.78)
Log Population									0.885***	-4.917***	-5.184***
									(6.13)	(-5.06)	(-5.90)
Constant	7.007***	6.807***	7.138**	7.075**	7.357***	6.751***	4.650*	5.899**	-8.170**	112.8***	118.1***
	(18.17)	(15.67)	(2.80)	(2.62)	(4.08)	(3.58)	(2.04)	(2.75)	(-2.89)	(5.50)	(6.37)
N	279	279	279	279	279	279	279	279	279	279	279

t statistics in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Appendix 4: Adding control variables (export analysis)

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(Country Dummy)	(Country + Year Dummy)
	Log total imports	Log total imports	Log total imports	Log total imports	Log total imports	Log total imports	Log total imports	Log total imports	Log total imports	Log total imports	Log total imports
Rail connection	0.678***	0.636***	0.638***	0.638***	0.383***	0.139	0.150	0.134	0.183*	0.212*	0.319***
	(6.92)	(6.75)	(6.74)	(6.74)	(3.88)	(1.49)	(1.58)	(1.43)	(2.00)	(2.20)	(4.13)
Tariff		-0.0948***	-0.0943***	-0.0943***	-0.0452*	0.0412	0.0417*	0.0452*	0.0186	0.0351	0.0760***
		(-4.74)	(-4.69)	(-4.69)	(-2.20)	(1.95)	(1.97)	(2.18)	(0.90)	(1.69)	(3.94)
Distance (km)			0.000142	0.000119	0.00000634	0.0000830	0.000159	0.0000282	-0.0000689	0.000659	0.000864**
			(0.50)	(0.41)	(0.03)	(0.40)	(0.65)	(0.11)	(-0.50)	(1.57)	(2.70)
Landlocked				-0.295	0.366	0.181	0.155	0.257	0.406	3.427	2.575
				(-0.40)	(0.71)	(0.35)	(0.29)	(0.49)	(1.67)	(1.40)	(1.39)
Country GDP (billion USD)					0.00111***	0.000795***	0.000791***	0.000853***	0.000395**	0.000543**	0.000189
					(6.98)	(5.29)	(5.26)	(5.72)	(3.01)	(3.05)	(1.34)
China's GDP (billion USD)						0.0000755***	0.0000753***	0.0000679***	0.0000680***	0.0000649***	0.000103***
						(8.34)	(8.30)	(7.44)	(7.54)	(6.51)	(10.81)
Arable land (hectares per person)							0.307	0.143	-0.473	0.722	1.150*
							(0.57)	(0.27)	(-1.17)	(1.04)	(2.16)
IMF development								0.379***	0.424***	0.372***	0.376***
								(3.53)	(4.13)	(3.41)	(4.51)
Log Population									0.891***	1.772	1.524*
									(9.51)	(1.83)	(2.07)
Constant	8.369***	8.649***	7.607***	7.860***	7.651***	6.665***	6.017**	6.724***	-6.326***	-29.00	-26.27
	(25.88)	(25.88)	(3.61)	(3.54)	(4.98)	(4.27)	(3.12)	(3.51)	(-3.67)	(-1.42)	(-1.69)
N	279	279	279	279	279	279	279	279	279	279	279

t statistics in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Appendix 5: Adding control variables (import analysis)