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The Impact of China´s Belt Road Initiative on European Trade: A Gravity Model Simulation

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TABLE OF CONTENTS

ABSTRACT

China´s Belt Road Initiative (BRI) is the biggest global infrastructure project of the 21^{st} century. It aims to gradually improve regional trade and cooperation among Eurasian countries by improving infrastructure connectivity. I predict using a gravity model and global trade data that after the implementation of BRI infrastructure, Non-EU BRI countries on average benefit from a higher predicted increase in trade flow than EU countries. Trade of the median Non-EU BRI country is prognosed to increase between 1.19% and 2.23%, compared to 0.31% to 0.61% of the median EU country. Moreover, I estimate that Western EU countries not directly involved in infrastructure projects benefit least from an increase in trade flow, remaining below 0.5% on average. Some South-Eastern EU countries directly involved in specific regional projects are predicted to experience a trade increase of over 1%. I conclude that direct involvement in the BRI supports a country´s rise in trade but can also entail a trade-off causing increasing financial dependence on China.

INTRODUCTION

With the declaration of Covid-19 as a global pandemic by the World Health Organization on 11th of March 2020 (WHO, 2020) globalization which has been shaping society since the beginning of Industrialization in the 19th century may have reached its peak (O´Rourke and Williamson, 2000; Craven and Wilson, 2020; Oba, 2020). This drastic prediction is mainly based on the evidence of globalization being a driving factor in the rapid spread of pandemics, because of inter-connectedness of economies and hence increasing cross-border movements of individuals (Kitenge, 2020; Oba, 2020). Immediate national actions to maintain the spread of the pandemic such as the closing of borders, travel bans and export restrictions are heavily disrupting globalization in the short run (Fontaine, 2020). On the other hand, nations still rely on international cooperation such as exchange of medical supply or joint research projects on vaccination in order to defeat the pandemic in the long run (United Nations, 2020).

This development has re-initiated a global debate on the future course of interconnected economies and markets defining the track of globalization. Amid the debate, this thesis discusses one of the potentially biggest drivers of globalization in the coming decades: China´s Belt Road Initiative (Wu and Wong, 2020). In September 2013, China´s President Xi Jinping announced the new infrastructure project during a state visit in Kazakhstan (Ministry of Foreign Affairs of the People´s Republic of China, 2013). With this initiative, President Xi declared to renew China´s ancient commercial ties from Central Asia to Europe, as once established 2100 years ago with the Silk Road. With the Belt Road Initiative (BRI), China aims to gradually form regional cooperation among Eurasian countries. This should be achieved as follows: "first to strengthen policy communication […], second, to improve road connectivity […], third, to promote trade facilitation […], fourth, to enhance money circulation […], fifth, to strengthen people-to-people exchanges" (Ministry of Foreign Affairs of the People´s Republic of China, 2013).

While in the fall of 2013, the impact of this ambitious project may have appeared rather vague, experts´ projections in the following years have been substantiating it. The OECD estimated USD 1 trillion of planned funding into BRI related infrastructure in a 10-year timeframe from 2017 onwards (OECD, 2018), which is about 7.4 percent of China´s 2018 GDP (Worldbank, 2020). Moreover, as the BRI entails projects in 72 countries[1] and builds strong trade corridors between Asia and Europe, it is expected to influence more than 60 percent of the world´s population with a combined share of around 30 percent of global GDP (Johnson, 2016; Herrero and Xu, 2017). Given this heavy impact, I aim to answer the following research question:

> *How will the progress of the Chinese Belt Road Initiative influence long term trade behaviour in the European Union?*

So far, the BRI is still in its infant stage, yet a few projects promise to improve international economic connectivity between Europe and Asia in the near future. A prominent example: The China-Western European International Expressway, a highway starting at the port of Lianyungang at China´s Yellow Sea and passing through Russia to Western Europe (Xi, 2017). After completion of the missing link from Russia´s border to Belarus, this "primary nervous system of the Silk Road Economic Belt" (Shepard, 2019) could allow highway-transport of goods from China to Western Europe in only 11 days as opposed to 30-50 days via maritime transfer. This illuminates the decrease in transport costs towards Europe resulting from a BRI infrastructure project.

According to economic trade theory, a decrease in transport costs is related to increasing trade flows (Limão and Venables, 2001). Existing research predicting the influence of BRI projects on European trade flows already gives first insights based on that relation. Herrero and Xu (2017) predict, that European trade would be affected positively by a reduction in transport costs resulting from the BRI. De Soyres et al. (2018) empirically estimate global transport reduction resulting from the BRI. This thesis aims to gain a more accurate picture of the explanatory value of transport costs on trade using a gravity equation based on global trade panel data. The resulting coefficient is then applied to the novel dataset of De Soyres et al. (2018), ultimately creating two scenarios to prognosticate EU trade change after the implementation of BRI projects.

[1] As the BRI is still in the planning process, the affected areas differ depending on the publication dates of sources. In this thesis, the OECD-Report of 2018 is used as primary source on assessing the number of affected countries (OECD, 2020). Literature agrees on affected regions of the Initiative: East Asia, Southeast Asia, Central Asia, Middle East and North Africa, Europe and Central Asia.

In the following section, I will outline the current trade situation in the EU and BRI affiliated countries, as well as currently planned BRI projects. Furthermore, existing literature investigating the impact of transport cost on trade volume will be discussed. In a next part, the data delivering grounds to the empirical analysis will be described, followed by a detailed explanation of the methodology. I will use a gravity equation controlling for individual country fixed effects to estimate the effect of transport costs on trade volume. This will serve as a basis for two simulation exercises predicting the change in EU trade resulting from the BRI´s impact on transport cost. Subsequently, the results will be discussed and put into perspective with existing empirical findings. Finally, concluding remarks will be made.

LITERATURE REVIEW AND THEORETICAL FRAMEWORK

In this section, I describe how trade behaviour between the European Union and BRI states interplays. I then illustrate the progress and challenges of the BRI, followed by discussing existing research on how the BRI so far impacted European trade. Lastly, I discuss the methodological difference between distance and transport cost as an independent variable predicting trade volume.

EU and BRI

In 2019, all member states of the EU combined made up the world´s largest economy, accounting for over 20% of global GDP and a trade volume of close to EUR 5.4 trillion (European Parliament, 2019). With almost EUR 2.8 trillion worth of exports in 2018, it is further the largest exporter of services and manufactured goods. Historically, the EU´s very existence is based on the motivation to build a common market and promote trade among member states with the foundation of the European Economic Community (EEC) in 1957 (European Union, 2020). In 2020 the EU holds free trade agreements (FTA) with a multitude of non-EU states, substantially reducing barriers to trade, for example with South Korea, Japan and Singapore. China as Europe´s second biggest trade partner alone accounts for a trade flow of more than EUR 600 billion with the EU in 2018. This illuminates the strong trade relationships of the EU to the Asian economic cycle, specifically China.

While the EU is a unique and historically well-established union of shared values and goals and thus deeply connecting its member states, little can yet be inferred about the impact of the BRI on inter-connectedness on its member states. Certain as of now is, that a union of BRI participating countries primarily focuses on economic gains by improving connectivity and easier facilitating trade and investment (OECD, 2018). According to chapter 51 in China´s 13th Five-year plan (2016), connectivity will be reached through a multitude of measures. These involve enhancement of financial co-operation within the regions, negotiation of free trade agreements and perhaps most importantly strengthening of the transport infrastructure along six BRI corridors[2]. While China is the single initiator and main contributing force of the project, it has been emphasized by China´s president Xi (2017) and his government that the focus lies on mutual benefitting partnerships. However, internationally China´s motives have been questioned extensively. One main remark is that China may use the newly strengthened trade relationships to better accommodate its large excess industrial capacity, which may pose a larger threat than benefit to trade partners (Johnson, 2016; OECD, 2020). Another point of critique is that Chinese state-owned enterprises would further increase its influence as a globally competitive economic power. This poses a threat to global free markets, that China supposedly tries to strengthen with the BRI. The controversy underlines the uncertainty of the BRI´s long-term effects on bilateral trade.

Progress and Challenges

Currently implemented projects of the BRI summarize progress on strengthening transport infrastructure, but also illuminate aforementioned points of criticism. The following described BRI achievements are a selection of projects directly impacting Asia´s trade relationship with the EU. Already tackled BRI infrastructure projects include advancement in sea transport as well as land transport. In 2017, China has upgraded the ports Piraeus in Greece and Gwadar in Pakistan with the objective to transform Piraeus into Europe´s biggest harbour and making it a key link for trade between Asia and Europe (Xi, 2017; Amaro, 2019). To do so, China´s

[2] The corridors are categorized into: New Eurasia Land Bridge (via Kazakhstan, Russia, Belarus and Poland); China, Mongolia, Russia Economic Corridor; China, Central Asia, West Asia Economic Corridor; China Indochina Peninsula Economic Corridor; China, Pakistan Economic Corridor (linking China´s landlocked region of Xinjiang with Pakistan port of Gwadar); China, Bangladesh, India, Myanmar Economic Corridor (OECD, 2018, p.11)

shipping company Cosco acquired a major stake of Piraeus port in 2016 and announced another investment of EUR 600 million to develop the port in 2019 (Amaro, 2019).

Via the land corridor, one important almost finalized component of the BRI is the China-Western European International Expressway, as mentioned in the introduction. Yet there are more finalized trans-continental BRI projects linking Asian´s economies with the EU. Since 2015, a railway connection between Chongqing, China and Duisburg, Germany has been used for cargo transport, reducing average transport times from 45 days to 14 days between China and Germany (UNECE, 2019; The Oltermann, 2018). Other EU countries benefit from this connection as well: in total China-Europe rail freight service links 49 cities of 15 European countries with 59 Chinese cities. These developments have helped increasing European trade via railway networks to Asia. Whether it helps to increase European trade volume in its entirety will be analysed further in the following sections of this thesis.

Another trade promoting and BRI-related involvement is China´s cooperation with the 16 Central and Eastern European countries (CEECs), including 11 EU member states, called the 16 + 1 format (EPRS, 2018). Even though this partnership came into existence one year before the announcement of the BRI, it is heavily used to promote BRI projects. Its flagship is the enhancement of the Budapest-Belgrade railway (EPRS, 2018; The Diplomat, 2020). So far, the project, valued at around EUR 3.6 billion, has been delayed due to legal EU-level investigations and cost-miscalculations. Critics fear that the financing practices employed by Chinese lending facilities with regards to this project may come at high costs especially for Hungary (EPRS, 2018; The Diplomat, 2020). Despite public criticism, construction on the Serbian side has been in progress since 2017 and is predicted to be completed in 2025. Further expectation exists, that the connection will be extended towards Piraeus which would then create a new and more efficient corridor of transportation from China into the European Union than currently used trade routes to the Northern European ports of Antwerp, Rotterdam or Hamburg.

The discussed examples indicate the complexity and ambiguity of the BRI towards Europe. They also show that implementation does influence trade in a certain way. The question of whether the increased transport infrastructure just shifts transport towards the newly implemented routes or in fact increases trade volume between the EU and Asia remains unanswered. Hence, existing empirical research has combined the methodology of the gravity equation and information on planned BRI projects to predict future developments of trade resulting from the BRI. The following section discusses existing research on this correlation.

Existing Empirical Research

Herrero and Xu (2017) predict that BRI infrastructure developments increase EU trade. The authors use a gravity equation based on cross-sectional trade data to estimate trade creation potential of the Belt Road Initiative for the European Union. The dependent variable is bilateral trade flow and predicted by explanatory variables containing bilateral transport costs and an array of controls. Important to note is that the authors use bilateral distance as a proxy for transport costs, a commonly used method which will be discussed in a subsequent section. One finds statistically and economically significant effects of transport costs on bilateral trade: "a 10-percent reduction in railway, air and maritime costs increases trade by 2, 5.5 and 1.1 percent, respectively" (Herrero and Xu, 2017, p. 92). Based on their findings, Herrero and Xu (2017) continue with predicting the effect of the BRI on EU trade using simulation exercises. Referring to already implemented BRI infrastructure projects and their effect on transport cost, a certain proportional reduction of transport costs is assumed. In their scenario solely focusing on the influence of existing BRI-related infrastructure, reducing railway transport cost by 50 percent and maritime transport cost by 5 percent between all BRI member countries, EU trade volume would increase by more than 6 percent, while Asian trade volume would merely increase by 3 percent. This shows that EU trade would be boosted strongly because of improved transport infrastructure.

