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More than Roads?
A Gravity Model Analysis of the Institutional effects of Trade in the Belt and Road

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Abstract

Export data from 2007 – 2016 with 175 exporters and 195 importers is combined with institutional data from World Governance Indicators in order to ascertain the institutional effects on trade. This effect is measured by three different metrics using a gravity model: the effects on trade due to institutional quality of exporters and importers, the effects of particularly good and bad institutions and the effects of institutional similarity. These results are then used in order to analyze China's Belt and Road Initiative and its possible goals. China was found to export more to nations with good institutions and far less to nations with poor institutions, even when only looking at trade flows between China and B&R nations. Existing funding information and agreements listed in the last B&R Forum did not follow China's trend of exporting more to nations with good governmental institutions. Instead, a negative correlation exists between B&R funding and agreements and the institutional quality leading to the conclusion that China is not just strengthening existing trading relationships with the B&R Initiative but rather is pursuing other goals, such as trade diversification.

Keywords

Belt and Road, China, Gravity Model, Institutional quality, WGI

Declaration of Authorship

1. The author hereby declares that he compiled this thesis independently, using only the listed resources and literature.

2. The author hereby declares that all the sources and literature used have been properly cited.

3. The author hereby declares that the thesis has not been used to obtain a different or the same degree.

Prague … 12/07/2018 Cezary Baraniecki

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Topic characteristics / Research Question(s):

China's One Belt, One Road initiative, or Belt and Road, is expected to launch a series of infrastructure projects within the 65 involved countries in order to develop what has been described as a "modern Silk Road". Better infrastructure means lower transportation costs and thus more interconnectedness for the region. Studies have already been done that predict the increases in trade that the One Belt, One Road initiative will bring due to faster and cheaper transportation costs. This thesis will further analyze the potential effects of China's initiative by considering trade and how institutional quality can affect it. This will be done quantitatively using a gravity model of trade along with analysis of existing B&R funding data. Institutional quality will be input into a gravity model of trade by utilizing existing WDI data on governance. These results will then be qualitatively assessed in conjunction with existing data on the B&R member countries and existing B&R projects.

Working hypotheses:

1. Political institutional quality has an impact on trade flows
2. B&R project funding closely follows what would be expected if China was aiming to maximize trade when institutional quality is used as a predictor.
3. B&R project funding goes against what would be expected if China was aiming to maximize trade when institutional quality is used as a predictor. Other reasons behind B&R must be posited, such as the possibility the initiative is a way to bypass poor institutions.

Methodology:

The methodology that will be used include constructing several gravity models of trade using existing data sets. Different models will be employed to test the sensitivity of trade to institutional quality and existing trade balance deficits. Finally, the results will be qualitatively analyzed in conjunction with existing B&R funding information. The WBI Worldwide Governance Indicators will be used in order to assess institutional quality.

Outline:

1. Introduction
2. Theoretical background and the review of world literature
3. An Analysis of China's One Belt, One Road Initiative
4. Gravity model of trade
5. An Analysis of Political Intuitions in B&R nations
6. Gravity model of trade utilizing governance as a factor
7. Results
8. Conclusions
9. References / Bibliography / Appendix

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1 Introduction

A series of meetings commencing in Kazakhstan and Indonesia at the end of 2013 led to China's announcement of a "Silk Road Economic Belt" (Haiquan 2017). This project was eventually combined with a "21st Century Maritime Silk Road", coalesced under the name of "The One Belt One Road Initiative" and today is more commonly referred to as the "Belt and Road Initiative" (Huang 2016).

The loosely defined nature of the Belt and Road has led to a plethora of opinions and actual research on both what China and participating nations aim to accomplish with the initiative and whether they will be able to accomplish their goals. The range of responses to the question of "why the Belt and Road" has been vast and has included everything from strict economics, such as increasing trade (Grieger 2016) to more geopolitically oriented reasons, such as extending China's regional power (Blanchard and Flint 2017) or simply securing resources (Ziromwatela and Changfeng 2016).

This paper aims to explore the effects of governmental quality on trade with the purpose of enriching the discussion of possible motivations behind China's Belt and Road Initiative. This will be carried out in two steps:

- First, a gravity model of trade is applied to export trade flows which includes governmental institutional quality as an explanatory variable. Three different specifications will be used to ascertain different institutional effects including: general importer/exporter institutional effects on exports, differences between very good and very bad institutions on exports and finally the effects of institutional similarity.
- Second, existing Belt and Road funding information and information on agreements forged in the Belt and Road Forum is correlated between the same governmental institutional quality indices used in step one.

The methodology employed to achieve this end will be a well-specified gravity model utilizing a Poisson pseudo likelihood estimator using fixed effects. The second part will use standard statistical techniques of correlation along with a frequency count, carried out by the author, of nations and associated B&R projects listed in the last B&R forum.

The reasoning behind the two parts of the thesis are to extend discussion of the Belt and Road by including both economic and political data within an analytical frame. The problem, as will be apparent in the second part of the paper, is the lack of reliable and official information on the concrete aspects of the Belt & Road.

The contribution of the thesis will be the expanded knowledge of the role of institutions on trade along with a clearer idea of the purposes behind the Belt and Road Initiative. While a number of studies have tackled the role of institutions on trade, numerous advances in gravity model specification along with the large and recent sample employed make this paper novel.

2 Literature Review

This thesis will examine the links between trade and governmental quality with the aim of helping explain China's Belt and Road Initiative. This will be done by first examining the general links between trade and governance and then secondly Belt and Road funding and governance. Past literature on each of these subjects will be examined in turn beginning with an exploration of China's Belt and Road Initiative. The literature review is partitioned in three main sections which relate to the overall thesis topic and work to bring up the questions that are eventually systematized as hypotheses. Section 1 deals with the Belt One Road Initiative from both official Chinese discourse and additional academic perspectives. Section 2 with Institutional Quality and its effect on trade. Section 3 with the Gravity Model itself.

2.1 The Belt One Road Initiative

A combination of principles, frameworks and cooperation priorities under the heading of a "Silk Route Economic Belt" (SREB) were released by China in March of 2013, followed shortly thereafter with the addition of another initiative: "the 21st-century Maritime Silk Road" (MSR) (PwC 2016). These initiatives, which came to be referred to as the "One Belt, One Road" (OBOR) initiative, now shortened to the "Belt and Road Initiative" (BRI or B&R), have grown to include over 70 nations engaged in thousands of agreements. The expansive nature of these projects, along with the fact that the initiatives are set to take place for nearly fifty years, make the economic value of the projects hard to gauge. Estimates thus far run from nearly one trillion dollars (Chang 2015) to over four trillion dollars (Truman, Lawrence, and Toohey 2016), with some authors citing a figure as high as eight trillion dollars (Lejtenyi 2018). While it would be impossible to deduce a single purported outcome from an initiative that will come to include thousands of projects affecting millions of people around the world, the official Chinese discourse does cite key themes and goals with respect to the B&R.

2.1.1 The Official Goals of the Belt and Road Initiative

As suggested by its name, the new Silk Road aims to re-establish the interconnectivity that was symbolized by the ancient Silk road: a reference to the sea-routes and land paths used in Chinese trade for nearly 15 centuries (Truman, Lawrence, and Toohey 2016). The "establishment" of interconnectivity is likewise symbolic as, at least in terms of trade, the region is far more interconnected today than it was at the dawn of the first millennium. The explosion of international trade is attested by the fact that, from just mid-twentieth century, trade has increased over sevenfold in terms of absolute value (Irwin 2005).

Chinese media on the Belt and Road stress goals such as interconnectivity in relation to the Initiative. Speeches by Chinese president Xi Jinping include mentions of "peace and cooperation", "openness and inclusiveness", "mutual learning" and "mutual benefit" (Yamei 2017) when bringing up the B&R. It is this same lack of specificity that been criticized by other researchers (Aris 2016).

More concrete aims behind the Belt and Road Initiative gleaned from the various press releases, forums and meetings held concerning the initiative itself. For example: a recent Chinese hosted forum, the Belt and Road Forum for International Cooperation (BRF), which took place in Beijing in May of 2017, resulted in 76 action points which included over 270 major deliverables (China Daily 2017). Despite its sheer volume, crucial information on funding amounts, project transparency and timelines were absent from the forum's associated press release.

Other examples include an early Chinese document concerning the initiative - "Vision and Actions on Jointly Building Silk Road Economic Belt and 21st-Century Maritime Silk Road" - explored five key areas, or categories, that the B&R would aim to facilitate. These include the coordination and promotion of policy coordination, facilities connectivity, unimpeded trade, financial integration and people-to-people bonds (National Development and Reform Commission 2015).

The physical manifestation of interconnectivity is to come through increased international trade with those involved in the initiative. This increase is expected due to

the new and updated infrastructure – ports, roads, railways, airports etc. – in Asia, Europe and Africa that are to be financed by the Belt and Road Initiative via a diverse range of institutions, financial and otherwise. The investment in infrastructure is not limited to that which carries physical goods and commodities but includes plans for improved IT, financial and telecommunications networks (PwC 2016).

The official English version of the Belt and Road website (State Information Center 2018a) lists the following economic corridors that the initiative aims to establish:

1. New Eurasian Land Bridge Economic Corridor (NELBEC)
2. China – Mongolia – Russia Economic Corridor (CMREC)
3. China – Central Asia – West Asia Economic Corridor (CCWAEC)
4. China – Indochina Peninsula Economic Corridor (CICPEC)
5. Bangladesh – China – India – Myanmar Economic Corridor (BCIMEC)
6. China – Pakistan Economic Corridor (CPEC)

These corridors are divided by the general trade routes they represent and the infrastructure upgrade plans that go along with them.

