CHANGE IN COMPREHENSIVE BILATERAL TRADE COST UNDER CHINA'S BELT AND ROAD INITIATIVE

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ABSTRACT

China's Belt and Road Initiative was announced in 2013 with the goal of improving international cooperation mainly through enhancing infrastructures and reducing transportation costs. Various economies are expecting to benefit, especially those within the Belt and Road Initiative region. I estimate how much the bilateral trade cost might decline among 71 of the Belt and Road economies through the use of a Difference-in-Difference model. The bilateral trade costs I analyze are comprehensive, which include all bilateral costs involved not only in transportation and tariff, but also other direct and indirect costs. The result shows that the comprehensive bilateral trade cost for agricultural goods in the BRI economies decline 14.14% compared to that of non-BRI economies. For manufacturing goods, the comprehensive bilateral trade cost decline 5.15%. The decrease is less for the total products which are the sum of agricultural goods and manufacturing goods(4.59%). With more infrastructure projects and other facilitation policies on the way, there could be further decreases in international comprehensive trade costs in the future.

BIOGRAPHICAL SKETCH

Haolin Zhu, born in July 4, 2021, is from Chengdu, Sichuan, China. Haolin experienced the 8.0 level earthquake of Wenchuan when she was only in primary school. She witnessed the devastated natural disaster not only killed numerous locals, but also harmed the economy and infrastructures in the region that made the recovery for the people in the region even harder. She felt rebuilding the region was just as important as saving lives under the ruins. She was interested in seeing all the economics and financial measures that were taken could actually help with this situation. She then decided to pursue more understanding in economics and hopes she could use the knowledge to help with regional development in the future.

She studied at University of Wisconsin Madison as an undergraduate student from 2014 to 2018. She double majored in Economics and International Studies, with a minor in Business. She attended Cornell University starting on September, 2021 majoring in Applied Economics and Management. Her research interests are in international economics and development, and international trade.

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I. Introduction

As Covid-19 disrupted global economic activities, world trade flows declined by 7% in 2020 due to direct health impact, government policies in preventing the spread of the virus, and the economic impacts of the pandemic in third countries.[1] However, under these circumstances, freight train trips increased drastically from China to European countries. In 2020, a record 12,400 China to Europe freight train trips were made, and the number was up 50 percent from 2019. Those trains transported 1.14 million twenty-foot equivalent unit containers in 2020, a 56 percent increase from the previous year. Trade in goods between Europe and China exceeded trade in goods between Europe and United States for the first time in 2020.

Healthcare supplies are shipped from China to European countries by rail. Freight train trips had transported 27,000 tonnes of medical supplies from China to European countries by June 2020, according to Hua Chunying, the China foreign ministry spokeswoman. A representative from Hupac, a Swiss railway company stated that all face masks being imported from China to Europe are shipped by rail, and the company doubled traffic with China in September 2020. [2] To transfer such large volumes of goods with faster speed is due to the development of infrastructures and roads with China's Belt and Road Initiative playing a key role.

In 2013, Chinese government proposed the Belt and Road Initiative (BRI), also referred as the New Silk Road, to encourage greater regional connectivity and

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[1]Liu X., Ornelas E., Shi H(2021). The 2020 trade impact of the Covid-19 pandemic.VOX EU. Retrieved from https://voxeu.org/article/2020-trade-impact-covid-19-pandemic.
[2]Contessi N(2021). Is Covid-19 Shifting the Future of Eurasian Rail. RECONNECTING ASIA.Retrieved from https://reconasia.csis.org/is-covid-19-shifting-the-future-of-eurasian-rail/

cooperation between Asia, Europe and Africa, and to promote joint development by creating a trade network of railways, highways, and energy pipelines both westward and southward from China. As of mid-2020, more than 2,600 projects at a cost of $3.7 trillion were linked to the BRI, although the Chinese foreign ministry said last June that about 20% of projects had been seriously affected by the COVID-19 pandemic.[3] Some of the investments are provided by Chinese companies, mostly state-owned, while others are provided by loans from Chinese banks.