The transport costs coefficients found by Herrero and Xu (2017) can be put into perspective with other empirical findings. Disdier and Head (2008) examined nearly 1500 distance effects published in over 100 papers. The authors observe that the mean distance effect on bilateral trade is about -0.9, implying nearly inverse proportionality to trade. The authors link this result sufficiently to economic theory, thus supporting its economic significance. While Herrero and Xu´s (2017) results re-iterate the inverse relationship of distance and bilateral trade, the values deviate strongly. This provides grounds to re-estimate distance coefficients using different methodology and data. Based on these previous empirical findings I expect to find significant evidence that reducing distance positively influences trade:

H1: A reduction in transport costs has a statistically and economically significant positive effect on bilateral trade flow.

De Soyres et al. (2018) created a database estimating current global shipment times and trade costs and how these would change as a result of BRI infrastructure projects. The database focuses on maritime and railway transport, as maritime shipping accounts for 70% of global transport, followed by railway transport[3]. Shipment times are calculated based on mapping transport routes between country pairs and applying a certain average travel speed, differentiating between maritime and railway transport. This strongly emphasizes on distance as the driver of shipment times, as it lays the arithmetical foundation. Additionally, processing time at international borders is part of the calculation. Trade costs are monetized shipment times by an added time-valuation based on Hummels and Schaur (2013) and bilateral tariffs. The development of the BRI is expected to reduce global shipment times and trade costs because of increasing average travel speeds and reduced border processing times. The empirical results reveal: the BRI decreases global trade costs between 1.05 and 2.19 percent and in BRI countries between 1.50 and 2.81 percent, depending on whether to include the option to change the mode of transport reacting to the BRI infrastructure changes. Considering these empirical findings on the BRI causing a reduction in trade costs and assuming that the first hypothesis holds, I expect EU trade flows to increase as a result of BRI infrastructure development:

H2: BRI infrastructure development increases EU trade flow.

The two raised hypotheses will be examined empirically and assessed in the results section. However, before delving into the empirical part of the thesis, the terminology regarding transport costs needs to be clarified, as existing research applies different types of measurements to assess transport costs. As observed in Disdier and Head (2008) and Herrero and Xu (2017), distance is used as a proxy for transport costs.

[3] Measured in value of goods

Distance Versus Transport Costs

In most applications of the gravity equation used to investigate bilateral trade volume, distance proves to not be the preferred variable to reduce trade, but instead transport cost (Geraci and Prewo, 1977; Martinez-Zarzoso and Nowak-Lehmann, 2007). This is because transport cost empirically provides the better "trade resistance factor" (Geraci and Prewo, 1977, p. 67). Distance does not sufficiently reflect the elasticity of transport cost to the value of goods transported and neither the dependence on non-geographical obstacles of transport cost. Nevertheless, in past researches examining the influencing factors of bilateral trade, distance has been used as a proxy for transport cost (OECD, 2018; Herrero and Xu, 2017). The reason is mainly the lack of consistent data of transport costs between countries, as measurement techniques vary greatly (Geraci and Prewo, 1977).

Korinek and Sourdin (2009) point out in their research on maritime transport costs, that distance used as a proxy for transport costs prohibits determining the true effect of actual transport costs. They argue that using distance as an independent variable affecting bilateral trade entails other significant factors, such as information costs, business networks and cultural barriers. The authors isolate transport costs using panel-data of maritime transport expressed in dollars per tonne of goods shipped. It is estimated, that "doubling in bilateral maritime transport costs (expressed in $/tonne of goods shipped) is associated with between 66 and 80 percent decline in the value of imports between two given countries [ceteris paribus]" (Korinek and Sourdin, 2009, p.10). Having accounted for the effect of transport itself, they find that a 10 percent increase in distance between trading countries results in a reduction of imports of 7 percent on average. This shows that distance still influences bilateral trade, even if transport costs are accounted for in a separate variable.

This finding is important because it shows that distance entails more than only transport cost. While this can be seen as a shortcoming to use distance as a proxy for transport cost, its importance as an explanatory variable for bilateral trade becomes evident. In this thesis, distance will be used as a primary explanatory variable, because it does, in fact, entail more than just transport cost and thus will play a key part in the simulations part of this thesis. The intuition is that the impact of the Belt Road Initiative goes beyond just reducing transport costs: it also aims to connect cultures and business networks. Hence distance seems a more suitable explanatory variable for this thesis.

Now that the BRI and its linkages to the EU, existing literature related to the research question and distance as an appropriate variable to approximate trade have been discussed, the focus changes towards empirically finding an answer to the research question.

DATA & METHODOLOGY

Data

This section explains the data used for the thesis´ empirical models. To assess both hypotheses, two different data sets are used. The first dataset provides data to run a model inferring on the first hypothesis. The second dataset provides data on the changes in trade costs resulting from the BRI, providing a basis to assess the second hypothesis.

The first data source is *CEPII*, a leading French economic research centre offering publicly available data. The specific dataset used is called *TRADHIST* and contains global historical bilateral trade and gravity data from the years of 1827 until 2014. Data is clustered into 5 types of variables, namely bilateral nominal trade flows, country-level aggregate nominal exports and imports, nominal GDPs, exchange rates and other bilateral factors impacting trade (Fouquin and Hugot, 2017). This allows to extract an extensive panel dataset describing the sample used for further analysis. This thesis focuses on the influence of a change in transport costs within the BRI region on trade in the EU. Thus, the sample contains all 72 BRI-participating economies, as listed by the OECD in 2018 (see Appendix A), as well as all 16 member states of the European Union not listed in the OECD report and Great Britain. The time frame of the sample contains observations of the years from 1990 until 2014. This specific panel allows to accurately infer on model parameters.

The second dataset is from the *World Bank* and contains information about transport times and trade costs between 191 countries and 47 different industry sectors (De Soyres et al., 2018). The data has been aggregated combining geographical data and network algorithms to compute the difference in transport times via current transportation networks and after accounting for all planned BRI transport infrastructure related projects. The dataset only considers maritime and railway transport as modes of transport. Two scenarios were created: a "lower bound scenario" preventing the switching of transport modes pre- and post-BRI and an "upper bound scenario" in which transport mode switching is allowed.

For the purpose of this thesis, a sample matching the same countries as selected from the first dataset has been extracted. Some countries remain unmatched, as the second database does not contain information on all 89 listed countries, but only on 72 (see Appendix B).

Methodology

Having described the databases allows to lay out the empirical model used to assess the first hypothesis. I first give a qualitative overview of the gravity equation and its empirical significance for trade prediction, including shortcomings. I then describe how I augment the equation to account for some of its original shortcomings. The resulting coefficient serves as an empirical foundation for assessing the two different simulation exercises presented in the results section.

Gravity Equation

The model used in this thesis is based on a gravity equation. A first form of the gravity function was brought into existence in 1687 by Isaac Newton. In *Philosophiae Naturalis Principia Mathematica* he explains how the gravitational force between two objects depends on the mass of each object and their distance apart from each other (Jha, 2013). The importance of this theory became evident in other scientific disciplines, such as the social sciences and economics (Filippini and Molini, 2003). Nobel Laureate Jan Tinbergen is recognized to be the first economist to examine international trade flows using a gravity model in 1962 (Gerritse, 2020; Filippini and Molini, 2003). He set the foundation for the gravity model as a frequently used tool to examine trade flows between countries, as the model contains high statistical explanatory power (Bergstrand, 1985).

The basic economic gravity model is closely related to Newton´s universal law of gravitation[4]. It generally follows this relationship (Anderson, 2011, p.135)

$$X_{ij} = \frac{Y_i \times E_j}{d_{ij}^2}$$

Where X_{ij}represents the predicted flow of goods or labour between origin country *i* and destination country *j*. Y_i represents the mass of goods or labour supply at origin country *i*, while E_j represents mass of goods or labour demand at destination country *j*. In economic research, masses denoted as Y_i and E_j are usually measured as annual GDP of origin and destination countries (Bergstrand, 1985). Distance d_{ij}^2 is the squared distance between origin country *i* and destination country *j* and reduces flow, as it increases.

Despite the model´s strong statistical fit to describe actual trade flows, the approach has been criticized to not be tied sufficiently to economic theory. As a response, Bergstrand (1985) derived a form of gravity function very similar to the original framework under a set of economic assumptions. However, many of these assumptions, such as perfect substitution of internationally traded goods, have not been supported by empirical evidence. Yet, the author proves that a generalized version of the gravity approach to predict trade flows, in fact, can be supported by economic theory. One important remark in Bergstrand´s analysis is that the original framework lacks to incorporate prices and exchange rates, which are expected to influence bilateral trade flows as well. This shortcoming is later addressed more extensively by the introduction of multilateral resistance by Anderson and Van Wincoop (2003). The authors define multilateral resistance as the impact of the average resistance to trade with all partners of two regions on their bilateral trade, which would account for Bergstrand´s (1985) mentioned prices and exchange rates.

Endogeneity and How to Tackle It

The lack of accounting for multilateral resistance is one example of endogeneity when estimating trade volume using a gravity equation based on cross-sectional data. Endogeneity

[4] Newton´s universal law of gravitation is expressed in $F = G \times \frac{m_1 \times m_2}{R^2}$ (Verlinde, 2011), where F is the gravitational force, G the gravitational constant, m_1 and m_2 the masses of two objects and R the distance of the two objects.

arises when an explanatory variable is correlated with the error term of the model. The three main causes for endogeneity are omitted variable bias, simultaneity and measurement errors. In this thesis, I assume measurement errors to not interfere with my results, because the data sources are very transparent and have carefully been evaluated by Fouquin and Hugot (2017), respectively De Soyres et al. (2018). Hence, I focus on methods to tackle omitted variable bias (OVB) and simultaneity.

OVB poses a common threat in existing empirical research as there is unobserved heterogeneity (Baier and Bergstrand, 2006; Disdier and Head, 2008). Adding control variables ranging from an indicator of a common language to technological distance between trading country pairs is one approach to reduce OVB (Fillipini and Molini, 2003). A more promising approach is to control for individual country fixed effects, given the availability of panel data. This allows to account for all country specific time-invariant characteristics that may normally influence the dependent variable while being correlated with one or more independent variables. Baier and Bergstrand (2006) find that the effect of free trade agreements on bilateral trade volume in a gravity equation is significantly larger, when controlling for bilateral country fixed effects. The result proves to be economically and statistically consistent. This shows, that controlling for time-invariant fixed effects may even be necessary to obtain statistically more accurate results and reduce OVB.

While controlling for time-invariant fixed effects allows to better isolate the effect of the explanatory variable, there are still two mentionable shortcomings. One, the method does not account for time-variant unobserved heterogeneity (Baier and Bergstrand, 2006). Two, when analysing panel-data, non-stationarity may occur (Zwinkels and Beugelsdijk, 2008). This means that the distribution of a certain variable is not constant over time, leading to co-integration and biased results. Gravity equations based on panel data may experience non-stationarity when estimating the effect of GDP on trade volume, as GDP is assumed to underly a certain trend. A solution is to take the first differences of the variable.

Simultaneity may also limit the explanatory power of a gravity equation, even after controlling for time-invariant fixed effects. This is because the explanatory variable GDP may be endogenous to bilateral trade flows as reasoned by existing research (Frankel and Romer, 1999; Disdier and Head, 2008). Yet, Baier and Bergstrand (2006) argue that simultaneity, in this case, may be neglectable, as GDP is stronger correlated with net-multilateral trade, while the gravity equation infers on absolute bilateral trade. Nevertheless, potential simultaneity in gravity equations can be partially tackled by including lagged values of GDP, as these are unlikely endogenous to current bilateral trade (Anderson, 1979).

So far, existing literature showed that a gravity equation can be a precise statistical and explanatory method to predict bilateral trade flows if endogeneity is accounted for appropriately. The original methodological foundation based on Newton´s universal law of gravitation has remained the same. Alterations such as the additions of control variables, as well as the approach relying on panel data and time-invariant fixed effects have enhanced the model's explanatory power.