The funding and coordination for the various planned infrastructure improvement or creation projects are, perhaps surprisingly, not formally institutionalized into a sole body and are rather spread between multiple stakeholders and actors (Ministry of Foreign Affairs 2017). This lack of centralization is at times held up as a boon for the nations involved but has also been criticized as a high barrier to the potential success of the initiative (Huang 2016)

Funding for B&R projects has been planned along four distinct institutional groupings and will include both new and preexisting establishments. They include:

1. Policy Banks
    a. Agricultural Development Bank of China (ADBC)
    b. China development Bank (CDB)
    c. Export-Import Bank of China (CHEXIM)
2. State Owned Banks

   a. Agricultural Bank of China (ABC)
   b. Bank of China (BOC)
   c. China Construction Bank (CCB)
   d. Industrial and Commercial Bank of China (ICBC)
3. State Owned Funds (selection)
   a. China Investment Corporation (CIC)
   b. Silk Road Fund (SRF)
4. International Financing Institutions (selection)
   a. Asian Development Bank (ADB)
   b. Asian Infrastructure Investment Bank (AIIB)
   c. New Development Bank (NDB)

China's aforementioned Belt and Road Forum for International Cooperation (BRF) updated and further specified points first mentioned in the "Vision and Actions on Jointly Building Silk Road Economic Belt and 21st-Century Maritime Silk Road" document released in 2015. The initial goals and visions further specified as listed as follows:

1. Synergize Connectivity of Development Policies and Strategies
2. Deepen Project Cooperation for Infrastructure Connectivity
3. Expand Industrial Investment, Enhance Trade Connectivity
4. Enhance Financial Cooperation, Promote Financial Connectivity
5. Invest More in People's Livelihood, Deepen People-to-People Exchange

The first three of these points fall in line with the previously mentioned goals of trade facilitation through various infrastructure spending. The scope and range of these projects is nicely encapsulated in item (III.14) which includes, italics added for effect:

> "…loan agreements on *industrial park projects, projects of power transmission and distribution, wind power project, water projects, dam project, satellite project, hydraulic factory projects* with the relevant government departments of […], loan agreements on *power grid upgrading project, thermal power project, coal mine modernization project, tire factory project,* with relevant companies …" (National Development and Reform Commission 2015)

Categories III and VI from the document present goals slightly outside of the hitherto presented themes of trade creation. The desire to elevate the state of China's currency, the renminbi, is here made explicit. For example, IV.2. encourages the use of the renminbi in facilitation international business and includes a provision for 300 billion yuan of additional financial support for the Belt and Road Initiative (National Development 2015). Category four, on the other hand, introduces some humanitarian goals to the Belt and Road Initiative. Rather than being mere symbolic talk, the document specifies a Belt and Road Scholarship (National Development and Reform Commission 2015) and various other schemes for the funding of refugees, other scholarships and general aid.

In conclusion, the official discourse from China concerning the Belt and Road Initiative should not give pause to the rest of the world. This is to be expected, given the highly attuned political sensibilities of official governmental statements in general including that of China in particular. Save for the explicit push of the renminbi, which may concern governments invested in the US dollar or Euro, the goals look benign, mutually beneficial or – in their reference to expanding general aid – even altruistic. Scholarship has explored motives that look beyond the political rhetoric released in official statement and it is to these that we turn to next.

2.1.1 Further Goals and Ramifications of the Belt and Road Initiative

An exploration of an initiative the size of the Belt and Road would not be thorough by only focusing on official discourse. Though statements by China's current president, Xi Jinping, naturally highlight the beneficial aspects of the project, other scholarship has both confirmed motives stated in official documents and explored possible outcomes that sound less optimistic.

A long term goal of the Belt and Road may include the restructuring of China's economy. Some authors have pointed out China's necessary trajectory away from a manufacturing-based and towards a service and consumption-based economy (Truman, Lawrence, and Toohey 2016) though this purely domestic focus doesn't account for the broad international scope along with the infrastructure and trade focus of the Belt and

Road initiative. Others see the international initiative as a way of fostering technological innovation through exchange, with China transforming towards more high-tech, high-value-added sectors in lieu of its focus on labor-intensive manufacturing goods (Huang 2016). This is being done in order that China may escape what has been labeled as the "middle-income trap". This is the attempt to deal with a declining rate of capital accumulation as the growth of the labor force slows and total factor productivity declines which has been documented in many economies transitioning from a developing status (Eichengreen 2011).

Foreign investment and diversification has also been pointed out as a goal in China's restructuring of their economy. This can be seen in the equity positions taken in various ventures by The Silk Road Fund. Total investments are too numerous to fully list but have included stakes in countries and industries as diverse as: a liquefied natural gas project with Russia's gas producer, Novatek (Liu 2015); real estate financing and development in Sri Lanka (Chowdhury 2015); and a sea port in Myanmar (Lee and Myint 2017).

Diversification is not a new theme for China and long predates the B&R, having been officially pursued in every Five-Year Plan since 1986 (Xuefeng and Yaşar 2016). These make explicit that steady export growth is to be achieved through export market diversification. This general trend has been noted in academic literature (Edmonds, La Croix, and Li 2008) and is also cited as a response to both regional and global financial crises.

Diversification, being tied to trade, is likewise tied to China's stature as a manufacturing giant. During its relative economic slowdown in 2014, the country suffered from various overcapacity issues. Some authors have cited the necessary resolution of these domestic overcapacity issues, through finding new export markets (Truman, Lawrence, and Toohey 2016) and by decreasing trade bottlenecks in existing markets (Herrero and Xu 2016) as another major reason behind the Belt and Road. Overcapacity has been cited in specific sectors such as of steel, cement, machines and other various capital goods (Chaisse and Matsushita 2018). Some of these industries have utilization rates that have dropped to 70%, which – in the case of steel – resulted in 450 million excess capacity in 2014 (Grieger 2016). To put that figure into perspective,

China's *excess* capacity was greater than the total capacity of the US and Japan in this industry (Huang 2016).

The theme of cementing and building new relationships was prevalent in the previous section on the official Chinese Belt and Road stance, both through infrastructure spending, joint financial institutions and aid. The real-world instantiation of this can be seen not only though the aforementioned multinational institutions such as the Silk Road fund, the Asia Infrastructure and Investment Bank (AIIB), the BRICS New Development Bank but also with newly proposed Free-Trade-Agreements (FTA) with nations such as Pakistan (Truman, Lawrence, and Toohey 2016). The potential positive effects of China leading efforts to head these multilateral institutions has likewise been studied (He and He 2018).

The connection between the Belt and Road and FTAs has been debated within the literature. Researchers have looked at the Belt and Road Initiative as rival economic order to American led efforts, notably through the formerly US-led Trans-Pacific-Partnership (TPP). Though the TPP has seemed to have lost much of its importance with the US' withdrawal, it should be remembered that its initial negotiation not only preceded the announcement of the Belt and Road initiative but also introduced novel elements against state owned enterprises which were seen as an afront to China. In fact, ex-US president Obama was quoted after TPP negotiations concluded in 2015 as saying, "[W]e can't let countries like China write the rules of the global economy," (Wu 2016). The conflictual nature of comments such as these and the seeming rivalry between US and Chinese led economic blocks have led some to declare a new US-China "Cold Economic" war (Ilia 2016).

Despite Obama's comments, China has been busy writing rules and already concluded 14 FTAs with 22 countries or regions from the announcement of the Belt and Road up to 2015 (Zhang et al. 2017). The State Council of China even released a set of guidelines that expressly mentioned the formation of a global FTA as an end goal of the B&R (The State Council 2015). Other authors explicitly reject the comparison between the Belt and Road and the TPP, or likewise the Belt and Road as simply a vehicle towards FTAs and instead see the initiative as *sui generis* and a first for China on the international stage (Chaisse and Matsushita 2018).

As the principal function of initiative is loan-based, as opposed to charity or aid, the potential for many countries to fall into a "debt trap" has been widely discussed. Excessive debt through the B&R has been considered a possibility in the many economic under-performing regions within the initiative (Pandey 2018) and with specific nations such as Sri Lanka (Chellaney 2017). The excessive debt that many countries within the B&R are seen to be taking on has even been described as a form of economic imperialism (Ziromwatela and Changfeng 2016).

Supporting the claim of the B&R as a Chinese ploy to economic power over weaker nations are the growing list of controversial and seemingly economically fruitless projects These include a practically unused stadium, highway, port and airport in Sri Lanka (Larmer 2017), an unnecessary and economically unviable railroad in Kenya (*The Economist* 2018) and questionable loans and power plants in Pakistan (*The Economist* 2017). However, so far rigorous analytical academic papers on the connection between a debt-trap and the B&R initiative have not been produced to the best knowledge of the author.

The list of questionable projects under the B&R initiative's belt, along with the unstable political nature of some of the countries these projects were carried out in, have led to a charge of the initiative being a tool to take advantage of and further corruption. The literature on this topic is again mixed, with some authors pointing out corruption as just one more challenge that China needs to heed (Grieger 2016; Truman, Lawrence, and Toohey 2016), some viewing it as a potential mechanism for the spread of corruption (Feng et al. 2017) and others seeing the initiative as sign of China's emergence as a globally responsible power, overturning a previous era of corruption (Sarvari and Szeidovitz 2016).

Though the focus thus far has been economic, it must be noted that potential geopolitical motivations have also been pointed out in the Initiative. The geopolitical dimension of the initiative has been described as a Chinese push for more regional power (Blanchard and Flint 2017), with specific focus on controlling contentious areas such as the South China Sea (Haiquan 2017) and countering American military power by setting up China's first overseas military base in Djibouti (Calamur 2017). On the other hand,

the B&R initiative has been also cited as a peaceful pathway of development that president Xi Jinping will take as a substitute for the regional struggle for control in the South China Sea (Nie 2016). The geopolitical dimensions of initiative have also been analyzed in other regions, such as China's increasing presence in areas such as Africa and its effect on domestic labor markets and manufacturing therein (Ziromwatela and Changfeng 2016). The initiative has also been seen as a tool for China to conduct "offensive mercantilism" which could threaten European market share in B&R countries (Holslag 2017).

It is clear that far from being a simple "win-win" deal between willing nations in need of infrastructure spending and a purely altruistic donor state, more political dimensions are at play. It is hard to categorize all the previously listed motivations into one theme but one attempt to do so may be by looking at institutions and trade. Trade was made explicit in both official and non-official discourse behind the B&R and is the concrete phenomenon behind rhetoric such as "interconnectivity" and the less optimistic sounding "unloading overcapacity". Institutions, on the other hand, are what will facilitate all the finance, projects and agreements within the B&R and likewise might make the difference between a partner nation successfully executing projects under the B&R or instead being a victim of a "debt-trap" or economic imperialism.

2.2 The Connection Between Institutions and Trade

While studies, notably that of Herrero and Xu (2016), have already been done on the connection between the Belt and Road, infrastructure and potential trade, economic studies that model institutional determinants of trade in relation to the Belt and Road have not been carried out. The following section surveys existing literature on the connection of institutions and trade in general. The inclusion of institutional factors on trade may ultimately shed light on some of the connections between economics and politics within the B&R Initiative. Institutional effects on trade may hint at possible institutional effects on the B&R funding, agreements and the Initiative more generally. The question is: "is trade affected by institutional factors and is the B&R a means to take advantage of these factors".

2.1.2 Institutions

China has publicly stated their principle of "non-interference" in the domestic affairs of countries they trade with (Misiągiewicz 2016). Whether or not this motto is borne out in practice doesn't answer if China, or any other nation, discriminates in trade based on institutional factors. If institutions, either those of an exporter or importer, play any role in trade, then B&R membership may partially be explainable with reference to institutional quality. More specifically, examining the institutional quality of countries that have received B&R funding or signed agreements may bolster or dismiss some of the aforementioned B&R goals. For instance, we would expect funding to go to countries with high quality institutions if the link between institutions and trade is positive and we take the goal of extending well-established trade relationships seriously. On the other hand, the opposite relationship may hint at the B&R being more than a simple trade deal and necessitate more study on export-diversification with underserved countries or even as potential "debt-traps".