According to the Vision, the goals of the BRI include facilities connectivity, policy coordination, unimpeded trade, financial integration, and people-to-people bonds[4]. Countries are to coordinate their economic development strategies and policies and jointly provide policy support for cooperation and large-scale projects. Investment and trade cooperation is also a main point of the BRI. Countries along the BRI region try to remove investment and trade barrier and form free trade areas. Customs cooperation including information exchange, standard measurement, lowering costs of customs clearance, and lowering non-tariff barriers are targeted. Free trade areas and mutual investment areas, cooperation in different sectors such as agriculture, coal, and clean energies are built. Participating countries also promote financial integration where they expand the scope and scale of bilateral currency swaps and settlements with other countries along the BRI region, and further develop and integrate financial markets in these regions. International banks such as the Asian Infrastructure

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[3] Holland S., Faulconbridge G.(2021).G7 rivals China with grand infrastructure plan.Reuters.Retrieved from https://www.reuters.com/world/g7-counter-chinas-belt-road-with-infrastructure-project-senior-us-official-2021-06-12/.

[4] Vision and Actions on Jointly Building Silk Road Economic Belt and 21st Century Maritime Silk Road(2015). Retrieved from http://www.chinese-embassy.org.uk/eng/zywl/t1251719.htm

Investment Bank and the BRICS New Development Bank are developed mainly to carry out multilateral financial cooperation of syndicated loans and bank credit. China makes efforts in supporting participating countries and their companies maintain RMB bonds in China. Commercial equity investment funds and private funds are also encouraged to participate in the construction of large projects. Besides economic and financial cooperation, public support and bonds among all people including cultural and academic exchanges with joint labs and research centers, cooperation among the media, and volunteer services are also promoted. China provides large government scholarships to countries among the BRI region every year, and there are also tourism promotion, epidemic information sharing, and exchange of treatment technologies and medical resources.

With all these objectives, the main goal emphasized is infrastructure connectivity. The projects are financed by the BRI funding mechanism or are branded under the BRI. The BRI is built upon the old silk road mainly connecting Asia, Europe and Africa through the landmass of Eurasia, and the Indian and Pacific Oceans. These lands and sea routes are divided into six economic corridors. The 6 economic corridors planned in the project are: China-Mongolia-Russia, New Eurasia Land Bridge, China-Central Asia-West Asia, China-Pakistan, Bangladesh-China-India-Myanmar, and the China-Indochina Peninsula. A map showing the 6 corridors[5] and a map showing corridors with specific countries are shown below.[6]

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[5] Xinhua Silk Road(2020). What are the six economic corridors of BRI? Xinhua News.Retrieved from https://en.imsilkroad.com/p/311988.html.

[6] Business Reporting Desk(2020). Six Major Economics Corridors under Belt & Road Initiative.Belt & Road News.Retrieved from https://www.beltandroad.news/six-major-economic-corridors-under-belt-road-initiative/.

Figure 1: 6 Corridors of Belt and Road Initiative

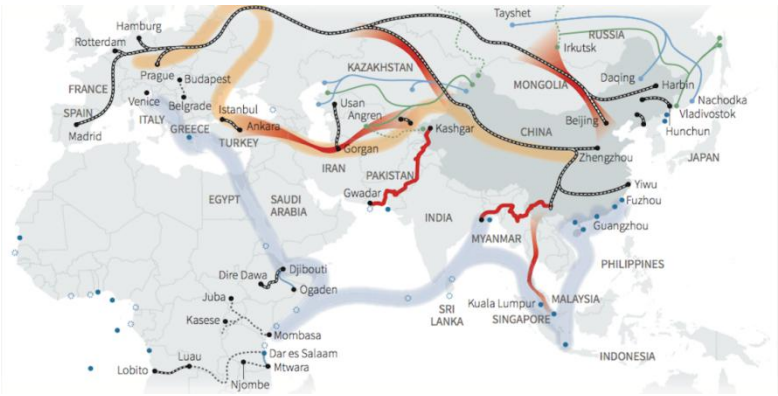

Figure 2: Specific Countries on the 6 Corridors of Belt and Road Initiative

At the same time, projects under the BRI are mainly for infrastructural development in terms of transportation. Most transportation projects are along the corridors shown below.[7]