Gravity Equation controlling for Individual Country Fixed Effects

To assess the first hypothesis, I use a gravity equation controlling for individual country fixed effects and applying robust standard errors. An array of time-variant control variables is added, given the limitations of individual country fixed effects. This array is consistent with previous research on the topic (Baier and Bergstrand, 2006; Head and Mayer, 2014), with the addition of including multilateral resistance terms. Previous research assumes multilateral resistance to be controlled for with individual country fixed effects (Anderson and van Wincoop, 2003; Baier and Bergstrand, 2006, 2009; Feenstra, 2015). However, the data shows that multilateral resistance is, in fact, time-variant and thus needs to be separately controlled for (see Appendix C).

The gravity model is transformed from its original multiplicative form into a log-log form for two reasons. First, this reduces statistical outliers. Second, it allows to estimate the elasticity of the dependent variable with respect to the independent variable. In that form the estimates will be most valuable in the later performed simulations. This gives the following equation:

$$ln\ (Flow_{ijt} + 1)$$

1(a)

$$= \beta_0 + \beta_1 lnGDP_{it} + \beta_2 lnGDP_{jt} + \beta_3 lnGDP_{it-1} + \beta_4 lnGDP_{jt-1} + \beta_5 lnDist_{ij} + \beta_6 lnSeaDist_{ijt} + \beta_7 lnExchR_{it} + \beta_8 lnExchR_{jt} + \beta_9 OECD_{it} + \beta_{10} OECD_{jt} + \beta_{11} EU_{it} + \beta_{12} EU_{jt} + \beta_{13} GATT_{it} + \beta_{14} GATT_{jt} + \beta_{15} lnMRT_{it} + \beta_{16} lnMRT_{jt} + \alpha_i + \alpha_j + \varepsilon_{ijt}$$

Where:

i	denotes the origin country
j	denotes the destination country
t	denotes the observed year
$Flow_{ijt}$	is the dependent variable representing bilateral trade volume measured in current British pounds (GBP)
GDP_{jt} & GDP_{jt}	are the Gross Domestic Products measure in current GBP
GDP_{it-1} & GDP_{jt-1}	are the one-year lagged values of the countries GDPs
$Dist_{ij}$	is the time-invariant continental distance between the bilateral country pairs, measured in kilometres as a "city population-weighted mean of the great-circle distance between each pair of countries" (Fouquin and Hugot, 2017, p.23)
$SeaDist_{ijt}$	measures the sea distance between the bilateral country pairs, measured in kilometres as the shortest bilateral sea distance between each largest port of the country (for landlocked ports the closest foreign port is chosen)
$ExchR_{it}$ & $ExchR_{jt}$	indicate the exchange rate of the local currency to GBP
$OECD_{it}$ & $OECD_{jt}$	are dummy variables indicating whether the countries are part of the OECD
EU_{it} & EU_{jt}	are dummy variables indicating whether the countries are part of the EU
$GATT_{it}$ & $GATT_{jt}$	are dummy variables indicating whether the countries are part of the World Trade Organisation (WTO)

MRT_{it} & MRT_{jt} are multilateral resistance terms[5]

α_i & α_j are constants controlling for all time-invariant individual country fixed effects

ε_{ijt} is the unobservable error term, which is assumed to be independent and identically distributed

Table 1 Descriptive statistics of the variables used in equations 1(a) and 1(b)

Variable	Obs.	Mean	Std. Dev.	Min.	Max.
Log Trade Flow	144,159	13.65	6.480	0	25.49
Log GDP origin (GDP_o)	139,494	24.23	1.964	19.07	29.47
Log GDP dest. (GDP_d)	140,074	24.25	1.944	19.07	29.47
First Lag of Log GDP_o	132,459	24.19	1.965	19.07	29.43
First Lag of Log GDP_d	133,049	24.21	1.946	19.07	29.43
First-Difference Log GDP_o	132,125	0.076	0.116	-0.827	0.505
First-Difference Log GDP_d	132,710	0.076	0.117	-0.827	0.505
Log Continental Distance	143,993	8.197	0.827	4.742	9.880
Log Sea Distance	76,161	8.779	0.926	4.113	10.11
Log Exchange Rate origin	75,615	-3.584	2.607	-14.77	0.818
Log Exchange Rate dest.	76,313	-3.583	2.606	-14.77	0.818
OECD origin	144,245	0.255	0.436	0	1
OECD dest.	144,245	0.256	0.436	0	1
EU origin	144,245	0.247	0.431	0	1
EU dest.	144,245	0.249	0.432	0	1
GATT origin	144,245	0.720	0.449	0	1
GATT dest.	144,245	0.727	0.446	0	1
Multilateral Resistance origin	139,245	18.86	1.885	14.43	23.66
Multilateral Resistance dest.	143,996	20.28	0.381	19.43	21.79

[5] Multilateral Resistance Terms are based on remoteness terms introduced by Head (2003) to control for multilateral resistance: $MRT_i = \sum \frac{Dist_{ij}}{GDP_i/\sum GDP_i}$ & $MRT_j = \sum \frac{Dist_{ij}}{GDP_j/\sum GDP_j}$

Robustness Mechanisms

To verify the statistical validity of the method used, three robustness checks have been conducted (see Appendices D-F). The first one accounts for the aforementioned potential non-stationarity of the variables controlling for the countries´ GDPs. As a result of the conducted Dickey-Fuller test, an alteration to equation 1(a) using first differences of GDP is presented (see Appendix D).

A second robustness check is done by attempting to control for country-pair random effects (see Appendix E).

Lastly, a Poisson specification is estimated to account for the criticism of Linder and de Groot (2006), that adding a small constant of 1 to the log-value of the dependent variable in order to deal with Zero-Trade-Flows is not theoretically and empirically justifiable (see Appendix F).

RESULTS

Having discussed the model and its specifications to best predict bilateral trade flow, the results will be presented next. I first discuss the results of models 1(a) and 1(b), assessing the first hypothesis. The particular result of the coefficient of distance on bilateral trade flow of model 1(a) gives means to be further applied in two simulation exercises. These simulation exercises are based on the dataset of De Soyres et al. (2018), who predict the change in trade costs resulting from the BRI in two scenarios. Applying the explanatory coefficient of model 1(a) to this novel dataset yields promising results to infer on the second hypothesis.

Models 1(a) and 1(b)

First, I assess hypothesis one, which states that a reduction in transport costs has a statistically and economically significant effect on bilateral trade flow. Recall, that transport in this thesis is proxied by distance. In table 2, the first column shows the results of model 1(a): the coefficient of continental distance on bilateral trade flow is -0.79472 and highly significant ($p<0.01$). This means, that on average a reduction of distance by one percent increases bilateral trade flow by 0.79472 percent, ceteris paribus. Sea distance does not have a significant effect on bilateral trade volume. The empirical result of the significant effect of continental distance on bilateral trade flow is consistent with the findings of Disdier and Head (2008), which was discussed in the theoretical framework. Therefore, one cannot reject the first hypothesis that a reduction transport costs has a statistically and economically significant effect on bilateral trade flow.

The second column of table 2 shows the results of model 1(b), which controls for first differences of the GDP values to account for their potential non-stationarity when used as level values in model 1(a). I find that this alteration only minimally changes the coefficient of the explanatory variable continental distance. From this, one can conclude that potential non-stationarity of GDP does not heavily influence the value of the explanatory variable, namely continental distance. Model 1(a) thus remains the primary model of this research, as taking first differences leads to efficiency reduction as information is dropped (Zwinkels and Beugelsdijk, 2008). The results of the specifications further checking on the robustness of models 1(a) and 1(b) are examined in Appendices E and F.

Table 2 Linear regression results of equations 1(a) and 1(b)

Variable	1(a) Log Trade Flow	1(b) Log Trade Flow
Log GDP origin (GDP_o)	0.19544	
	(0.12204)	
Log GDP dest. (GDP_d)	0.97972***	
	(0.07763)	
First Lag of Log GDP_o	-0.26731***	
	(0.08330)	
First Lag of Log GDP_d	-0.06282	
	(0.06922)	
First Difference Log GDP_o		0.22878***
		(0.08265)
First Difference Log GDP_d		0.54913***
		(0.06479)
Log Continental Distance	**-0.79472*****	**-0.79232*****
	(0.17025)	(0.16902)
Log Sea Distance	-0.15281	-0.15738
	(0.13885)	(0.13846)
Log Exchange Rate origin	0.02143**	0.02420***
	(0.00834)	(0.00892)
Log Exchange Rate dest.	-0.00387	0.02324**
	(0.00975)	(0.00937)
OECD origin	-0.04336	-0.12165
	(0.10439)	(0.10876)
OECD dest.	-0.02941	-0.10093
	(0.11945)	(0.11836)
EU origin	0.44375***	0.45427***
	(0.05803)	(0.05804)
EU dest.	-0.11204	0.14422*
	(0.07808)	(0.07800)
GATT origin	0.55177***	0.57388***
	(0.13000)	(0.13491)
GATT dest.	0.13546	0.48120***
	(0.10384)	(0.10369)
Multilateral Resistance origin	-0.28131**	-0.25753***
	(0.13191)	(0.07952)
Multilateral Resistance dest.	-0.63123***	-2.29640***
	(0.18413)	(0.07056)
Constant	12.05927	63.44678***
	(7.84332)	(2.69925)
Observations	30,100	30,100
R^2 (overall)	0.7055	0.7033

Note. Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

Simulation Exercises

To assess the second hypothesis, two simulation exercises are computed, prognosing the changes in trade flows between all country pairs as a result of the BRI. These simulation exercises are based on the dataset of De Soyres et al. (2018). In this dataset, global shipment times and trade costs are calculated between all country pairs based on bilateral transport connections, the average transport speed via the given connections, average border and port delays and bilateral tariffs. These parameters are calculated once capturing the pre-BRI setting and once more based on assumptions about the changes, which the BRI would have on these parameters. The difference between these two gives the percentage change in transport cost between each country pair. De Soyres et al. (2018) reduce the ways of transport to two modes: maritime and railway transport. This is justified with the large majority of BRI projects consisting of rail and maritime infrastructure. Moreover, most international transport (70% of all trade value) occurs via maritime routes, followed by rail transport (OECD, 2017). In order to construct the shares of transport modes in the dataset close to real data, an optimal path algorithm is used. Given that a country pair is linked through a maritime and a railway connection, this algorithm selects the maritime route if the shipping time is less than four times the transport time via the railway connection (De Soyres et al. 2018). This yields a maritime transport share of 82.3% pre-BRI, leaving railway transport with 17.7%.

In the dataset two scenarios are considered. In a “lower bound scenario” the mode of transport is fixed. For example, given that trade between two countries mainly occurs via maritime transport, if a new more efficient railway connection is built as a result of the BRI, the optimal path algorithm would not allow the mode of transport to change.

In an “upper bound scenario”, the mode of transport can switch as a result of BRI transport infrastructure developments between two countries. This implies, that if a pre-BRI trade connection between two countries depends on maritime transport, a new, more efficient railway connection built as a result of the BRI would allow the mode of transport to change. The reason to consider both scenarios is to more accurately portray the current dynamics of the BRI and account for more than one possible development, specifically one more conservative outcome and a more progressive one.

The descriptive statistics in table 3 show that the “lower bound scenario” results in a much lower average change in trade costs than the “upper bound scenario”. On average, trade costs between a country pair decrease about 1.59% after the implementation of the BRI in the “lower bound scenario”, compared to an average decrease of 2.97% in the “upper bound scenario”. Important to note is that these results are based on a subsample out of the full country list used by De Soyres et al., as this thesis focuses only on EU countries and countries directly involved in the BRI (see Appendix B).

In each of the two scenarios, the coefficient of continental distance as calculated in model 1(a) is applied, yielding empirical results on how bilateral trade flows change based on the changes in transport costs. Recall, that the second hypothesis states that BRI infrastructure development increases EU trade flow. I find that in both scenarios of the simulation exercises bilateral trade flow increases in all EU countries. This gives means to not rejecting the second hypothesis. The following sub-sections answer the research question by showing how the progress of the Belt Road Initiative will influence long term trade behaviour in the European Union, given the specifications of the two scenarios.