The concept of institutions and institutional quality extends beyond formal structures created to facilitate cooperation between nations. Institutions can be both formal or informal, domestic or multilateral, and be judged by various measures – corruption, for instance – which affect institutions in different ways (Nunn and Trefler 2015). The concept is too broad to speak of generally, as it can include everything from common language to common political ideologies.

Institutions have been defined in a variety of way that, at least in trade literature, typically intersects with the type of data researchers use to gauge institutional quality. These indexes are too many to list in full, but a brief sample of indexes which show up in the next section includes:

- The Worldwide Governance Indicators (WGI) released by the World Bank
- The Corruption Perceptive Index (CPI) released by Transparency International
- The International Country Risk Guide (ICRG) released by the PRS Group
- The Polity IV Individual Country Regime Trends released by The Center for Systemic Peace (CSP)

- The Economic Freedom of the World Index (EFWI) released by the Fraser Institute
- The ICY index of trade restrictiveness by Hiscox & Kastner (2002)
- The World Business Environment Survey (WBES) released by the World Bank

The variety of indices shows the variety of institutions and the different ways their quality can be estimated. Based on the research question, the main institutional focus of this paper will be on institutional quality of governance. As such, the focus will be on the papers that use indices, such as the WGI, that measure governmental quality.

2.2.1 Institutional effects on Trade

A range of studies have been done that explore the connection between institutional quality and trade performance. This includes studying the interplay between trade and informational institutions such as trust, individual habits, values, groups routines and social norms (all 'informal institutions') or laws, rules and organization (all 'formal institutions') (Álvarez et al. 2018). The following focuses on formal institutions and includes some theoretic background as to why these would affect trade or economic performance more generally. A more concise table solely summarizing papers using the gravity model of trade to investigate institutional effects, including the authors, institutional indices and summary finding, can be found in Appendix 1.

Various economic theories predict a decrease in trade due to corruption which is a popular as a proxy for governmental institutional quality. Trade based on a comparative advantage would predict that countries with good contract enforcement would have an advantage in the production of goods that rely on relationship-specific investments (Nunn and Trefler 2015). This theory was substantiated in a study that found that good contract enforcement actually leads countries to specialize in these goods and that judicial quality and contract enforcement were able to explain more trade variation than capital and skilled labor endowments. Trade is expected to decrease with incomplete or asymmetric information and uncertainty in exchange, both of which are mitigated by strong institutions (Prasada 2013). Without institutions that mitigate these effects, transaction costs in general go up which in turn affects both domestic business and international trade

(Wei 2000). The protection of property rights, which are enforced via domestic institutions, are a necessary aspect to engaging in trade in an unfamiliar environment. Therefore, both the quality of domestic institutions, and the perception of that quality, is an important component of international trade.

The international trade flows between South-Eastern Europe and the Commonwealth of Independent States was found to far below expected due to the significant contribution of the low quality economic institutions therein (Kucharčuková, Babecký, and Raiser 2012). The regions were respectively found to be 230% and 150% below their potential trade flows had they the same institutional quality as that measured for the EU. The authors also found that joining existing institutions – the WTO in this case – positively influenced trade. This finding coincides with early work that found accession to the WTO raised national incomes but only when the accession procedures were found to be rigorous (Tang and Wei 2009). This explained the insignificant difference WTO membership had on early members, when reform requirements were incredibly mild, to the more significant gains seen by members joining after the Uruguay Round. Policy reforms made during the accession process are legally binding so long as the member state remains part of the WTO. These policy recommendations have significant impact on domestic institutions as they include everything from: tariff rate reduction, termination of state monopolies, greater transparency requirements and adoption of stricter intellectual property rights. The conclusion was drawn that commitment to externally enforced policy reform prevented backsliding and substituted for poor domestic institutional quality. Other studies confirmed the correlation of positive economic outcomes (Suvankulov and Guc 2012) and potential gains (Babetskaia-Kukharchuk and Maurel 2004) from WTO membership.

Prasada expanded on the idea that joining existing institutions could lead to trade gains. He differentiated between domestic and international (or "multilateral") institutional quality and found that both are positively correlated with trade using a variety of institutional quality indexes and estimation techniques. Interestingly, multilateral institutional membership – which was ascertained using membership to trade and political organizations as a proxy – had a more significant effect on bilateral trade flows compared with domestic intuitional quality (Prasada 2013).

Similar findings on the benefits of specific multilateral institutions were likewise confirmed by Glyfason et al. They found positive effects of good multilateral institutions by examining trade with countries belonging to the EU. Specifically, the Eastern Partnership (EaP) states Ukraine, Georgia and Moldova – were found to benefit from free trade agreements with the EU whereas those with Russia did not (Gylfason, Martínez-Zarzoso, and Wijkman 2015). Other studies confirm the importance of the EU (Karkanis 2018) and yet show domestic institutional quality still greatly affects any EU-related trade benefits. This was shown for Romania and Bulgaria's entry to the European Union where institutional quality within these two countries hindered trade potentials after integration which suggested that growth requires an appropriate institutional structure (Horsewood and Voicu 2012).

A common proxy for governmental institutional quality are corruption levels. Corruption, for instance lowers the profitability of potentially productive business while corruption prevalence tends to enforce self-sustained corrupt behavior in which corrupt agents only conduct business with other similar agents. Predictability of corruption is connected with certainty in carrying out business. Some countries that rank as relatively corrupt, such as South Korea and China, do not suffer the same corruption-related obstructions due to the predictable form the corruption takes (Thede and Gustafson 2012). This is confirmed by (Rauch and Trindade 2002) who find that the existence Chinese "networks" in fact increase trade.

Corruption has been theorized as a method for gaining monopolizing market power which is then used for rent-seeking rather than productive activity (Álvarez et al. 2018). This has the economic effect similar to a hidden tariff on international trade. Strong institutions were found to be ways of preventing this type of activity and instead levelling the economic playing field and facilitating trade. In the long run, it was found that institutional quality is the most important source of gains due to trade.

On the other hand, Dutt and Traca found that corruption can both stimulate and detract from trade depending on the nominal tariffs trade came under (Dutt and Traca 2007). The study found that corruption *facilitated* trade when high tariffs existed between countries but was an obstacle to trade when such tariffs did not exist. As such, the suggestion is that corruption must be studied within existing tariff structures to be

significant. A potentially positive correlation between corruption and trade was also found between specific sectors such as non-manufactured goods (Méon and Sekkat 2008).

The previous sections relate to the overall scope of the paper as the institutional variables in the B&R may play a large role in the outcome of the initiative. Both the ad-hoc and unplanned nature between B&R institutional bodies, cited for "inefficiency, corruption, and conflict" (Truman, Lawrence, and Toohey 2016) and the potential for corruption within B&R member governments are risks, or perhaps clues, to the B&R. The analytical model that will help quantify the institutional effects, namely the "gravity model", is turned to next.

2.3 The Gravity Model

What follows is a discussion of the formation of the gravity model along with the theoretical justification behind its use. The summary would be to say that the gravity model has a history of "remarkable performance" in modeling econometric relationships (J. Anderson 2016). The persisting effect of distance, despite a world continually spouted as being closer than ever, have been well documented using the gravity model (Disdier and Head 2008). With its ability include the effects of political and institutional characteristics of countries on trade, it stands as a suitable tool for the purpose of this thesis.

2.3.1 History of the Gravity Model

The gravity model of trade has evolved from being an economic curiosity upon its initial discovery by Tinbergen in 1962 to an incredibly powerful analytic tool with strong microeconomic foundations (Head and Mayer 2013a). This evolution has tempered the aversion mainstream economists felt due to the model's past lack of a theoretical base.

At its inception, the model predicted economic flows using economic mass, typically GDP, and distance as explanatory variables. The intuitive model - borrowing its name from Newton's gravity equation in physics – predicted increase flows between

larger economic pairs and lower flows between distance economic pairs and resembled the following:

$$X_{ij} = \frac{Y_i E_j}{Y} \quad (1)$$

Where:

- X_{ij} represents world sales from country *i* to country *j*
- Y_i represents total sales by origin *i*
- E_j represents total expenditure by destination *j*
- Y represents total world sales

Despite the simplicity, even in its basic form the gravity model could account from a great deal of trade. With just these bare independent variables, the gravity model can explain a majority of trade variability. While specific results depend on several factors, including sample size, Baldwin and Taglioni (2006) credited the basic model with being able to achieve an R-squared value of 0.7 while van Bergeijk and Brakman (2010) cite its explanatory value at 70-80% for bilateral trade.

Despite popular claims to the contrary, distance has not ceased being an important factor in describing international economic interaction (van Bergeik and Brakman 2010). Interestingly, since falling slightly since 1870, the negative impact of distance has risen and stayed fairly stable since roughly 1950 (Disdier and Head 2008). This finding is consistent across both a wide range of data samples and estimation methodologies and is not mitigated by employing more recent data. Neither is it not explained by distance being a simple proxy for transportation costs. Anderson and van Wincoop (2004) show overall costs of traded goods are still 170 per cent of mill price for manufactured goods where transportation costs only make up 22 per cent of that figure. The persistence of the distance effect on international trade has been touted as potentially the only important effect that has stood the test of time when considering the evolution economic techniques (Disdier and Head 2008). The gravity law, which Head and Mayer (2013) defined as, "Holding constant the product of two country's sizes, their bilateral trade will, on average, be inversely proportional to the distance between them", has been touted as compelling

answer to Ulam's famous challenge: "name me one proposition in all of the social science which is both true and non-trivial".

However, in its original form, the gravity model could not explain economic phenomena such as trade creation or trade diversion (Bacchetta et al. 2012). Trade is affected between a bilateral pair due to conditions in a third country, whether that be lowered prices, a free trade agreement or lower transportation costs whereas the gravity model in its basic form neglects this issue. Another strike against the basic model is its inability to properly account for an equitable decrease in trade costs across the boards. The model would predict increased trade flows whereas economic theory would predict that, without a change in *relative* prices, consumption patterns would not be expected to change (Bacchetta et al. 2012).

In time, this framework would be bolstered and shown to be able to include various theories such as: differentiated goods and "iceberg costs" (J. E. Anderson 1979), monopolistic competition, the 'new trade theory' of the 70s and 80s, trade based on factor-endowments, Ricardo-based trade theory and trade in differentiated goods with firm heterogeneity (Head and Mayer 2013a). The exponential and recent growth in theory is remarkable given that as late as the mid-nineties a survey undertaken by (Leamer and Levinsohn 1994) paint the model as purely "descriptive" yet without "theoretical underpinnings". In just a span of a couple decades, the general criticism of the gravity model as having a "somewhat dubious theoretical heritage", as Alan Deardoff put it, gave way to the understanding that the model could incorporate a substantial number of theories (Baldwin and Taglioni 2006). Ironically, Deardoff (1998) revised his earlier criticism to indicate that the model now has the ability to incorporate too many theories and is thus is unable to function as a tool to distinguish between them.