[7] Mercator Institute for China Studies(2018). Mapping the Belt and Road initiative:this is where we stand. Retrieved from https://merics.org/en/tracker/mapping-belt-and-road-initiative-where-we-stand

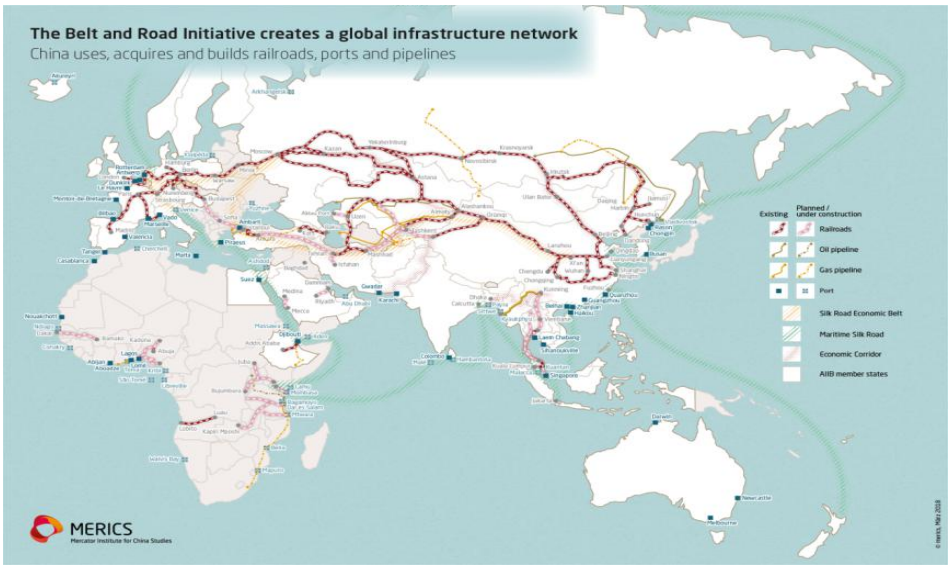

Figure 3: Infrastructure Projects Under Belt and Road Initiative

The range of the Belt and Road Initiative is wide in terms of the number of participating countries and the geographical spread.There is no official list of which countries are participating in the initiative. However, there are 71 countries according to De Soyres(2018)[8] that are along the BRI region I use in this research as the treatment group (explained in more details later in the Methods section).

With the development of the trade war between China and the United States and with China having trade surplus, China is exploring new opportunities with countries on the BRI to both trade, foster relationships, and enhance soft power. The BRI initiative not only affects nations along related regions but could also potentially change the trade costs and eventually trade patterns. At the same time, with increasing air freight rates, the BRI is valuable in reducing trade costs and increasing the volume and value of trade between China and other countries.

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[8] De Soyres François, Alen Mulabdic, Siobhan Murray, Nadia Rocha and Michele Ruta, (2018). "How Much Will the Belt and Road Initiative Reduce Trade Costs?". Policy Research working paper; no. WPS 8614 Washington, D.C. : World Bank Group.

However, there are various critiques of the Belt and Road Initiative. Some argue that the BRI raises the risk of debt distress in borrowing countries.[9] For example, Sri Lanka has turned over a seaport to China for 99 years because it was unable to repay the loans. Some think that without a comprehensive and coordinated financing plan, some BRI projects could end up being wasteful . [10] Therefore, further study is needed on the role of the BRI and its effects on international trade.