Table 3 Descriptive statistics of the change in trade cost between EU and BRI involved country pairs before and after the implementation of BRI infrastructure (De Soyres et al., 2018)

Variable	Obs.	Mean	Std. Dev.	Min.	Max.
Change Cost lower bound (in %)	5,026	1.585	3.349	0	48.79
Change Cost upper bound (in %)	5,026	2.969	4.562	0	51.99

Lower Bound Scenario

The results of the “lower bound scenario” are visualized in figure 1 and figure 2. Figure 1 shows a map of the predicted change in trade flows of all EU countries as a result of the “lower bound scenario” of the BRI completion. Figure 2 adds the change in trade flows of all countries associated with the BRI. Comparing both figures shows that, keeping the modal distribution of transport fixed, trade is predicted to increase in all EU countries, yet is strongly outperformed by Non-EU BRI countries after the implementation of BRI infrastructure projects. This becomes obvious as predicted change in trade flows depicted in figure 2 generally shows higher percentage changes in countries outside of Europe.

This first impression from a glance at the two figures manifests itself when statistically comparing the groups of EU countries and Non-EU BRI countries: the trade flow of the median Non-EU BRI-associated country increases by 1.19%, whereas trade flow of the median EU country increases by only 0.31 percent (Appendix J). While the minimum values of both groups are similar at around 0.14%, some outliers marking the upper limit of change in trade become evident. Non-EU BRI countries profiting most from BRI infrastructure with respect to change in trade flows are Cambodia, Mongolia, Turkey and Tajikistan (Appendix G). All are predicted to experience an increase in trade flows larger than 4%. This can be attributed to heavily fostered infrastructure projects such as port- and railway construction but also the countries´ location within the economic BRI corridors leading from China towards the West (De Soyres et al., 2018).

The percentage changes in trade of EU countries is much smaller: only one country reaches a predicted trade change of over 2%, namely Greece. Other EU countries follow, such as Bulgaria, Romania and Malta with predicted trade changes of 1.53%, 1.19% and 0.85% post-BRI (Figure 10, Appendix G). The strong predicted increase of Greek trade does not come at a surprise, given China´s goal to transform Piraeus into Europe´s biggest harbour, as discussed in the theoretical framework. Moreover, Bulgaria and Romania are “ambitious partners” of the 16+1 format of CEECs and China (EPRS, 2018). As reviewed in the theoretical framework, this format is largely used to encourage Chinese foreign direct investments into (BRI-) infrastructure projects in CEECs. Hence, a larger predicted trade increase of Bulgaria and Romania could directly be impacted by infrastructure in and around the countries, as for example the aforementioned Budapest-Belgrade railway.

While South-Western EU countries tend to benefit from above EU-average increase in trade flow, EU countries experiencing the smallest trade gains are geographically scattered across Europe. The country predicted to increasing its trade flow the least as a result of the BRI is the Netherlands, closely followed by Lithuania, Latvia, Belgium and Portugal (Figure 9, Appendix G). In all 5 countries, increase in trade flow is far below 0.25%. Hence, the BRI threatens to become more of a challenge for the Netherlands and Belgium to maintain their positions as Europe´s largest maritime freight transport countries (Eurostat, 2018). One reason for this could be the improved land connectivity towards Asia via the New Eurasia Land Bridge. This means that goods transported via railway, for example the railway connection between Chongqing, China and Duisburg, Germany may increase European trade stronger due to reduced trade costs, than maritime freight via traditional routes to Antwerp or Rotterdam. A second and perhaps more relevant cause poses the strong trade improvements for Greece via the enhanced infrastructure of its main port of Piraeus. The empirical results of this thesis could be a first indication of how maritime trade flow may shift from European trade powerhouses Belgium and the Netherlands towards Greece, as Chinese investments under the BRI continue to strengthen that region.

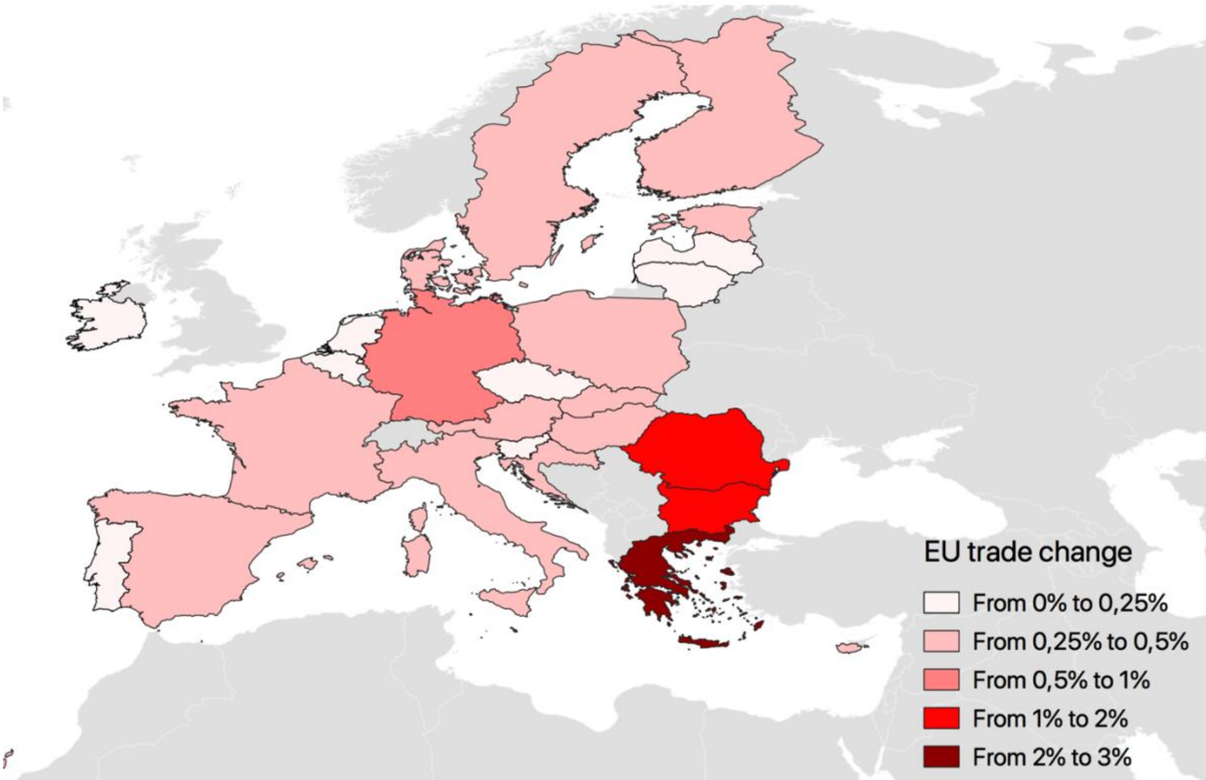

Figure 1 Increase in trade flows of EU countries resulting from the BRI in the "lower bound scenario"

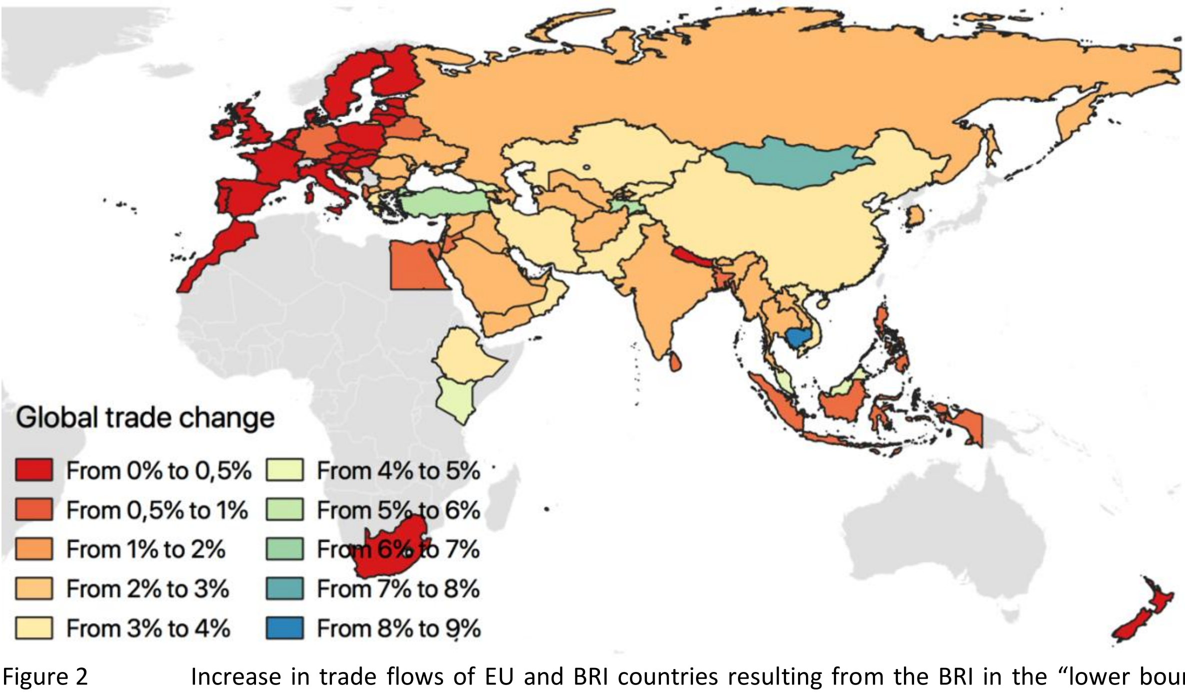

Figure 2 Increase in trade flows of EU and BRI countries resulting from the BRI in the "lower bound scenario"

Upper Bound Scenario

A first glance at figures 3 and 4, which visualize the predicted trade changes in the "upper bound scenario", hints a distribution of values similar to the "lower bound scenario". Once again, the predicted trade change is positive for all EU countries, yet strongly outperformed by Non-EU BRI countries. However, in this scenario the mode of transport is subject to change as a result of BRI infrastructure projects. This allows for example the implementation of a new railway link to change transport mode from maritime to rail transport between the affected country pairs. The consequence is higher trade increase per country on average, as can be observed when directly comparing figures 1 and 3, respectively 2 and 4. Statistical evidence underlines this: in the "upper bound scenario" trade of the median EU country increases by 0.61%, opposed to an increase of 2.23% of the median Non-EU BRI-associated country (Appendix J).

The countries with smallest predicted trade percentage change do not differ largely between Non-EU BRI-associated countries and EU countries. The minimum percentage change in the Non-EU group is 0.30% compared to 0.24% in the EU group (Appendix J). A difference to the "lower bound scenario" is, that fewer values are considered outliers, which mark the upper bound of the increase in trade (Appendix J). A possible explanation for that may be the better modal distribution of transport among the newly created transportation networks. If for example a newly constructed railway within the BRI creates a new optimal path of transport, the simulation considers this mode of transport as the preferred connection between two countries, even if maritime transport had been used before. This could lead to more equal trade expansion across countries, as the optimal path algorithm assigns the best mode of transportation, regardless of the pre-BRI connection established.

In the "upper bound scenario", previously outlying Non-EU BRI countries get replaced by the middle Eastern states of Kuwait, Oman and Iran. Each of these three states is expected to benefit from a trade increase of above 7% after the implementation of planned BRI projects. As Iran is a key-actor and endpoint of the China-Central and West Asia Economic Corridor, this development does not come as a surprise. Kuwait and Oman as members of the gulf cooperation council (G.C.C.) also benefit from ambitious bilateral partnerships with China, making the Arabian Peninsula another potential hub for further expanding the BRI (Fulton, 2017).

In the EU, Greece still forms the upper boundary of increased predicted trade change after BRI infrastructure implementation. The value increases to 2.47% (Figure 12, Appendix H) and can be interpreted in a similar manner as in the “lower bound scenario”. Moreover, Romania and Bulgaria remain among the EU countries benefitting most from the BRI with trade predicted to increase by 2.23% and 1.73% respectively. Important to note in the “upper bound scenario” is that Sweden´s predicted increase in trade of 2.31% is the second highest in the EU (Figure 12, Appendix H). This comes surprising, as Sweden´s approach towards China´s BRI has been rather reactive and passive (Weissmann and Rappe, 2017). Furthermore, unlike Romania and Bulgaria whose strong changes in trade can be interpreted by the countries´ proximity to concrete infrastructure projects, this reasoning is not applicable for the case of Sweden. Further research is needed to closer examine Sweden´s strong predicted increase in trade with regards to BRI infrastructure projects.