One of the most important roadblocks in the development of the gravity model was the persistence of what was described as the "border puzzle". The "border puzzle" related to the difference between intra-border - therefore intra-national - trade levels relative to international trade levels that could not be accounted for in the standard gravity model. This was specifically brought up in MacCallum's 1995 investigation of why Canadian provinces trade far more between themselves than between US states when

accounting for distance (McCallum 1995). He found that the gravity model couldn't explain the discrepancy by solely using distance as the only existing trade resistance.

Early efforts at overcoming the puzzle were made by Head and Mayer (2000) who hypothesized several ways at overcoming the problem. One hypothesis was that the elasticity of substitution was being underestimated between domestic and imported goods and thus trade was highly responsive to any barrier. Another, which they pursed in research, was that the standard method of measuring physical distance between nations led to "illusory border effects". While their research introduced a novel way to measure this distance (what they named "effective distance") the method only mitigated the border and adjacency effects rather than eliminate them. A hypothesis that they left unexplored was that border-related barriers to trade are larger than they appear in the standard model and could include non-conventional barriers such as informational asymmetry. This hypothesis contains the germ of the idea that led to the eventual solution of the "border puzzle" by Anderson and Wincoop.

The additional barriers to trade where eventually theorized as *multilateral resistance terms* by Anderson and Wincoop (J. E. Anderson and Wincoop 2003) in one of the most important additional microfoundations to the gravity model. These terms help explain the discrepancy between expected trade in a frictionless world and the trade that is actually seen (Eaton and Kortum 2002).

The model took the following form in an updated paper by Anderson which he called the 'structural gravity model' (J. Anderson 2016). Note the bracketed second part of the equation represents the addition to the intuitive model:

$$X_{ij} = \frac{Y_i E_j}{Y} \cdot \left(\frac{t_{ij}}{\Pi_i P_j} \right)^{1-\sigma}$$

The new terms are:

- t_{ij} represents the 'iceberg melting' factor which accounts for the difference in yield between a goods departure and its arrival
- Π_i & P_j represent the outward and inward trade frictions respectively (MRT)

Expanded as an estimation equation give it the following form:

$$\ln(X_{ij}) = a_0 + a_1 \ln(Y_i) + a_2 \ln(E_j) + a_3 \ln(t_{ij}) + a_4 \ln(\Pi_i) + a_5 \ln(P_j) + \varepsilon_{ij}$$

These terms (shown as Π_i & P_j) are intuitive in that they make explicit that bilateral trade depends not only on the two countries involved, but on both their positions relative to the world economy (van Bergeik and Brakman 2010). The introduction of multilateral resistance terms resolved the inability of the basic gravity model to include trade creation or diversion. Therefore, a change in trade between a bilateral pair was now affected by a change in prices somewhere else. Implicit in how the MRT variables were defined is the link between all economic masses in the world economy and the frictions between a country *i* and *j* (J. Anderson 2016).

Multilateral resistance terms have been metaphorically described as expanding the notion of trade "distance" (van Bergeik and Brakman 2010). This idea of physical distance as a proxy for transportation costs has been expanded to include other distance-related factors. These include both economic (examples include tariff barriers) and non-economic factors (examples include: cultural differences, differences in religion, language similarity, colonial ties, and similarities in technological development). These factors have been analogously described as adding "dark" distance (Head and Mayer 2013b). This ability is crucial in relation to this thesis, as "institutional distance" through a governance index will be one of the explanatory variables used to account for trade.

With its theoretical underpinnings developed and a history of empirical success, the gravity model has proved to be a reliable research tool as long as some common problems, described next, are treated.

2.3.2 Gravity Problems

Two common issues must be resolved in order to properly apply the gravity model. These include: zeros values in trade data and endogeneity. In solving them, we likewise bridge the problem of correctly specifying our model with previously mentioned multi-lateral resistance terms (MRTs). A third problem, heteroskedasticity, is briefly

mentioned in the "Methodology" section and accounted for through the appropriate choice of estimator.

2.3.3 Zeros

The simplest way to handle the existence of zeros is to follow a standard empirical practice set in Linnemann (1966) and drop them from the data set. This is problematic when considering trade data however. Firstly, it is unclear if the existence of zeros is due to rounding errors, statistical issues or the lack of actual trade (van Bergeik and Brakman 2010). Secondly, trade data can contain a significant number of zeroes. Helpman *et al*. (2008) found that over 50 percent of the 158 countries in their sample did not have bilateral trade data. That figure went up to 80 percent when considering FDI flows between the countries.

Dropping data with "zeroes" or adding a small constant to them so as to be able to estimate using a log-linear equation will only work if the zeroes are randomly distributed, otherwise it will introduce an element of selection bias (van Bergeik and Brakman 2010). As there is reason to suspect these are not randomly distributed, another method must be applied.

New methods for solving this problem include a novel sophisticated two step solution as used by Westerlund and Wilhelmsson (2006), the use of a Poisson fixed effects estimator (Helpman, Melitz, and Rubinstein 2008), a Poisson pseudo-maximum likelihood estimator (Santos Silva and Tenreyro 2011) or even a Tobbit model (Prasada 2013). However, as the Tobit model is unable to handle residuals that are not normal and homoskedastic (Prasada 2013), the method is not typically employed in most trade analysis.

2.3.4 Endogeneity

The problem of trying to account for the institutional role in trade is that these variables are very likely endogenous and therefore may suffer from "reverse causality". This is typically also a problem with studying the effects of trade agreements more generally (Yotov, Piermartini, and Monteiro 2016). Simply put: studying institutional effects on trade may be difficult as trade may, and almost certainly does, affect institutions.

Early attempts to overcome this problem, namely endogeneity, included using Instrumental Variables (IV). However, these have not proved particularly successful, primarily due to lack of suitable instruments available to be used (Baier and Bergstrand 2007).

A more promising solution is the use of pair-fixed effects with panel data. That is, a set of dummy variables for each reporter-partner country pair in the dataset. While this eliminates time-invariant bilateral variables, such as distance, it has been found to account for bilateral trade costs better than standard gravity equations (Yotov, Piermartini, and Monteiro 2016).

Using appropriate fixed effects has the additional benefit of overcoming what Baldwin and Taglioni (2006) called the "gold medal" error in regard to gravity-based trade studies. In short, using appropriate fixed-effects ensures that multilateral resistance terms are properly accounted for (Baldwin and Taglioni 2006).

In short, a correctly specified gravity model, with appropriated MRTs and estimator accounts for the common problems of trade data: namely endogeneity, homoskedasticity and zeros.

3 Data and Methodology

3.1 Data

The goal of this thesis is to ascertain institutional effects on trade in order to shed light on the reasons behind the Belt and Road Initiative using a gravity model of trade. This requires accounting for the common problems associated with trade data and the gravity model which were discussed in section 2. The following describes the data used and the reasoning behind it.

3.1.1 General Description

Data on trade flows will be gathered from the World Bank (WITS) server which uses the UN Comtrade database. Export data for a 175 reporting and 195 partner countries will be used. This includes 72 of the 73 countries currently listed on the Belt and Road member page. A full country list, including description of missing data, can be found in Appendix 3. Data on Gross Domestic Product (GDP) was taken also taken from the World Bank server. Data on the Belt and Road member countries was taken from the English version of the official Belt and Road website (Office of the Leading Group for the Belt and Road Initiative 2018) . Funding information for Belt and Road projects was taken from a series of studies by the Austrian National Bank (Barisitz and Radzyner 2017a, 2017b).

It may seem odd that a gravity model of trade does not include a distance variable but the variability due to distance is captured in the country-pair fixed effects that are employed, as was discussed in suggested in the literature review. Nevertheless, the CEPII database is used, which includes distance and other dummy variables for country geographical information, along with information on past colonial relationships and shared language, for one regression as a check and is listed in Appendix 2.

The reason for not using the CEPII database for all regressions, in additional to not requiring it with the how the models were specified, is that the database is not updated

to reflect all existing nations. The most glaring omission is that of countries formed after the breakup of Yugoslavia. While dropping five countries (six, if counting Kosovo) would not seem severe in a large dataset, all of these five nations are a part of the B&R initiative. Therefore, it was deemed more important to include as many observations from nations included in the B&R initiative.

Institutional data used were the World Governance Indicators from the World Bank. These are described in more detail below in 3.1.3.

3.1.2 Panel Data

The data is arranged in a panel covering a ten-year span from 2007 to 2016. This encompasses the launch of the Belt and Road Initiative (2013) and allows for the examination of trade patterns before and after its commencement.

While cross-sectional data panels also been heavily used in existing trade literature dealing with institutional effects, there remain several advantages to panel data.

Baltagi lists several advantages (Baltagi 2005) of using panel data over cross-sectional or time series, of which the following are highly relevant for the purposes of this paper:

- Panel data allows for controlling individual heterogeneity.
- Insight into dynamics of adjustment is lost in only using time series or cross-sectional data.
    - This is significant in examining governance and trade and how or if these phenomena changed for countries with the introduction of the Belt and Road.
- Effects otherwise lost can be detected through panel data
    - The use of techniques such as time fixed effects on panel data allows us to better analyze the explanatory variable in question

3.1.3 Worldwide Governance Indicators

`The Worldwide Governance Indicators have been compiled by Kaufmann et al. under the World Bank Group. These are considered the best indicators available for governance (Prasada 2013). There are a total of six (6) indicators which include:

- Voice and Accountability,
- Political Stability and Absence of Violence/Terrorism,
- Government Effectiveness,
- Regulatory Quality,
- Rule of Law, and
- Control of Corruption

These indexes are available for over 200 countries with annual data available since 1996. They were compiled using 31 different data sources, each of which comprise hundreds of different variables (Kaufmann, Kraay, and Mastruzzi 2010).

While these indices nominally measure different aspects of governance, there is a large degree of interdependence among them. The high degree of positive correlation between the indexes can be seen in the correlation matrix in Appendix 4. Despite this, the indices are an attempt at capturing unique aspects of governance (Kaufmann, Kraay, and Mastruzzi 2010).

Using all six indices would risk introducing a large degree of multicollinearity into the gravity model. Thus, Principle Component Analysis (PCA) was done to see if it was possible to scale the indicators down. Based on the analysis of the highly correlated indicators it was decided to use one factor only, which alone explains 84.5% of the total variance in the six indices. The results of this can be seen in Appendix 4.

3.1.4 Data on the Belt and Road Initiative

The data pertaining to the Belt and Road Initiative was taken from three sources. Membership information was taken from the official English Belt and Road site (State Information Center 2018b) and compiled manually.

Every mention of B&R nations within this paper, however, also includes three countries[1] not listed on the official site but which are included in B&R funding information from a series of studies done by the Austrian National Bank (Barisitz and Radzyner 2017a, 2017b). Funding information was pulled from these studies as well.

The gap between the previously documented immensity of the B&R initiative, possibly reaching $8 trillion funding by 2046, and the lack of information on projects heretofore funded is immediately obvious. The Barisitz and Radzyner study is the only academic study found by the author which breaks down B&R projects on a country basis. Even here, only roughly $85 billion worth of projects among 11 nations (recall 3 of which are not even listed on the official B&R membership site) are cited.