It is difficult to measure the success of the BRI in all aspects with the intertwined effects of various factors such as trade, education, political power, and financial returns. I am choosing the trade cost angle because this is one of the most essential and direct effects of the BRI and is one of the main purposes of the BRI. While more infrastructure and other projects are on the way, it is necessary to understand whether or not BRI is truly reducing bilateral trade costs since building infrastructures is very costly. At the same time, the BRI is not only building infrastructure in the region, it also connects different nations and regions through trade zones and friendly public policies. Therefore, it is meaningful to not only look at how building infrastructure can reduce trade transportation time, but also there can be a reduction in comprehensive trade cost including other direct and indirect trade costs such as international policies that reduce custom costs.

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[9] Hurley J., Morris S., Portelance G.(2018) Examining the Debt Implications of the Belt and Road Initiative from a Policy Perspective.

[10]Kohli H., Linn J., Nag R.,Zucker L.(2019)Opinion:The promises and pitfalls of China's Belt and Road Initiative. Retrieved from https://www.devex.com/news/opinion-the-promises-and-pitfalls-of-china-s-belt-and-road-initiative-95871

In this paper, I will look into how comprehensive bilateral trade costs change among the 71 economies after the implementation of the BRI. I will quantify the associated decrease in bilateral trade costs using a Difference-in-Difference model.

II. Literature Review

The BRI has been in progress for 8 years now. For a complicated and large-scale project that all countries participate altogether, it touches upon various aspects such as international trade, infrastructure and economic development, communication and education, international supply chains, climate change and the like. There are a broad range of theoretical and empirical studies related to the topic of international trade and the BRI.

Most research tends to focus on how the BRI promotes trade instead of understanding how the BRI can change trade cost. Most papers ignore trade costs by using distances as a proxy in the gravity model to estimate trade.

For example, Herrero A., and Xu J.(2016）[11] estimate how much trade could be created because of the reduction in transportation costs by both railway and maritime using a gravity model. The authors use sea, road, railway, and air distance between any two capitals as measurements of transportation costs. The authors found that European Union countries could benefit considerably. The authors also compare the impact of reduction in transportation costs to a reduction in potential tariffs, and found that a 10% reduction in transportation costs fosters trade by 1.3 percent while a reduction in tariffs has a much smaller positive effect on trade. The authors use shipping distance as proxy of trade cost. However, the authors do not consider the fact that shipping methods may change. At the same time, transportation cost does not only include shipping cost, there could also be non-tariff measures such as administrative costs. The authors also ignore these trade facilitation aspects.

[11] Herrero A., Xu J.(2016) Can Europe expect trade gains? Bruegel. Working paper. Issue 5.

Lu H., Bohr C., Hafner M., Knack A.(2018)[12] finds similar results that transport infrastructure and connectivity would positively impact bilateral trade. In the BRI region, a rail connection improves total exports by 2.8 percent. The authors also ignore other trade barriers and trade facilitation measures besides transport infrastructure change.

Ramasamy B., and Yeung M.(2019)[13] add on policy facilitation and estimate the effects of physical infrastructures and trade facilitation and their interactions on the exports of member countries of the BRI. The authors use a gravity model including economic sizes of the exporting and importing countries and the distance between them with dummy variables to show whether the quality of border administration, the quality of transport infrastructure of exporting and importing country, and their interaction have a significant influence on exports. Information regarding the quality of border administration and transport infrastructures are indicators collected by the World Economic Forum's Enabling Trade Index. The authors find that both improvements in border administration and physical infrastructure promote exports.

All the above authors try to directly measure the change in trade flows in terms of size and using distance as proxies of trade cost without calculating how trade costs change. However, I am particularly interested in how trade cost actually change after the implementation of the BRI.