To reiterate, in both scenarios EU countries benefit significantly less from an increase in trade compared to Non-EU countries associated with the BRI. Outside of the EU, countries experiencing the highest predicted increase in trade are located in Central and South-East Asia in the “lower bound scenario” and shift towards the Middle East in the “upper bound scenario”. Within the EU, the South-Eastern European countries, namely Greece, Romania and Bulgaria are predicted to benefit the most from an increase in trade in both scenarios.

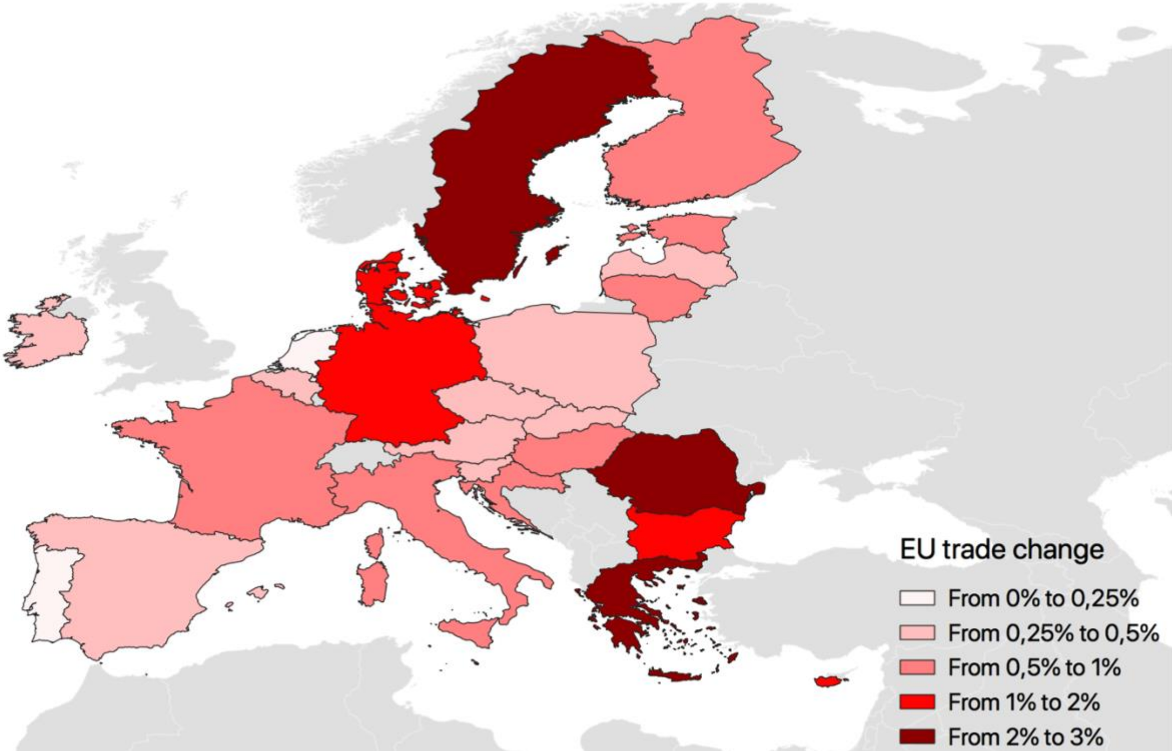

Figure 3 Increase in trade flows of EU countries resulting from the BRI in the "upper bound scenario"

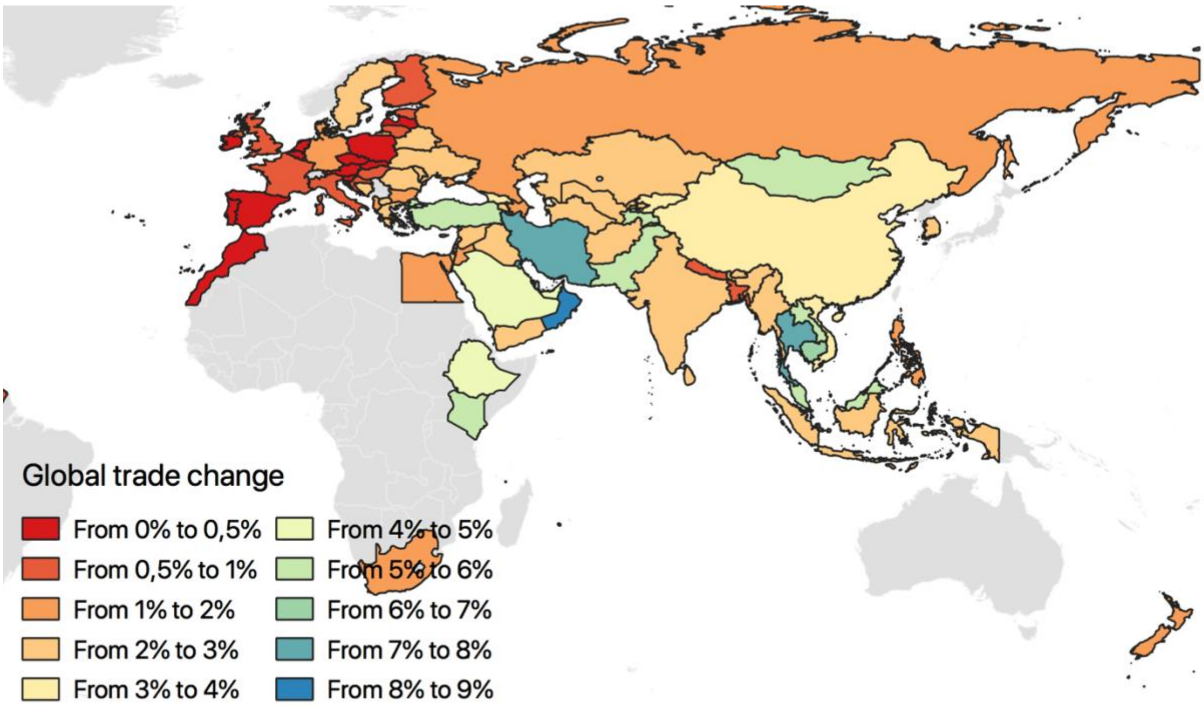

Figure 4 Increase in trade flows of EU and BRI countries resulting from the BRI in the "upper bound scenario"

DISCUSSION

This thesis contains two different types of results. The first type are the regression results of the gravity function, specifically the derived continental distance coefficient, which expresses the relation between bilateral transport costs and trade flow. The second type are the results of the simulation exercises, which allow to predict how individual country trade flows will change because of the BRI.

Gravity Model

As the continental distance coefficient is of central significance for the simulation exercises, the explanatory power of the results depends on the coefficient´s economic and statistical accuracy. This was attempted first by comparing the calculated distance coefficient to existing empirical results and second by conducting several robustness-checks. The value of the coefficient is well within the range of previously researched distance effects used to predict global trade data, when comparing it to the analysis of Disdier and Head (2008). More surprising is the difference of the coefficient to the findings of Herrero and Xu (2017). Since the authors investigate in the same field, namely the effect of the BRI on European trade, one may also expect similar resulting coefficients. Contrary to the findings of this thesis, Herrero and Xu are able to determine statistically significant transport cost coefficients strongly differing to the value of the continental distance effect presented in this thesis. In fact, Herrero and Xu´s (2017) effect of railway distance on trade is estimated to be around four times weaker. I expect the causes for this empirical divergence to be the difference in data used and the difference in methodology.

Just as Herrero and Xu (2017) I use a gravity equation. Unlike the authors, I base the gravity equation on a panel data set, which, besides larger data-availability, allows to control for country individual fixed effects. While this may serve better to extract an informative explanatory coefficient compared to using cross-sectional data, the model may still be subject to endogeneity. While country individual fixed effects control for all time invariant factors, time variant factors influencing the dependent variable, as well as correlating with the explanatory distance coefficient can still lead to omitted variable bias (Baier and Bergstrand, 2006). Model 1(a) therefore includes a variety of control variables in accordance with previous empirical research, yet they may still offer grounds for unobserved heterogeneity. One weak point here may be the computation of the multilateral resistance terms. These were calculated based on measuring remoteness between the country pairs, as introduced by Head (2003). This is criticised, as the method solely considers bilateral distance as a trade barrier (Anderson and van Wincoop, 2003). A more sophisticated approach to calculating multilateral resistance terms is suggested by Baier and Bergstrand (2009), which is based on linear approximation. Following this approach allows to include multiple factors besides distance. While Herrero and Xu (2017) claim to have followed this approach, it remains unclear how this calculation method changes the outcome of the coefficient compared to the remoteness approximation used in this thesis. Nevertheless, the approximation methods to measure multilateral resistance may pose a source of omitted variable bias.

Simulation Exercises

Potential omitted variable bias in the results of the gravity equation remains a caveat when applying the distance coefficient to the two simulation exercises. Hence, it needs to be noted, that all results derived in the simulation exercises are subject to the possibility of unobserved factors other than transport cost reduction of the BRI influencing the changes in trade. Another shortcoming in the conducting of the simulation exercises is that, while the continental distance coefficient of model 1(a) is statistically significant, the sea distance coefficient is not. This leads to only continental distance being used in the simulations, even to predict the change in trade, if occurring via the maritime transport. Existing empirical research does imply that maritime transport cost has an economically and statistically significant effect on trade (Korinek and Sourdin, 2009). Thus, solely relying on continental distance as a sufficient proxy for both continental and maritime transport costs may distort the results obtained from the simulation exercises. Herrero and Xu (2017) in fact find a significant effect of maritime distance on trade flow, which they include as an additional parameter in their simulation exercise. However, given the strong deviation in the data, as well as the methodology, no analogy of their findings can be drawn to the results of this thesis.

Aside from the validity of gravity model results, the reliability of the dataset used for the simulation exercises is substantial for obtaining informative results. De Soyres et al. (2018) mention that their data analysis is subject to two shortcomings. First, data on BRI projects as captured at the time of the research can change. Second, the choice between transport modes as a result of BRI developments is only vaguely estimated using the optimal path algorithm. As the BRI is still in its infant stage, this dataset nevertheless proves to be valuable for obtaining first estimations on how the Initiative could shape global trade.

CONCLUSION

This thesis provides an extensive databased method to answer the central research question of how the progress of the Chinese Belt Road Initiative will influence long term trade behaviour in the European Union.

The preceding results-section clearly visualizes the potential winners and losers of the BRI from a trade perspective, depending which of the two scenarios of De Soyres et al. (2018) is assumed. In both scenarios, EU trade on average increases by a smaller proportion than trade of Non-EU, BRI-affiliated countries. This outcome may be expected from a trade economic perspective, as transport frictions are reduced on a larger scale within the non-European BRI-zone through heavier BRI infrastructure investments.

Within the EU, in the “lower bound scenario”, which keeps the mode of transport fixed, the countries experiencing the largest increases in expected trade volume as the result of the BRI, are the South Eastern countries Greece, Bulgaria and Romania. This outcome can well be economically justified, as BRI investments within the EU strongly focus on the port of Piraeus in Greece and projects in the CEECs. Countries experiencing the smallest increases in trade are rather scattered around Europe. Especially the Netherlands and Belgium, as well as Lithuania and Latvia are predicted to experience only marginal increases in trade as a result of the BRI. In the “upper bound scenario”, in which the mode of transport can alternate after the implementation of the BRI, most EU countries experience a higher predicted increase in trade than in the “lower bound scenario”. Greece, Bulgaria and Romania remain among the countries benefitting most from predicted increasing trade yet are joined by Sweden. The Netherlands remains the country benefitting the least.

The implications for EU policy, assuming that the results do not suffer from econometric or theoretical flaws, are manifold. EU countries least affiliated with BRI projects should create BRI strategies on how to better interact with the infrastructure system connecting Asia with Eastern Europe. Especially Northern EU states that rely heavily on the maritime transport system linked through the harbours of Antwerp, Rotterdam and Hamburg may need to think about stronger connecting links towards the ending points of the BRI corridors. On the other hand, trade infrastructure fostered via the BRI does not come unconditional. Especially the Eastern European States actively engaging in BRI projects need to be aware of potential financial dependencies on China. The example of Hungary´s repayment difficulties in the Budapest-Belgrade railway project illuminate this danger.