The final source of data is the official Belt and Road Forum List of Deliverables (China Daily 2017) which listed a series of planned agreements between nations within the Belt and Road. This source, again, was far from perfect as expected commencement or completion dates, quantitative funding information and even the names of nations on several of listed agreements were not included.

[1] Kenya, Greece and Djibouti

3.2 Methodology

The methodology of the thesis is to employ a quantitative gravity model in part one and then include some quantitative statistics done on corruption data and B&R funding data for part two.

For part one, there will be three uniquely specified regressions run:

1. Governance institutional indicators for exporters and importers will be included as explanatory variables in the model. These were calculated using the WGI and PCA as described beforehand and shown in Appendix 4. This will analyze if there is a connection between governmental institutional quality and trade.
2. Dummy variables are created for "Good Governance" and "Bad Governance" for both exporters and importers and the regression is run again. Good governance corresponds to any indicator score half a standard deviation above the average governance score for a particular year. Similarly, Bad governance corresponds to half a standard deviation below the mean for a particular year.
3. A final regression is run using two institutional similarity indices as an explanatory variable. These are two variables that capture institutional similarity between both importer-exporter and exporters-importers separately in order to retain information on directionality.

The Poisson pseudo-maximum likelihood estimator (PPML) is a commonly recommended technique for the gravity model of trade due to its ability to handle heteroskedasticity and zeros in the data. The estimator has been recommended on this ground by several authors (Prasada 2013; Egger 2005; Santos Silva and Tenreyro 2011; Matyas 1998). There are several ways to use a PPML estimator in Stata, the most popular choice being the *-ppml* command developed by Santos Silva and Tenreyro. The downside to this estimator is its inability to automatically incorporate fixed effects in Stata[2].

[2] Manually creating country-pair fixed effects proves difficult with large datasets, due to the matsize limitation of Stata which is easily exceeded with the large number of dummies variables required.

The regressions are estimated using a Poisson Regression Model that can automatically incorporate two dimensional fixed effects: country-pairs and time. This estimator has identical results to the maximum likelihood estimator when identically stipulated[3]. The advantage being the easy inclusion of country-pair fixed effects and time fixed effects which are recommended in the previously discussed gravity literature (Yotov, Piermartini, and Monteiro 2016).

The second part will be a mix of analytic and qualitative analysis. Existing Belt and Road funding information from a study commissioned by the Austrian National Bank (Barisitz and Radzyner 2017a) will be correlated with the same governance institutional indicators mentioned earlier. Likewise, a frequency count of nations mentioned for future B&R projects in the official B&R Forum List of Deliverables (Yamei 2017) will be carried out and again correlated to the institutional indices used through the paper. The results of this will be qualitatively compared with the results from part one. The idea being that results should align with the relationship found between institutions and trade in part one, thereby confirming that the Belt and Road initiative funding goes to nations with institutional quality that have and continue to trade with China or, conversely, that the results of part one do not account for the funding patterns found in part two and that other motivations, apart from institutional quality, must be postulated for the Belt and Road Initiative.

The hypotheses that will be considered in this thesis are as follows:

> H1 Institutional governance is significantly correlated with trade. We can therefore expect B&R funding and agreement information to match this correlation, showing that China is attempting to extend trade with historic trade partners.
>
> H2: Institutional governance is significantly correlated with trade. If B&R funding and agreement information do not match this correlation, we can posit that China is using the B&R in order to make up for lost trade potentials due to institutional factors or other motivations surveyed in the literature review.

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[3] Stata command *poi2hdfe* created and described in (Figueiredo, Guimarães, and Woodward 2015; Guimarães and Portugal 2010)

The equations used, along with the associated regression are as follows:

$$(1) Exports_{ijt} = a_0 + a_1 \ln(gdp_{it}) + a_2 \ln(gdp_{jt}) + a_3 gov_{it} + a_4 gov_{jt} + a_k countrypair_{ij} + a_m year_t + \varepsilon_{ijt}$$

$$(2) Exports_{ijt} = a_0 + a_1 \ln(gdp_{it}) + a_2 \ln(gdp_{jt}) + a_3 good\_gov_{it} + a_4 good\_gov_{jt} + bad\_gov_{it} + a_4 bad\_gov_{jt} + a_k countrypair_{ij} + a_m year_t + \varepsilon_{ijt}$$

$$(3) Exports_{ijt} = a_0 + a_1 \ln(gdp_{it}) + a_2 \ln(gdp_{jt}) + a_3 g\_similarity_{ijt} + a_4 ij\_similarity_{ijt} + a_5 ji\_similarity_{ijt} + a_k countrypair_{ij} + a_m year_t + \varepsilon_{ijt}$$

Where[4]:

- $Exports_{ijt}$: Exports from nation *i* to nation *j* during year *t*.[5]
- $\ln(gdp_{it}/gdp_{jt})$: Logarithm of exporter *i* or importer *j* during year *t*
- $year_t$: Dummy variables for year fixed-effects
- $countrypair_{ij}$: Country-pair fixed-effects
- gov_{it}/gov_{jt}: Institutional score exporter *i* or importer *j* during year *t*
- $good\_gov_{it}/good\_gov_{jt}$: Dummy variable equaling one (1) if institutional score of nation is at least one (1) standard deviation above mean for exporter *i* or importer *j* during year *t*

[4] A complete list of variables used in all the regressions, along with sources and descriptions can be found in Appendix 2

[5] Note that the dependent variable in all the Poisson regressions done is never logarithmic. Likewise, exporter (*i*) is specified as China for the second and third run of each regression and importer (*j*) is also specified as only B&R nations for the third run of each regression.

- $bad\_gov_{it}/bad\_gov_{jt}$: Dummy variable equaling one (1) if institutional score of nation is at least one (1) standard deviation below mean for exporter *i* or importer *j* during year *t*
- $ij\_similarity_{ijt}$: Institutional distance between exporter *i* and importer *j* during year *t* for all exporters (*i)* with greater institutional score than importers (*j)*. Zero otherwise.
- $ji\_similarity_{ijt}$: Institutional distance between exporter *i* and importer *j* during year *t* for all importers (*j)* with greater institutional score than exporters (*i)*. Zero otherwise.

4 Results

4.1 Part I: Institutions and Trade

As the first regression will be looking at the effects of both exporter and importer institutions on trade, it will be beneficial to first examine the data used for institutions:

Table 1: Exporter and Importer Governance Components

Variable	Mean	Std. Dev.	Min	Max
gov_imp	-.0579822	2.200767	-5.930973	4.704303
gov_exp	.1381255	2.113992	-4.787772	4.704303
gov_china	-1.212224	.1243798	-1.33923	-.9522064

The variables, created using Principle Component Analysis (PCA), have a mean value near zero and a maximum value of 4.7. Interestingly, the variable for exporters has a minimum value of -4.78 whereas that of importers drops even further to -5.93. This intuitively makes sense as the data used all available export data between the years 2007-2016. The reason there were an additional 20 importers (total of 195) over the 175 exporters was due to these nations having no available export data for the years in

question. We can intuitively surmise that these importers that were not a part of the export governance score rated poorly on the WDI indices used to create the variables, especially that for "Voice and Accountability", as would be expected from a government that doesn't release or cannot gather their trade data. This likewise accounts for the small difference in means between the two variables.

Lastly, the range of scores for China in the 10-year sample is shown as having a mean near -1.21, which is below the average of the rest of the sample. These scores are further analyzed in Part II.

The first regression was carried out using equation (1) with Stata command - *poi2hdfe* which is a Poisson Regression Model with two high dimensional fixed effects, with results equal to a similarly specified Maximum Likelihood Estimator.

While it may seem odd that, so few independent variables appear on the regression output, it should be remembered that the country-pair fixed effects and time fixed effects coefficients are not shown. The country-pair fixed effects add an additional 33,950[6] variables alone, for instance, and include variability due to time-invariant bilateral information typically included in gravity models such as distance.

Column one (1) tests the effects on institutional quality for both exporters and their partner countries (importers) on the full sample. Column (2) restricts the exporter to China and therefore drops the exporter-exclusive coefficients due to perfect multicollinearity. Column (3) further specifies Chinese trade partners to only include nations in the B&R Initiative[7].

---

[6] Number of country-pairs is *(Exporters) x (Importers -1)* which for the sample used is (175) x (195 – 1) = 33,950

[7] This also includes the additional 3 nations not listed on the B&R Initiative and yet have had B&R projects funded, as explained in "Data & Methodology"

Table 2 – Exporter/Importer Institutional Indices using *poi2hdfe*

VARIABLES	(1) Entire Sample	(2) China to rest of the world only	(3) China to B&R only
lgdp_exporter	0.485***	0	0
	(0.0296)	(0)	(0)
lgdp_importer	0.493***	0.661***	0.674***
	(0.0366)	(0.100)	(0.151)
gov_exp	-0.0573**	0	0
	(0.0261)	(0)	(0)
gov_imp	0.0253	0.105**	0.154***
	(0.0193)	(0.0470)	(0.0423)
Observations	189,860	1,842	729
Country-Pair FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes

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

Interpretation of the results is simple and follows what we would expect from an OLS model, with the difference being the dependent variable not being specified as a logarithm due to our Poisson model (Shepherd 2016). The coefficients for GDP, as they are specified as logarithms, can be interpreted as simple elasticities, whereas the institutional variables should be interpreted as semi-elasticities.

The elasticities for both exporter and importer GDP are shown to be significant at 1%, in line with similar past studies. The values obtained, are slightly lower compared to past studies using PPML estimators such as Duc, Lavallée, and Siroën (2008) and far below estimates using OLS such as Horsewood and Voicu (2012). This may be partially explainable due to the well documented overestimation associated with OLS estimates with trade data (Santos Silva and Tenreyro 2006).

Results on the effects of institutions was less fruitful. Only the institutional score of exporters was found to be significant and that at only the 5% level. Interestingly, there is a negative relationship between institutional quality of exporters and export amounts. As China was shown to have institutional score below the average, and remains the world's largest exporter, this result may not be surprising.

Column two (2) shows that China is more sensitive than the average exporter when it comes to an importing countries GDP. Again, with the USA – the nation with the highest GDP – consistently the largest recipient of Chinese exports, this is unsurprising. Restricting the sample to China as exporter shows that institutional quality of Chinese trade partners is significant. There exists a slight positive correlation between Chinese exports and the institutional quality of their partner countries.

Restricting the sample further, and only looking at China's exports to B&R nations shows even more sensitivity to partner nation's institutions. The coefficient jumps by roughly 50% and is significant at even the 1% level.

The next set of regressions uses a series of dummy variables to differentiate between both very highly and very poorly rated institutional scores . By using a separate set of dummies for nations with "good institutions" and "bad institutions" for both exporters and importers, we can test if there is a U-shaped relationship between exports and institutions: perhaps world exporters, and China in particular, trade with nations with strong institutions and also take advantage of nations with severely poor institutions.