Given the empirical shortcomings explained in the discussion section, further research into the topic could account for other scenarios based on the most recent developments of the BRI, as the BRI is a dynamic process. Furthermore, the effect of distance on trade has been researched extensively, yet a causal effect can still not be extracted with certainty. Hence, alternative approaches to establish a causal effect, perhaps by better controlling for time varying factors, could lead to more accurate long-term insights on the relationship between distance and trade.

REFERENCES

Amaro, S. (2019). China bought most of Greece´s main port and now it wants to make it the biggest in Europe. *CNBC.* Retrieved from https://www.cnbc.com/2019/11/15/china-wants-to-turn-greece-piraeus-port-into-europe-biggest.html

Anderson, J. (1979). A theoretical foundation for the gravity equation. *The American economic review*, *69*(1), 106-116.

Anderson, J. (2011). The Gravity Model. *Annual Review of Economics, 3*, 133-160. doi: 10.1146/annurev-economics-111809-125114

Anderson, J., & van Wincoop, E. (2003). Gravity with gravitas: a solution to the border puzzle. *American Economic Review 93* (1), 170–192.

Baier S., Bergstrand J. (2007). Do free trade agreements actually increase members´ international trade? *Journal of International Economics, 71,* 72-95. doi: 10.1016/j.jinteco.2006.02.005

Belt and Road Portal (2019). *The Belt and Road Initiative Progress, Contributions and Prospects.* Retrieved from https://eng.yidaiyilu.gov.cn/zchj/qwfb/86739.htm

Craven M., & Wilson M. (2020). *Covid19: Implications for business*. McKinsey & Company Executive Briefing. Retrieved from https://www.mckinsey.com/business-functions/risk/our-insights/covid-19-implications-for-business

De Soyres, F., Mulabdic, A., Murray, S., Rocha, N., & Ruta, M. (2018). How much will the Belt and Road Initiative reduce trade costs?. *The World Bank, 8614.* Retrieved from https://elibrary.worldbank.org/doi/abs/10.1596/1813-9450-8614

Disdier, A., & Head, K. (2008). The puzzling persistence of the distance effect on bilateral trade. *The Review of Economics and statistics*, *90*(1), 37-48.

European Parliament (2020). *The European Union and the World Trade Organisation.* Retrieved from https://www.europarl.europa.eu/factsheets/en/sheet/161/the-european-union-and-the-world-trade-organisation

European Union (2020). *The history of the European Union.* Retrieved from https://europa.eu/european-union/about-eu/history_en

Feenstra, R. (2015). Advanced international trade: theory and evidence. Princeton university press.

Fillipini C., & Molini V. (2003). The Determinants of East Asian trade Flows: a Gravity Equation Approach. *Journal of Asian Economics, 14,* 695-711. doi: 10.1016/j.asieco.2003.10.001

Fontaine, R. (2020). *Globalization Will Look Very Different After the Coronavirus Pandemic.* Retrieved from https://foreignpolicy.com/2020/04/17/globalization-trade-war-after-coronavirus-pandemic/

Fouquin, M., & Hugot, J. (2016). *Two centuries of bilateral trade and gravity data: 1827-2014*. Universidad Javeriana-Bogotá. Retrieved from: http://www.cepii.fr/CEPII/en/bdd_modele/presentation.asp?id=32

Frankel, J., & Romer, D. (1999). Does trade cause growth? *American Economic Review, 89* (3), 379–399.

Fulton, J. (2017). *The G.C.C. Countries and China´s Belt and Road Initiative (BRI): Curbing Their Enthusiasm?* Retrieved from: https://www.mei.edu/publications/gcc-countries-and-chinas-belt-and-road-initiative-bri-curbing-their-enthusiasm#_ftn34

Geraci, V., & Prewo, W. (1977). Bilateral trade flows and transport costs. *The Review of Economics and Statistics*, 67-74.

Gerritse, M. (2020). Lecture 2 UPT Seminar. *Erasmus School of Economics*

Hummels, D., & Schaur, G. (2013). Time as a trade barrier. *American Economic Review*, *103*(7), 2935-59.

Jha, A. (2013). Newton´s Universal Law of Gravitation. *The Guardian.* Retrieved from https://www.theguardian.com/science/2013/oct/13/newtons-universal-law-of-gravitation

Johnson, C. (2016). President Xi Jinping's 'Belt and Road'Initiative. *Center for Strategic and International Studies*, *28*, 1-24.

Korinek, J., & Sourdin, P. (2009). Maritime transport costs and their impact on trade. *Organization for Economic Co-operation and Development TAD/TC/WP (2009)*, *7*.

Limao, N., & Venables, A. J. (2001). Infrastructure, geographical disadvantage, transport costs, and trade. *The world bank economic review*, *15*(3), 451-479.

Linders, G. & De Groot, H. (2006). Estimation of the gravity equation in the presence of zero flows. *Tinbergen Institute Discussion Paper.*

Martinez-Zarzoso, I. & Nowak-Lehmann, F. (2007). Is distance a good proxy for transport costs? The case of competing transport modes. *The Journal of International Trade & Economic Development*, *16*(3), 411-434.

NDRC (2016). *The 13th Five-Year Plan For Economic And Social Development Of The People´s Republic Of China.* Retrieved from https://en.ndrc.gov.cn/policyrelease_8233/201612/P020191101482242850325.pdf

NRDC (2020). *Belt and Road Initiative Creates Remarkable Achievements.* Retrieved from https://en.ndrc.gov.cn/newsrelease_8232/202003/t20200317_1223419.html

Oba, M. (2020). *Coronavirus and the Future of Globalization.* Retrieved from https://thediplomat.com/2020/03/coronavirus-and-the-future-of-globalization/

Oltermann, P. (2018). Germany´s `China City`: how Duisburg became Xi Jinping´s gateway to Europe. *The Guardian.* Retrieved from https://www.theguardian.com/cities/2018/aug/01/germanys-china-city-duisburg-became-xi-jinping-gateway-europe

OECD (2017). ITF Transport Outlook 2017. *OECD Publishing*. Retrieved from https://read.oecd-ilibrary.org/transport/itf-transport-outlook-2017_9789282108000-en#page1

OECD (2018). The Belt and Road Initiative in the global trade, investment and finance landscape. *OECD Business and Finance outlook 2018.* Retrieved from https://www.oecd.org/finance/Chinas-Belt-and-Road-Initiative-in-the-global-trade-investment-and-finance-landscape.pdf

O'Rourke, K., & Williamson, J. (2002). When did globalisation begin?. *European Review of Economic History*, *6*(1), 23-50.

Shepard, W. (2019). Silk Road Breakthrough: Russia To Begin Construction On The China-Western Europe Transport Corridor. *Forbes.* Retrieved from https://www.forbes.com/sites/wadeshepard/2019/07/23/silk-road-breakthrough-russia-to-begin-construction-on-the-china-western-europe-transport-corridor/#14c04310765d

UNECE (2019). *UN Presentation - Analysis of 6 Projects along the BRI.* Retrieved from https://www.unece.org/fileadmin/DAM/ceci/documents/2019/PPP/Forum/Presentations/Session_4_-_Henry_Tillman.PDF

United Nations (2020). *Globalisation linkage to Covid-19: How Africa´s Economy is Impacted?* Retrieved from https://www.un.org/africarenewal/news/coronavirus/globalisation-linkage-covid-19-how-africa's-economy-impacted

Verlinde, E. (2011). On the Origin of Gravity and the Laws of Newton. *Journal of High Energy Physics*, *2011*(4), 1-27.

Weissmann, M., & Rappe, E. (2017). Sweden's approach to China's Belt and Road Initiative: Still a glass half-empty. *Swedish Institute of International Affairs.* Retrieved from https://www.ui.se/globalassets/ui.se-eng/publications/ui-publications/2017/paper-1-swedens-approach-to-chinas-belt-and-road-initiative.pdf

World Bank (2020). *GDP (current USD) – China.* Retrieved from https://data.worldbank.org/indicator/NY.GDP.MKTP.CD?locations=CN

World Health Organization (2020). *WHO Director-General´s opening remarks at the media briefing on COVID-19.* Retrieved from https://www.who.int/dg/speeches/detail/who-director-general-s-opening-remarks-at-the-media-briefing-on-covid-19---11-march-2020

Wu, W., & Wong, C. (2020). How China´s coronavirus response may shape the future of its flagship Belt and Road Initiative. *South China Morning Post.* Retrieved from https://www.scmp.com/news/china/diplomacy/article/3076210/how-chinas-coronavirus-response-may-shape-future-its-flagship

Xinhua (2017). *Full text of President Xi´s speech at opening of Belt and Road forum.* Retrieved from http://www.xinhuanet.com//english/2017-05/14/c_136282982.htm

Zwinkels, R., & Beugelsdijk, S. (2010). Gravity equations: Workhorse or Trojan horse in explaining trade and FDI patterns across time and space?. *International Business Review*, *19*(1), 102-115.

APPENDICES

Appendix A

	Economy	Economic Corridor		Economy	Economic Corridor
1	People's Republic of China	-	37	Singapore	China-Indochina Peninsula
2	Bangladesh	Bangladesh-China-India-Myanmar	38	Thailand	China-Indochina Peninsula
3	Bhutan	Bangladesh-China-India-Myanmar	39	Timor-Leste	China-Indochina Peninsula
4	India	Bangladesh-China-India-Myanmar	40	Viet Nam	China-Indochina Peninsula
5	Myanmar	Bangladesh-China-India-Myanmar	41	Belarus	China-Mongolia-Russian Federation
6	Nepal	Bangladesh-China-India-Myanmar	42	Estonia	China-Mongolia-Russian Federation
7	Sri Lanka	Bangladesh-China-India-Myanmar	43	Latvia	China-Mongolia-Russian Federation
8	Albania	China-Central West Asia	44	Lithuania	China-Mongolia-Russian Federation
9	Armenia	China-Central West Asia	45	Mongolia	China-Mongolia-Russian Federation
10	Azerbaijan	China-Central West Asia	46	Russian Federation	China-Mongolia-Russian Federation
11	Bosnia and Herzegovina	China-Central West Asia	47	Afghanistan	China-Pakistan
12	Bulgaria	China-Central West Asia	48	Pakistan	China-Pakistan
13	Croatia	China-Central West Asia	49	Bahrain	China-Pakistan[1]
14	Georgia	China-Central West Asia	50	Kuwait	China-Pakistan[1]
15	Islamic Republic of Iran	China-Central West Asia	51	Oman	China-Pakistan[1]
16	Iraq	China-Central West Asia	52	Qatar	China-Pakistan[1]
17	Israel	China-Central West Asia	53	Saudi Arabia	China-Pakistan[1]
18	Jordan	China-Central West Asia	54	United Arab Emirates	China-Pakistan[1]
19	Kyrgyzstan	China-Central West Asia	55	Yemen	China-Pakistan[1]
20	Lebanon	China-Central West Asia	56	Czech Republic	New Eurasian Land Bridge
21	Former Yugoslav Republic of Macedonia	China-Central West Asia	57	Hungary	New Eurasian Land Bridge
22	Republic of Moldova	China-Central West Asia	58	Slovak Republic	New Eurasian Land Bridge
23	Montenegro	China-Central West Asia	59	Slovenia	New Eurasian Land Bridge
24	Palestinian Authority or West Bank and Gaza Strip	China-Central West Asia	60	Poland	New Eurasian Land Bridge
25	Romania	China-Central West Asia	61	Kazakhstan	New Eurasian Land Bridge[1]
26	Serbia	China-Central West Asia	62	Ukraine	New Eurasian Land Bridge[1]
27	Syrian Arab Republic	China-Central West Asia	63	Egypt	21st-C Maritime Silk Road
28	Tajikistan	China-Central West Asia	64	Ethiopia	21st-C Maritime Silk Road
29	Turkey	China-Central West Asia	65	Indonesia	21st-C Maritime Silk Road
30	Turkmenistan	China-Central West Asia	66	Kenya	21st-C Maritime Silk Road
31	Uzbekistan	China-Central West Asia	67	Maldives	21st-C Maritime Silk Road
32	Brunei Darussalam	China-Indochina Peninsula	68	Morocco	21st-C Maritime Silk Road
33	Cambodia	China-Indochina Peninsula	69	New Zealand	21st-C Maritime Silk Road
34	Lao People's Democratic Republic	China-Indochina Peninsula	70	Panama	21st-C Maritime Silk Road
35	Malaysia	China-Indochina Peninsula	71	Korea	21st-C Maritime Silk Road
36	Philippines	China-Indochina Peninsula	72	South Africa	21st-C Maritime Silk Road

Figure 5: States associated with BRI projects and the economic corridor they are situated in (OECD, 2018)

Appendix B

Albania	Kyrgyzstan
United Arab Emirates	Cambodia
Armenia	Korea
Austria	Kuwait
Azerbaijan	Lao People's Democratic Republic
Belgium and Luxembourg	Sri Lanka
Bangladesh	Lithuania
Bulgaria	Luxembourg
Bahrain	Latvia
Belarus	Morocco
Brunei Darussalam	Malta
China	Mongolia
Cyprus	Malaysia
Czech Republic	Netherlands
Germany	Nepal
Denmark	New Zealand
Egypt	Oman
Spain	Pakistan
Estonia	Panama
Ethiopia	Philippines
Finland	Poland
France	Portugal
United Kingdom	Qatar
Georgia	Romania
Greece	Russian Federation
Croatia	Saudi Arabia
Hungary	Singapore
Indonesia	Slovakia
India	Slovenia
Ireland	Sweden
Iran	Thailand
Israel	Tajikistan
Italy	Turkey
Jordan	Ukraine
Kazakstan	Viet Nam
Kenya	South Africa

Figure 6: List of countries extracted from the dataset of De Soyres et al. (2018) to assess hypothesis 2

Appendix C

Time variance of Multilateral Resistance Terms

The subsequent scatterplots visualize the time variance of multilateral resistance terms. Figure 1 shows that as time increases multilateral resistance of the origin country slightly decreases. Figure 2 shows that time invariance of multilateral resistance is even larger, as it decreases more strongly over time.

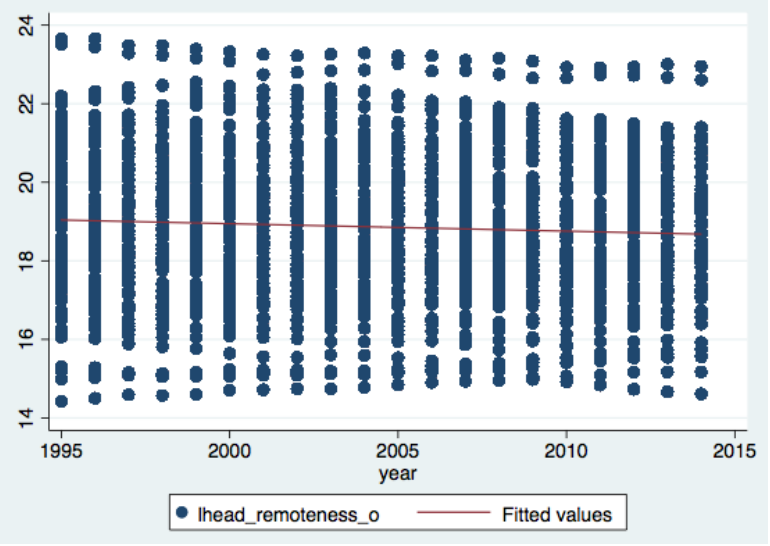

Figure 7: Scatterplot of the distribution of origin country multilateral resistance (denoted as *lhead_remoteness*) over time (denoted as *year*)

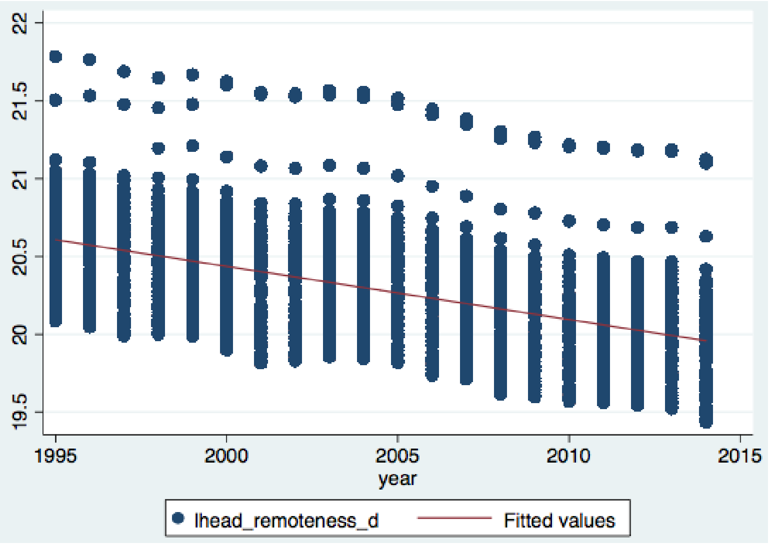

Figure 8: Scatterplot of the distribution of destination country multilateral resistance (denoted as *lhead_remoteness*) over time (denoted as *year*)

Appendix D

Augmented Dickey Fuller Test

To check for non-stationarity of the control variables GDP_{it} and GDP_{jt} an augmented Dickey Fuller Test has been conducted. Because of technical limitations, the test has been conducted to check for non-stationarity of the summed-up values of GDP_{it} per year t. From the Z-test statistic of 2.56 and the corresponding P-value of 0.30 the Null-Hypothesis stating that the sum of GDP_{it} contains a unit root, cannot be rejected. This result is in line with the reasoning of Zwinkels and Beugelsdijk (2008).

Non-stationarity of GDP

This leads to an augmented version of equation (1a), replacing the level-values of GDP_{it} and GDP_{jt} and their first lags of GDP_{it-1} and GDP_{jt-1} with first differences:

$$\begin{aligned} \ln(Flow_{ijt}+1) &= \beta_0 + \beta_1 \partial lnGDP_i + \beta_2 \partial lnGDP_j + \beta_3 lnDist_{ij} + \beta_4 lnSeaDist_{ijt} \\ &+ \beta_5 lnExchR_{it} + \beta_6 lnExchR_{jt} + \beta_7 OECD_{it} + \beta_8 OECD_{jt} + \beta_9 EU_{it} \\ &+ \beta_{10} EU_{jt} + \beta_{11} GATT_{it} + \beta_{12} GATT_{jt} + \beta_{13} lnMRT_{it} + \beta_{14} lnMRT_{jt} \\ &+ \alpha_i + \alpha_j + \varepsilon_{ijt} \end{aligned} \quad (1b)$$

Where ∂ represents the change between the periods *t* and *t-1.*

Appendix E

Country-Pair Random Effects

This model attempts to control for bilateral random effects. However, using the random effect approach implies the following assumption: the covariance of the random effects (α_i) and all independent variables is equal to 0. Should this assumption not hold, the estimators would be inconsistent.

$$\begin{aligned} \ln\left(Flow_{ijt}+1\right) &= \beta_0 + \beta_1 lnGDP_{it} + \beta_2 lnGDP_{jt} + \beta_3 lnGDP_{it-1} + \beta_4 lnGDP_{jt-1} + \beta_5 lnDist_{ij} \\ &+ \beta_6 lnSeaDist_{ijt} + \beta_7 lnExchR_{it} + \beta_8 lnExchR_{jt} + \beta_9 OECD_{it} + \beta_{10} OECD_{jt} \\ &+ \beta_{11} EU_{it} + \beta_{12} EU_{jt} + \beta_{13} GATT_{it} + \beta_{14} GATT_{jt} + \beta_{15} lnMRT_{it} \\ &+ \beta_{16} lnMRT_{jt} + \alpha_{ij} + \varepsilon_{ijt} \end{aligned} \quad (2)$$

Where α_{ij} serves as a constant controlling for time-invariant country-pair random effects.

Hausman test

To verify the underlying assumption of this model, a Hausman test was conducted. The Hausman test tests the Null-Hypothesis that country-pair random effects are adequately modelled by the random effects model. The χ^2-test statistic of 575.29 and the resulting P-value of 0.00 leads to a rejection of the Null-Hypothesis. Based on this result, using random effects as an empirical model to predict trade flow would lead to inconsistent estimators.

Appendix F

Poisson Specification

The Poisson specification is used to verify the robustness of accounting for Zero-Trade-Flows in model 1(a). Using a Poisson distribution has the advantage of treating Zero-Trade-Flows consistently with theoretical and empirical justifications (Burger et al., 2009). Furthermore, using Poisson distribution provides consistent estimates in the presence of heteroskedasticity and accounts for potential bias resulting from logarithmic transformation. It needs to be noted that using Poisson the effect of continental distances on bilateral trade flow changes to a significant value of -0.95779. This means that a one percent change in distance decreases the difference in the logs of expected counts of trade volume by 0.95779, while holding other variables in the model constant. Further research is needed whether the Poisson approach more accurately models trade flow than model 1(a). Given the empirical commonness of the gravity equation used in trade economics, model 1(a) remains the preferred model to estimate the coefficient used in the simulation exercises.

Table 4 Results using Poisson estimation

	(1a) Log Trade Flow
Log GDP origin (GDP_o)	0.64343***
	(0.07648)
Log GDP dest. (GDP_d)	0.76688***
	(0.05651)
First Lag of Log GDP_o	-0.37646***
	(0.06114)
First Lag of Log GDP_d	-0.09371*
	(0.05661)
Log Continental Distance	**-0.95779*** **
	(0.07064)
Log Sea Distance	0.06016
	(0.05070)
Log Exchange Rate origin	-0.00459
	(0.00617)
Log Exchange Rate dest.	0.00147
	(0.00719)
OECD origin	0.08816
	(0.06889)
OECD dest.	-0.10957*
	(0.06205)
EU origin	0.34123***
	(0.05903)

EU dest.	0.18012***
	(0.06328)
GATT origin	0.27606***
	(0.06043)
GATT dest.	0.30050***
	(0.05557)
Multilateral Resistance origin	-0.21585***
	(0.06975)
Multilateral Resistance dest.	-0.52316***
	(0.07044)
Constant	11.93146***
	(3.05071)
Observations	30,100

Note. Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

Appendix G

Figures describing the changes in trade of EU countries in the "lower bound scenario"

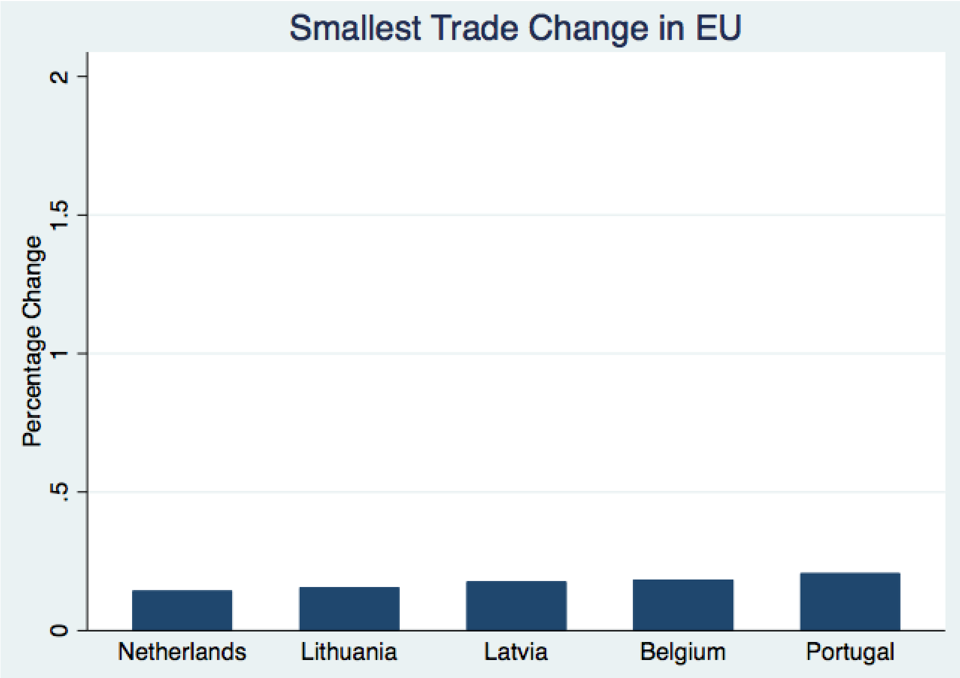

Figure 9: EU countries with smallest predicted change in trade flows in the "lower bound scenario"