Table 3 – Exporter/Importer Institutional dummies (+/- 0.5 STD) using *poi2hdfe*

VARIABLES	(1) Entire Sample	(2) China to Rest of the World	(3) China to B&R only
lgdp_exporter	0.440***	0	0
	(0.0314)	(0)	(0)
lgdp_importer	0.509***	0.632***	0.646***
	(0.0323)	(0.0825)	(0.131)
good_gov_exp	0.0290	0	0
	(0.0351)	(0)	(0)
good_gov_imp	0.0729***	0.0685***	0.0435
	(0.0272)	(0.0222)	(0.0326)
bad_gov_exp	-0.0457*	0	0
	(0.0244)	(0)	(0)
bad_gov_imp	0.0225	-0.238**	-0.217**
	(0.0325)	(0.0933)	(0.0852)
Observations	190,855	1,855	729
Country-Pair FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes

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

The "good governance" and "bad governance" variables for bother importer and exporter accounted for roughly one third of the countries in the sample respectively. Bad governance on the importer side (bad_gov_imp) included, for at least one year, 74 of the 195 countries, 30 of which were in the B&R initiative. Good governance on the importer side (good_gov_imp) included, for at least one year, 69 of the 195 countries, 20 of which were in the B&R initiative. Bad governance on the exporter side (bad_gov_exp) included, for at least one year, 61 of the 175 countries, 27 of which were in the B&R initiative. Good governance on the exporter side (good_gov_exp) included, for at least one year, 64 of the 175 countries, 20 of which were in the B&R initiative.

Coefficients for GDP were roughly unchanged from the previous regression and thus merit no further mention.

Column (1), using the full sample, showed significant results only for "good governance" on the importer side and "bad governance" on the exporter side for all

institutional dummies. A nation could expect a 7.6% increase in exports when exporting to a nation with "good governance" ($e^{0.0729} - 1 = 0.0756$). An exporting nation could expect a 4.5% drop in exports if it has bad institutional quality, as previously defined ($e^{-0.0457} - 1 = -0.0447$). This result was only significant to a 10% level though.

When limiting the sample to just China, good governance on the importer side (good_gov_imp) was again found to be significant at a 1% level. This was slightly lower as compared with the full sample, showing China could expect only a 7.1% increase in trade flows when trading with a nation with good institutions ($e^{0.0689} - 1 = 0.0709$). China was found to be sensitive to trading with nations with bad governance (bad_gov_imp) at the 5% level. We can predict 21.2% less exports from China to a nation with poor governance, *ceteris paribus* ($e^{-0.238} - 1 = -0.212$).

Limiting China's trading partners to the B&R nations roughly replicated the results that showed the significance of importers with bad governance. The coefficient on good governance for importers was found to be insignificant, however.

Taken together, these results agree with the previous regressions in showing that exports are positively correlated to good institutions in partner trading countries. Rather than showing a U-shaped relationship, with large export flows to both really good and really bad trading partners, exports are found to only increase with good institutional quality and, for China, significantly decrease when trading with nations with poor institutions.

The last series of regressions continues with the same PPML regression but looks at institutional distance between exporters and importers. This is done with two separate variables in order to capture the direction of institutional difference. Therefore, the institutional difference between importers and exporters, for all importers with better institutional score than exporters, is captured in "imp_exp_diff". The institutional difference between exporters and importers, for all exporters with better institutional score than importers, is captured in "exp_imp_diff".

Table 4 – Exporter/Importer Institutional Distance using *poi2hdfe*

VARIABLES	(1) Entire Sample	(2) China to Rest of the World Only	(3) China to B&R Only
lgdp_exporter	0.481***	0	0
	(0.0281)	(0)	(0)
lgdp_importer	0.489***	0.660***	0.676***
	(0.0387)	(0.101)	(0.151)
imp_exp_diff	0.0814***	0.255***	0.338***
	(0.0292)	(0.0968)	(0.0834)
exp_imp_diff	-0.0327	-0.166**	-0.217***
	(0.0208)	(0.0765)	(0.0635)
Observations	189,860	1,842	729
Country-Pair FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes

Column one (1) shows that only the institutional distance between importers and exporters - for importers with better institutions than exporters - is significant when looking at exports of the entire sample. This is in line with the previous regressions, showing that export flows tend to increase to countries with better institutions and, also, that exporters tend to have weaker institutions than the nations they are exporting to.

This effect becomes even more pronounced when limiting the sample to China as exporter, and even more so when limiting China's trade partners to B&R members. China is therefore even more sensitive to partner nation institutional quality than the general sample. A part of this might be accounted for by China's below average institutional index score. There is also an additional significance, not seen in the general sample (Column 1), of China's sensitivity to nations with worse institutions than their own. This is shown to be significant to a 5% level when limiting the sample to China as exporter but becomes more pronounced, and significant to a 1% level, when limiting China's partners to B&R nations.

From the results, we can say that China is more sensitive to the institutional quality of its trading partners than the average nation. This is even more pronounced in B&R Initiative nations. The results of these regressions cannot confirm that the B&R is a

trading bloc between China and corrupt countries. So far, the data shows that China exports far more to institutionally sound nations and does so even more within the B&R. If anything, the results show that despite the open nature of the B&R initiative, nations with weak institutional structures cannot expect to receive increased exports from China by becoming part of the deal.

The next part will examine if existing information on B&R funding and agreements can tell us anything about China's motives with the B&R initiative, when combined with the regression results just analyzed.

4.2 Part II: Existing B&R Information

One of the largest challenges in examining the Belt and Road Initiative is the paucity of information on actual funding, projects and even nations involved in it. The following section tries to connect the results from Part one with the available data on B&R funding and B&R agreements as mentioned in the last forum held for the initiative.

There is a slight upward trend when examining governmental institutional quality of exporters. This is also true when isolating nations with the B&R agreement, though the average level of governmental institutional quality of these nations is below that of the average nation used in the sample.

Figure 1: Institutional Trend for Exporters

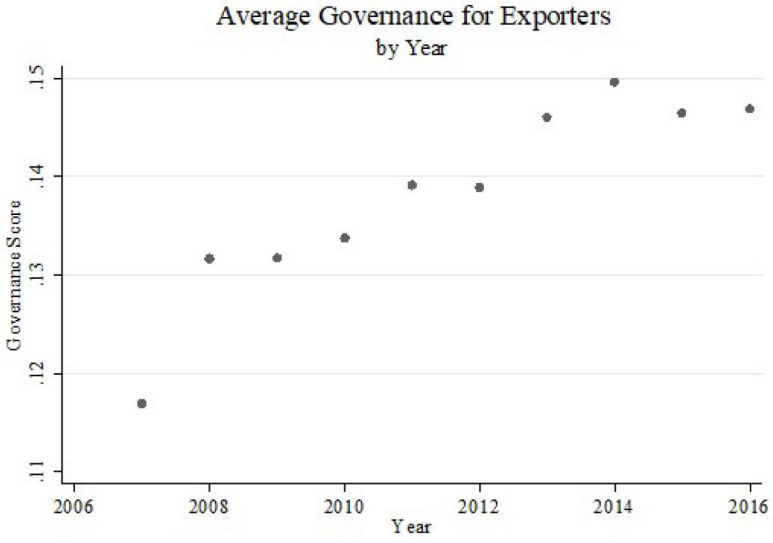
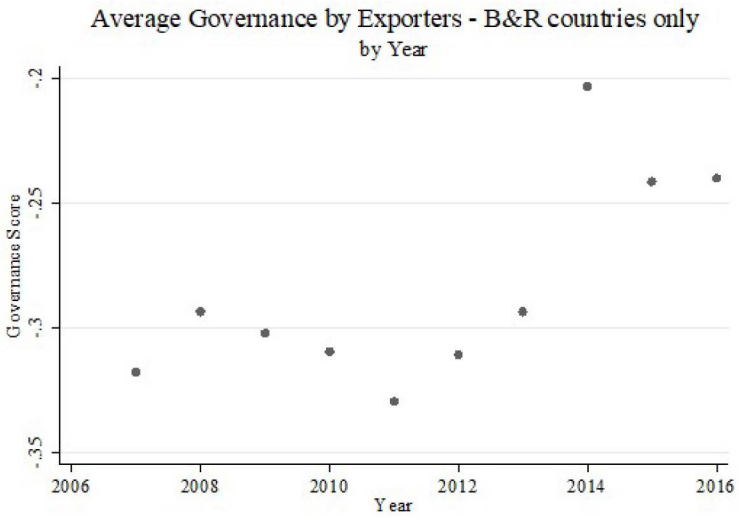
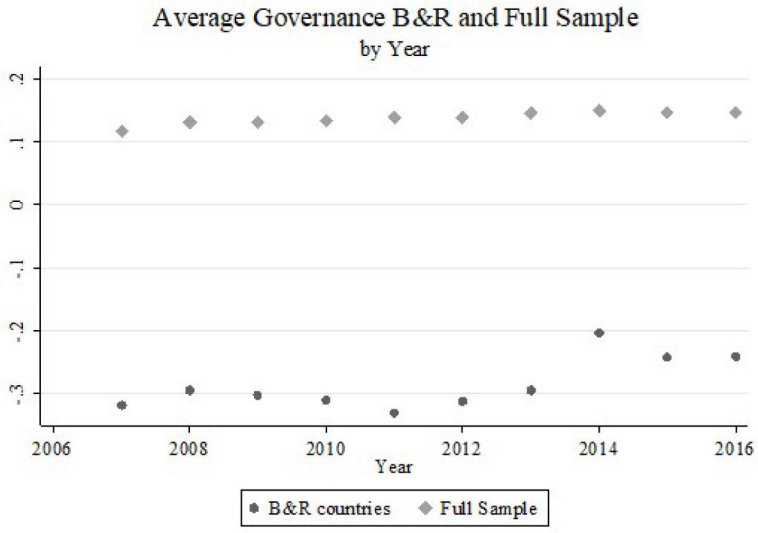


Figure 2: Institutional Trend for Exporters in B&R



Source: Author

Figure 3: Institutional Trend for Exporters B&R and Full Sample



Source: Author

Though graphically there appears to be a large gap between average B&R institutional level and those from the entire sample, the range of the component

measured goes from -5.9 to 4.7, which therefore makes the roughly 0.2 point gap between B&R nations and the entire sample look less drastic.

Below is a full summary of institutions of both exporters and importers, broken down between the full sample and those within the B&R initiative. The only notable difference between exporters and importers is the lower average institutional level of importers due to reasons previously mentioned. Also, the average institutional level for importers in the whole sample trends slightly downwards, whereas the importers in the B&R initiative trend slightly upwards. We can therefore say that the nations within the B&R initiative with the worst level of institutional quality continue to improve whereas the nations with bad institutions quality outside the agreement are getting worse.

Table 5 – Institutional Scores by Year

Year	All Exporters	B&R Exporters	All Importers	B&R Importers
2007	.1168851	-.3178169	-.054819	-.4326998
2008	.131653	-.2934923	-.0438238	-.4049668
2009	.131697	-.3021331	-.0406976	-.4144025
2010	.1337615	-.3095295	-.0400982	-.4228323
2011	.1391044	-.3295372	-.0554043	-.4425821
2012	.1389237	-.3107214	-.0549904	-.4221032
2013	.1460728	-.2934572	-.0544968	-.4070877
2014	.1496177	-.2031639	-.0769816	-.3080821
2015	.1465023	-.2413155	-.0796274	-.3488703
2016	.1469154	-.2401051	-.0796731	-.3520194
Total	**.1381133**	**-.2841272**	**-.0580612**	**-.3955646**

The limited source of funding information was already mentioned and, in addition to this limitation, no information as to *when* this funding was provided exists in academic literature. As such, the only way to correlate institutional scores with the limited funding information was to specify a year to use for institutional information and to assume all funding was provided in that year. The following shows the statistics and correlation between B&R funding and the institutional quality of the countries funded for the most recent year, 2016.

Table 6 – Institutional Scores for B&R Funded Countries Summary Statistics

Variable	Mean	Std. Dev.	Min	Max
Governance	-1.136873	1.366477	-2.392776	2.030412
BR_funding	7.741818	9.418676	.17	30.45

Table 7 – Institutional Scores and B&R Funding Correlation

	Governance	BR_funding
Governance	1.0000	
BR_funding	-0.3677	1.0000

There exists a slight negative correlation between institutional quality and funding within the B&R (-0.3677). This finding contravenes what we would expect if China was funding projects based on historically tested trade partners, which as we have seen, tend to be nations with well-established governmental institutions. Funding is not, therefore, going to nations with which China already heavily exports to. It must again be stressed that the above findings are limited to projects from eleven (11) nations, three (3) of which[8] do not even appear on the English version of China's official B&R membership website.

The last correlation was done between the number of agreements a nation was associated with, as listed in the B&R Forum, and institutional scores. Here we have more data points, with 200 agreements mentioned with 63 nations but with a weaker interpretation as all agreements were taken to be equal as there was no quantitative way apart from count to judge between them.

Table 8 – Institutional Scores for B&R Forum Mentioned Countries Statistics

Variable	Mean	Std. Dev.	Min	Max
Governance	-.3514055	1.893398	-4.787772	4.561834
BR_mentions	2.413333	2.843168	0	12

[8] Kenya, Greece, Djibouti

Table 9 – Institutional Scores and B&R Forum Mentions Correlation

Governance	BR_mentions	
Governance	1.0000	
BR_mentions	-0.2302	1.0000

We see again that there is slight negative correlation between institutional governance scores and the chance of being mentioned in an agreement in the Belt & Road Forum. Again, it must be stressed that no concrete funding information and commencement or completion dates were listed as a part of the Belt and Road Forum Communiqué agreements and the research decision to count every agreement equally was therefore done out of lack of additional information. This finding does agree with the available funding information, however, and suggests that China is forging relationships with countries with poorer institutions, nations it has historically underserved in exports.

5 Conclusion

The goal of this thesis was twofold: first to consider the influence of governmental institutions on trade using a wide panel-dataset; secondly, to tie those findings to existing funding and agreement information on China's Belt and Road Initiative. A Poisson Pseudo-Maximum Likelihood (PPML) estimator was used to carry out this research in order to overcome common problems in trade data, mainly heteroskedasticity and zeros in trade data.

The PPML estimator used (*-poi2hdfe* in Stata) incorporated both the multidimensional fixed-effects of both time and country-pairs. This allowed for the isolation of institutional effects on exports, by accounting for multi-lateral resistance (MRT).

The results obtained in the three sets of regression runs were mixed. The first checked the general institutional effect on trade using a separate importer and exporter institutional component created from WGI data. The results on the full sample only

showed a slight tendency for exporters with worse institutions to export more. Focusing on China revealed that China exports more to nations with good governmental institutions. This result gains significance and magnitude when only analyzing Chinese exports to B&R countries.

The second part looked into potentially different institutional effects on trade with very good and very bad institutions by using a series of importer and exporter dummies to account for nations on the institutional fringes. Again, world trade showed that good institutions in importing countries only had a small impact in additional trade. This effect was minor when only considering China, which also showed a tendency to export less to countries with very poor governmental institutions.

The last looked into the effects of institutional similarity. We were able to see the separate impacts of institutional differences between exporters that had better institutions than importers and vis-versa. The finding again did not contradict the previous regression and only found that institutional difference helps exports, when importers have better institutions than exporters. This finding was supplemented when considering only China, which displayed more sensitivity to their partner nation institutional quality compared to the whole sample, and even more so when only considering their export patterns to B&R nations. Instead of finding that China exports heavily to both nations with very strong and very poor institutions, it was found that China is especially sensitive to exporting to nations with institutions poorer than its own.

A summary of the results would be that export flows increase towards nations with better governmental institutions. In fact, exports were found to increase with worse institutions on the exporting side though this result was not particularly significant. China, more so than the general sample of nations, is sensitive to the institutional quality of its trade partners and trades far more with nations with good governmental institutions and less with nations with poor institutions, even if they are a part of the B&R initiative.

These results do not conform to the general trend of studies show unmitigated benefits to trade due to sound institutions. They are not completely unique, however, as studies such as Duc, Lavallée, and Siroën (2008) have likewise shown ambiguous effects of institutions on trade.

The patterns of trade found from the regressions in the first part of the study did not match the general trend of institutional quality, funding information and agreement information considered in the second part. China, while consistently exporting more to nations with strong institutions, is providing funding and forging agreements with nations with subpar institutional quality. We cannot conclude, therefore, that China is simply following its practice of improving ties with historical trade partners.

We reject hypothesis one (1) that the B&R is following historic export patterns of China along institutional lines. The only robust findings, especially concerning China, is that exports improve towards nations with strong institutions and drop significantly towards nations with poor institutions and that similarity hinders, rather than helps, Chinese exports.

Instead, we have to look at the B&R as, in part, making up for institutional deficiencies in member nations. Ideas that membership in multilateral organizations was a way to circumvent poor governance was established for organizations such as the WTO (Tang and Wei 2009). A wide variety of new institutions were created for the B&R that could prove useful to nations without the capacity for strong institutions themselves. It is too early to tell as the data used only incorporated three years of trade flows from the beginning of the Initiative, yet this may well be China's hope and the hope of nations joining the B&R. The scope of the analysis undertaken do not allow for confirmation of this potential reasoning, however.

The contradictory trend between Chinese exports and governance and B&R funding and governance also does not contradict other goals behind the B&R: geopolitical power expansion, economic imperialism, resource extraction and trade diversification. Nations such a Djibouti, which was included in both the B&R funding and B&R agreements, likewise hosts China's first overseas military base (Calamur 2017). Trade diversification has been an important aspect of China's 5 year economic plans for decades (Xuefeng and Yaşar 2016) and the B&R could be an opportunity to invest in nations hitherto not an important part of its export strategy.

The main insight gained by this research is negative. More than institutional factors must be posited in order to explain trade in general and the reasoning behind the B&R in specific. To conclude, though there exists an expansive body of writing concerning the B&R, future research would be greatly improved if the concrete plans behind the initiative were more transparent, public and easily accessible. This would help substantiate or dispel the various theories, themes and goals posited for the B&R initiative and the nations involved in it.

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Appendix

1 Summary of Gravity-Model based trade studies with Institutions

Author(s)	Year(s)	Specification	Sample	Indicators	Findings
(Bilgin, Gozgor, and Lau 2017)	1976-2004	Unspecified	166 / 47	WGI	Significant positive correlation between inst. quality and exports
(Subasat and Bellos 2013)	1990-2003	Tobit	14	PRS Group Risk Guide	Lack of good governance does not deter, but rather encourages, foreign direct investment.
(Karam and Zaki 2018)	1995-2014	The zero-inflated Poisson model	21	WGI	Consensus that bad institutions decrease trade, and trade liberalization leads to institutional reforms
(Duc, Lavallée, and Siroën 2008)	2000	Poisson (PPML) ZPL OLS	145	Polity IV Freedom House ICRG	Ambiguous results. No clear trade benefits between democratic nations however corrupt nations trade less.
(Prasada 2013)	2005	Poisson (PPML) OLS Tobit	192	Various	Good Institutions positively correlated to trade
(Zeynalov 2017)	1995-2012	Poisson (PPML)	50	WGI	Institutional similarity was significant for trade
(Álvarez et al. 2018)	1996-2012	Poisson (PPML)	186	WGI	Significant positive correlation between trade and good institutions using sectoral data.
(Mendonça et al. 2014)	2005-2010	Poisson (PPML)	59	Institutional similarity using CEPII	Institutional differences between countries have a significant and negative effect on agricultural trade
(Bojnec and Ferto 2015)	1995-2003	Poisson (PPML)	29	EFWI	Quality of inst. for exp/imp not significant. Inst. Similarity found to be negatively correlated.
(Kucharčuková, Babecký, and Raiser 2012)	1997-2004	Poisson Tobbit	82	IMF WGI	Low quality of economic institutions contribute to sub-par trade performance
(Roperto 2013)	2008-2012	OLS MLS	90	Heritage Foundation Indices	Most governance indices found to be not significant in determining trade flows

(Couttenier and Toubal 2017)	1996-2006	OLS	117	International Country Risk Guide (ICRG)	Corruption reduces the sales of new firms entering markets, while having no impact on the sales of incumbents.
(Dutt and Traca 2007)	1982-2000	OLS Heckman	90/ 84	International Country Risk Guide (ICRG)	Corruption effects on trade differ depending on tariff levels. May even help trade at certain tariff levels
(de Jong and Bogmans 2011)	1999-2002	OLS Hausman–Taylor	Not specified	WBES WGI CPI	The effects of unpredictability of corruption and policies are inconclusive
(Babetskaia-Kukharchuk and Maurel 2004)	1994-2001	OLS GLS Hausman-Taylor	42	WDI	Trade and institutions are mutually reinforcing
(Horsewood and Voicu 2012)	2000-2009	OLS	Not specified	CPI	Significant positive correlation between trade and low corruption in EU/OECD countries
(Sonora 2014)	2000-2009	OLS	122	EFWI HFI	Regulation quality found to have biggest impact on trade
(Karkanis 2018)	2001-2015	OLS	29	EU membership	EU membership show to be proxy for institutional quality
(Suvankulov and Guc 2012)	1996-2009	OLS	165	CEPII - Law WB	Membership in WTO institution strongly correlated to trade
(Rasoulinezhad and Wei 2017)	1998-2014	OLS	15	CTI WTO as proxy	WTO Membership positively correlated to trade
(Gylfason, Martínez-Zarzoso, and Wijkman 2015)	1995-2012	MPML EK-Tobit	60/ 150	Depth of integration with EU/RUS. Corruption / Democracy indices	Greater integration with EU institutions positively influences trade. Democracy/Corruption levels not as significant
(Thede and Gustafson 2012)	1999	GMM	Not specified	WBES	The total trade effect of corruption found to be negative
(Chen and Li 2014)	1988-2005	GLS	200	WDI - Law	Rule of law as proxy for institutional quality found significantly correlated with trade