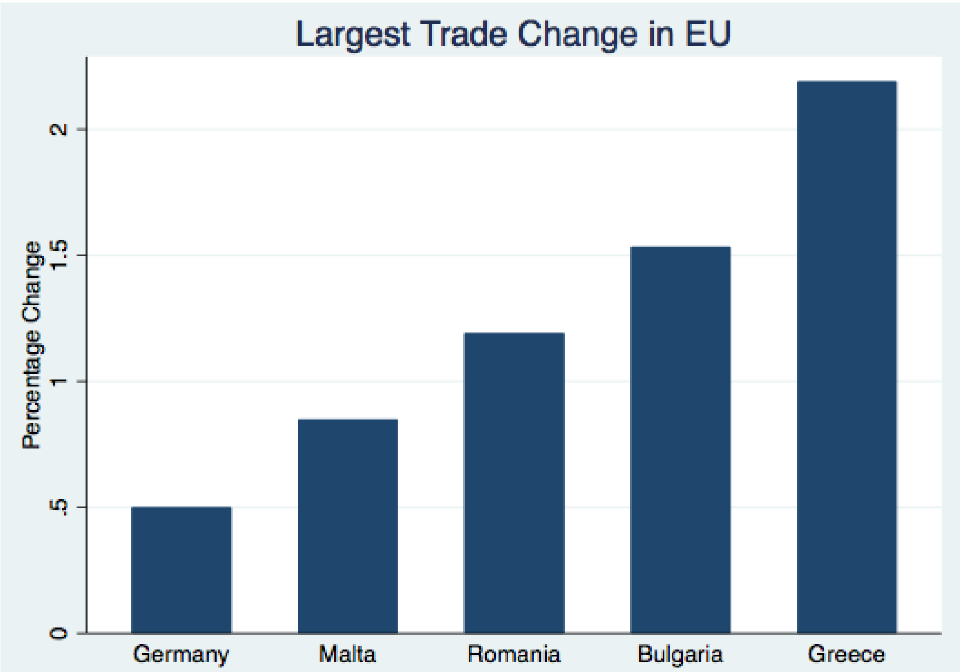

Figure 10: EU countries with largest predicted change in trade flows in the "lower bound scenario"

Appendix H

Figures describing the changes in trade of EU countries in the “upper bound scenario”

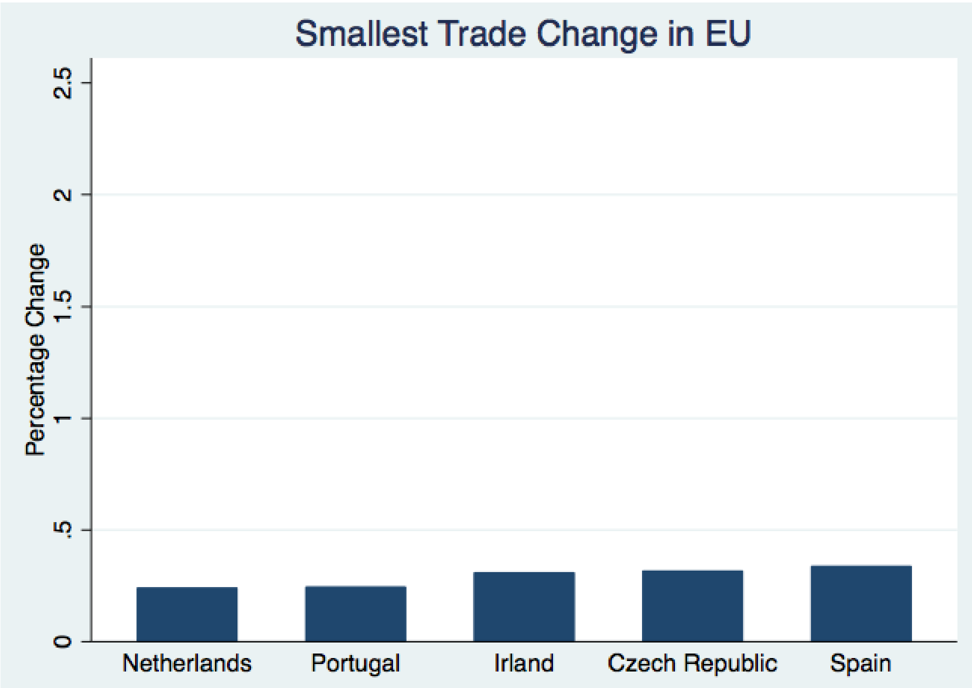

Figure 11: EU countries with smallest predicted change in trade flows in the “upper bound scenario”

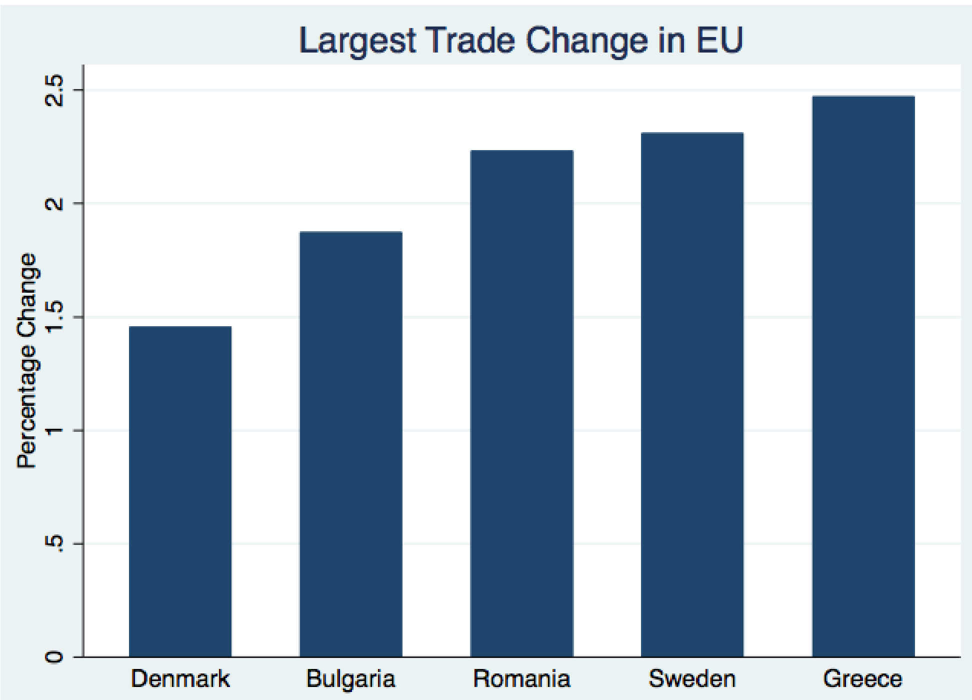

Figure 12: EU countries with largest predicted change in trade flows in the “upper bound scenario”

Appendix J

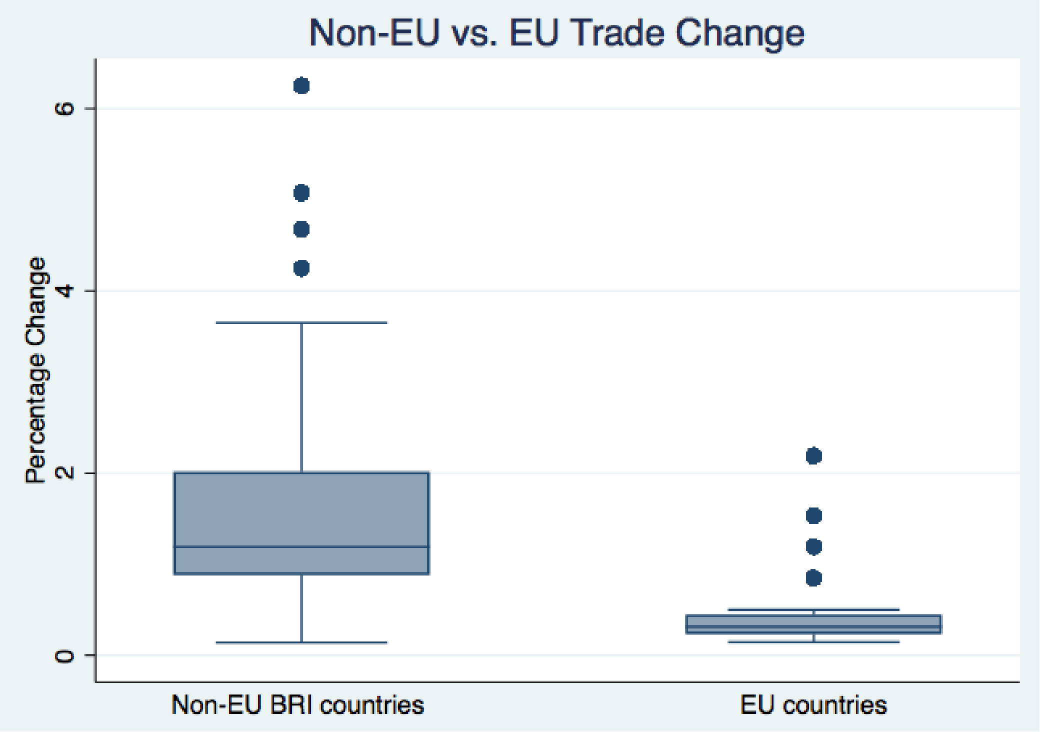

Figure 13: Boxplot describing trade change in percentage between Non-EU countries and EU countries in the "lower bound scenario"

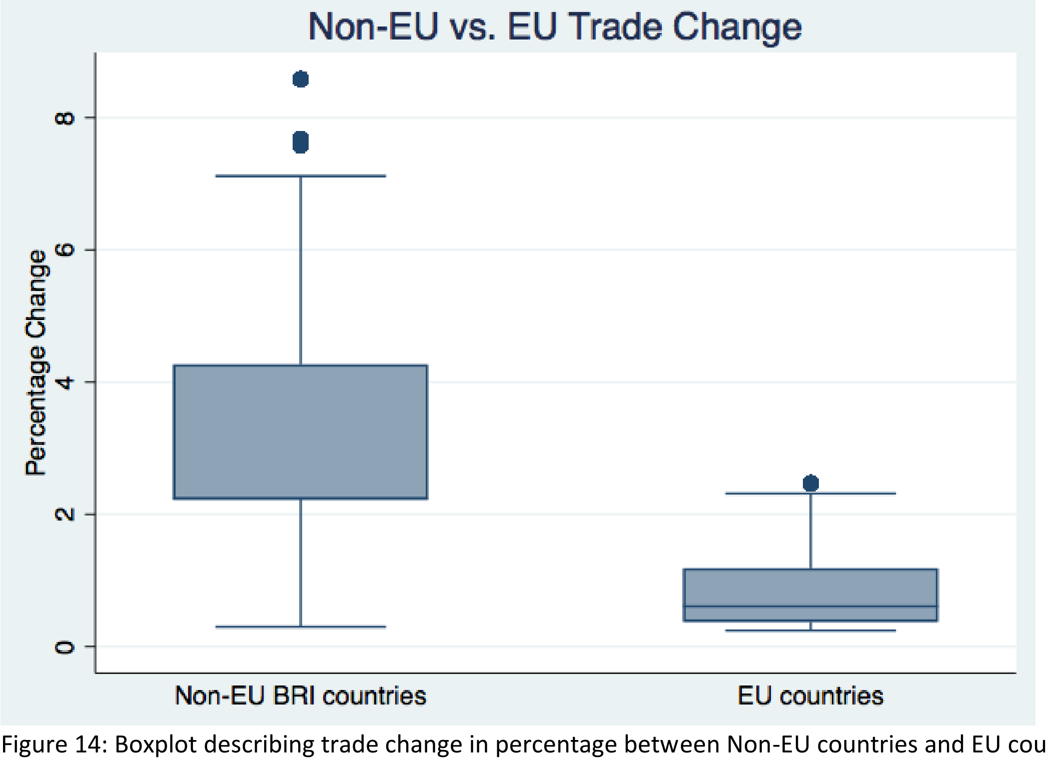

Figure 14: Boxplot describing trade change in percentage between Non-EU countries and EU countries in the "upper bound scenario"