2 Complete List of Variables, Definitions and Sources

Variable name	Definition	Source & units
Exports (exports)	Unilateral export flows from 175 exporting countries to 195 partner countries (190,855 observations)	UN Comtrade database (from WITS)
GDP Exporter (gdp_exporter)	Gross domestic product of the exporting country (reporter)	World Bank
GDP Importer (gdp_importer)	Gross domestic product of the importing country (partner)	World Bank
Pc1	Component from running Principle component analysis on six WDI indices ranging from -5.9 to 4.7	Calculated
Exporter Institutional Score (gov_exp)	Pc1 score for exporters	Calculated
Importer Institutional Score (gov_exp)	Pc1 score for importer	Calculated
Good Exporter (good_gov_exp)	Dummy variable taking value of 1 if exporter gov_exp score is ½ standard deviation above mean for the year	Calculated
Bad Exporter (bad_gov_exp)	Dummy variable taking value of 1 if exporter gov_exp score is ½ standard deviation below mean for the year	Calculated
Good Importer (good_gov_imp)	Dummy variable taking value of 1 if importer gov_imp score is ½ standard deviation above mean for the year	Calculated

Bad Importer (bad_gov_imp)	Dummy variable taking value of 1 if importer gov_imp score is ½ standard deviation below mean for the year	Calculated
Importer/Exporter Similarity (imp_exp_diff)	Difference between importer and exporter institutional score for all gov_imp > gov_exp, zero otherwise	Calculated
Exporter/Importer Similarity (exp_imp_diff)	Difference between exporter and importer institutional score for all gov_exp > gov_imp, zero otherwise	Calculated
Voice & Accountability (vae)	Voice and Accountability, Estimate running from approximately -2.5 to 2.5, with higher values indicating better vae	The World Bank Group
Political Stability (pve)	Political Stability and Absence of Violence/Terrorism, Estimate running from approximately -2.5 to 2.5, with higher values indicating better pve	The World Bank Group
Government Effectiveness (gee)	Government Effectiveness, Estimate running from approximately -2.5 to 2.5, with higher values indicating better gee	The World Bank Group
Regulatory Quality (rqe)	Regulatory Quality, Estimate running from approximately -2.5 to 2.5, with higher values indicating better rqe	The World Bank Group
Rule of Law (rle)	Rule of Law, Estimate running from approximately -2.5 to 2.5, with higher values indicating better rle	The World Bank Group
Control of Corruption (cce)	Control of Corruption, Estimate running from approximately -2.5 to 2.5, with higher values indicating better cce	The World Bank Group

distance (dist)*	Distance measures the distance between two countries applying the great circle formula which takes into account the most important cities and their population size.	CEPII Geodist database
Contiguity (contig)*	Contiguity is a dummy which is equal to 1 if two countries share a common border and 0 otherwise.	CEPII Geodist database
common language (comlang_off)*	Common language is a dummy that takes the value 1 if in two countries at least 9% of the population speak the same language and 0 otherwise	CEPII Geodist database
colony (colony)*	Colony is a dummy that takes the value 1 if there was any colonial relationship between two countries and 0 otherwise.	CEPII Geodist database
REPlandlocked (landlocked)*	Landlocked is a dummy that takes the value 1 if exporter is landlocked and 0 otherwise	CEPII Geodist database
PARTlandlocked (landlocked)*	Landlocked is a dummy that takes the value 1 if importer is landlocked and 0 otherwise	CEPII Geodist database

**Only used in ppml regression included in Appendix*

3 Country List used in Database

Belt and Road Countries		Remaining Countries in Data Set		
Afghanistan	Myanmar	Algeria	Gabon	Palau
Albania	Nepal	American Samoa†	Gambia, The	Papua N. Guinea
Armenia	New Zealand	Angola	Germany	Paraguay
Austria	Oman	Antigua and Barb.	Ghana	Peru
Azerbaijan	Pakistan	Argentina	Greece††	Portugal
Bahrain	Panama	Aruba	Greenland	Rwanda
Bangladesh	Philippines	Australia	Grenada	Samoa
Belarus	Poland	Bahamas, The	Guam†	San Marino†
Bhutan	Qatar	Barbados	Guatemala	Sao T. & Principe†
Bosnia & Herz.	Romania	Belgium	Guinea	Senegal
Brunei	Russian Fed.	Belize	Guinea-Bissau†	Seychelles
Bulgaria	Saudi Arabia	Benin	Guyana	Sierra Leone
Cambodia	Serbia	Bermuda	Haiti†	Solomon Islands
China	Singapore	Bolivia	Honduras	Somalia†
Croatia	Slovak Republic	Botswana	Hong Kong, China	South Sudan†
Czech Republic	Slovenia	Brazil	Iceland	Spain
Egypt, Arab Rep.	South Africa	Burkina Faso	Ireland	St. Kitts and Nevis
Estonia	Sri Lanka	Burundi	Italy	St. Lucia
Ethiopia	Syrian A. Rep.	Cameroon	Jamaica	St. Vincent & G.
Georgia	Tajikistan†	Canada	Japan	Suriname
Hungary	Thailand	Cape Verde	Kenya††	Swaziland
India	Timor-Leste*	Cayman Islands†	Kiribati	Sweden
Indonesia	Trinidad & Tob.	Cen. African Rep.	Korea Dem. Rep.†	Switzerland
Iran, Islamic Rep.	Turkey	Chad†	Lesotho	Tanzania
Iraq	Turkmenistan†	Chile	Liberia†	Togo
Israel	Ukraine	Colombia	Libya	Tonga
Jordan	U. Arab Emirates	Comoros	Luxembourg	Tunisia
Kazakhstan	Uzbekistan†	Congo, Rep.	Macao	Tuvalu†
Korea, Rep.	Vietnam	Costa Rica	Malawi	Uganda
Kuwait	Yemen, Rep.	Cote d'Ivoire	Mali	United Kingdom
Kyrgyz Republic		Cuba†	Malta	United States
Lao PDR		Cyprus	Marshall Islands†	Uruguay
Latvia		Djibouti††	Mauritania	Vanuatu
Lebanon		Dominica	Mauritius	Venezuela
Lithuania		Dominican Rep.	Mexico	Zambia
Macedonia, FYR		Ecuador	Micronesia	Zimbabwe
Madagascar		El Salvador	Mozambique	
Malaysia		Eq. Guinea†	Nauru†	
Maldives		Eritrea†	Netherlands	
Moldova		Estonia	Nicaragua	
Mongolia		Fiji	Niger	
Montenegro		Finland	Nigeria	
Morocco		France	Norway	

** Belt and Road Country (Timore-Leste) not in Dataset due to missing trade data*

† Indicates countries in dataset with no export data (only appear as partner)

†† While these nations do not appear on the official B&R memebership list, they have been included as part of the B&R in this thesis due to having projects funded under the initiative

4 WGI and Component Analysis

The following show the steps taken to reduce the six (6) WGI using Principle Component Analysis (PCA). First WGI variables are described and correlation matrix is printed:

Statistically:

Variable	Obs	Mean	Std. Dev.	Min	Max
vae	3545	-.0118574	.9999192	-2.313395	1.800992
pve	3511	-.0049445	.9851516	-3.314937	1.961483
gee	3487	-.0152991	.9897729	-2.445876	2.436975
rqe	3488	-.0183993	.9916868	-2.645041	2.260543
rle	3551	-.0150609	.9932273	-2.606445	2.100273
cce	3496	-.0189373	1.001598	-1.868714	2.469991

Correlation Matrix:

	vae	pve	gee	rqe	rle	cce
vae	1.0000					
pve	0.6678	1.0000				
gee	0.7573	0.6864	1.0000			
rqe	0.7817	0.6447	0.9332	1.0000		
rle	0.8231	0.7769	0.9329	0.9021	1.0000	
cce	0.7702	0.7360	0.9273	0.8672	0.9412	1.0000

Next principal component analysis showing one component is suitable for all six WGI:

```
Principal components/correlation                  Number of obs    =       3457
                                                  Number of comp.  =          6
                                                  Trace            =          6
    Rotation: (unrotated = principal)             Rho              =     1.0000
```

Component	Eigenvalue	Difference	Proportion	Cumulative
Comp1	5.06829	4.6461	0.8447	0.8447
Comp2	.422192	.127456	0.0704	0.9151
Comp3	.294736	.172693	0.0491	0.9642
Comp4	.122043	.0742963	0.0203	0.9845
Comp5	.0477468	.00276027	0.0080	0.9925
Comp6	.0449866	.	0.0075	1.0000

Principal components (eigenvectors)

Variable	Comp1	Comp2	Comp3	Comp4	Comp5	Comp6
vae	0.3861	0.0336	0.9063	-0.0799	0.1426	-0.0403
pve	0.3604	0.8767	-0.1813	0.2350	0.1108	0.0334
gee	0.4242	-0.2885	-0.2723	0.0660	0.5084	-0.6323
rqe	0.4153	-0.3707	-0.0661	0.6790	-0.1059	0.4620
rle	0.4344	-0.0300	-0.0881	-0.1934	-0.8106	-0.3288
cce	0.4240	-0.0933	-0.2437	-0.6599	0.2016	0.5253

Variable	Unexplained
vae	0
pve	0
gee	0
rqe	0
rle	0
cce	0

This component was then created using the Stata command: *predict pc1, score*

5 Institutional Similarity using *-ppml*

Table 4 – Exporter/Importer Institutional Similarity using *PPML*

VARIABLES	(1) Entire Sample	(2) China to Rest of the World Only	(3) China to B&R Only
lgdp_exporter	0.494***	0.342***	0.424***
	(0.0283)	(0.0381)	(0.0540)
lgdp_importer	0.511***	0.660***	0.664***
	(0.0388)	(0.100)	(0.159)
ldist	-0.764***	-0.842***	-0.867***
	(0.0269)	(0.125)	(0.139)
colony	0.245**		
	(0.102)		
contig	0.530***	0.874***	1.070***
	(0.0858)	(0.284)	(0.380)
comlang_off	0.120	1.418***	1.393***
	(0.0831)	(0.348)	(0.0464)
REPlandlocked	-2.383***		
	(0.770)		
PARTlandlocked	0.143	-1.172***	-4.674***
	(0.851)	(0.330)	(1.196)
imp_exp_diff	0.0560***	0.0894*	0.126**
	(0.0213)	(0.0513)	(0.0495)
exp_imp_diff	-0.0272	-0.167**	-0.226***
	(0.0199)	(0.0764)	(0.0642)
Constant	-7.148***	-4.831**	-7.294
	(0.942)	(2.055)	(4.460)
Observations	188,360	1,819	681
R-squared	0.851	0.994	0.985
Country FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes

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