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[12] Lu H., Bohr C., Hafner M., Knack A.(2018).Measuring the Impact of Improving Transport Connectivity on International Trade in the Region-A Proof-of-concept Study. RAND Corporation.

[13] Ramasamy B., Yeung M.(2019)China's one belt one road initiative: The impact of trade facilitation versus physical infrastructure on exports.*The World Economy.*

Few papers that focus on how infrastructure reduces trade costs mostly just use transportation data only. De Soyres et al[14](2018) looked into how much the BRI will reduce trade costs related to shipping time change empirically. The authors use a combination of geographical data and network algorithms to compute the reduction in travel times in 191 countries, and use sectoral estimates of the value of time to transform reductions in shipment time into reduction in trade costs. The authors use Geographic Information System to estimate shipment times before and after the BRI. The change in shipping time is then transformed into a change in trade costs at the country level. The authors find reduction in shipping time is between 1.2 percent and 2.5 percent for all country pairs. For the BRI economies along the corridors, which I also use those economies in my research, they have larger decreases due to reduction in shipment times, declining by up to 11.9 percent. The authors then compute the decrease in total trade costs that can be expected by the decrease in shipping time using the value of time. The reduction in global trade costs is between 1.1 and 2.2 percent. For the Belt and Road economies along the corridors, the trade costs decline by up to 10.2 percent. The authors only look at the decreased time cost and assume tariffs and transport costs stay the same. However, this is not the reality because some countries participating in the BRI also formed trade zones and policies that reduced tariffs. Even countries that are not participating in the BRI, tariffs may not necessarily stay the same.

Meanwhile, countries participating in the BRI does not only build infrastructure but also cooperate in trade zones that reduce tariffs and non-

[14] De Soyre F., Mulabdic A., Murray S., Rocha N., Ruta M.(2018) How Much Will the Belt and Road Initiative Reduce Trade Costs? World Bank Group.

infrastructure trade barriers such as trade facilitation procedures. It is also worth understanding how the comprehensive bilateral trade cost change with the BRI.

There is only few literature focusing on trade cost, and there is currently no literature on how the BRI changes the comprehensive trade costs including not only international transport costs and tariffs, but also other trade cost components such as direct and indirect costs associated with differences in languages, currencies and import or export procedures. There was also no literature that look into how different sectors of goods may change differently. Therefore, this paper aims to fill this gap and contribute to literature by using a Difference-in-Difference model to analyze the change of 71 comprehensive bilateral trade costs after the implementation of the BRI.

III. Methods

This paper uses a Difference-in-Difference (DID) model to analyze the Average Treatment Effect of the BRI on comprehensive bilateral trade costs among 71 economies. The DID methodology is able to solve the random sampling issue of the treatment group, and to estimate the treatment effect of policy shocks as a quasi-experimental design by comparing the changes in outcomes over time between participants that are in the intervention and those who are not. The method is able to remove bias from permanent differences between treatment and control groups.

The DID method is a great fit for my study since randomization on the individual level is not possible in this case, and there may be permanent differences between the treatment and the control group.

3.1 Treatment Group and Control Group

There is no official announcement regarding which countries are covered by the BRI. Even though there is a Memorandum of Understanding that could be signed by participating countries, other countries that do not sign could also participate and eventually benefit from BRI. For example, with infrastructure development, countries may obtain an advantage in less shipment time as long as a part of the transport journey could use the BRI infrastructure. More information is explained in the discussion validity section later.

Since countries that are along the BRI regions would directly benefit from the initiative, I am including 71 economies that are along the BRI regions as the treatment

group following De Soyres(2018)[15]. Other countries are in the control group. Of the regions that are in the treatment group, 15 economies are in the East Asia and Pacific region. 30 countries are in the ECA region, which includes Eastern Europe, South Eastern Europe, South Caucasus, and Central Asia, 16 are in the Middle East and North Africa region, 8 are in the South Asia Region,and 2 countries are in Africa. A map that shows the treatment group in red is shown below.

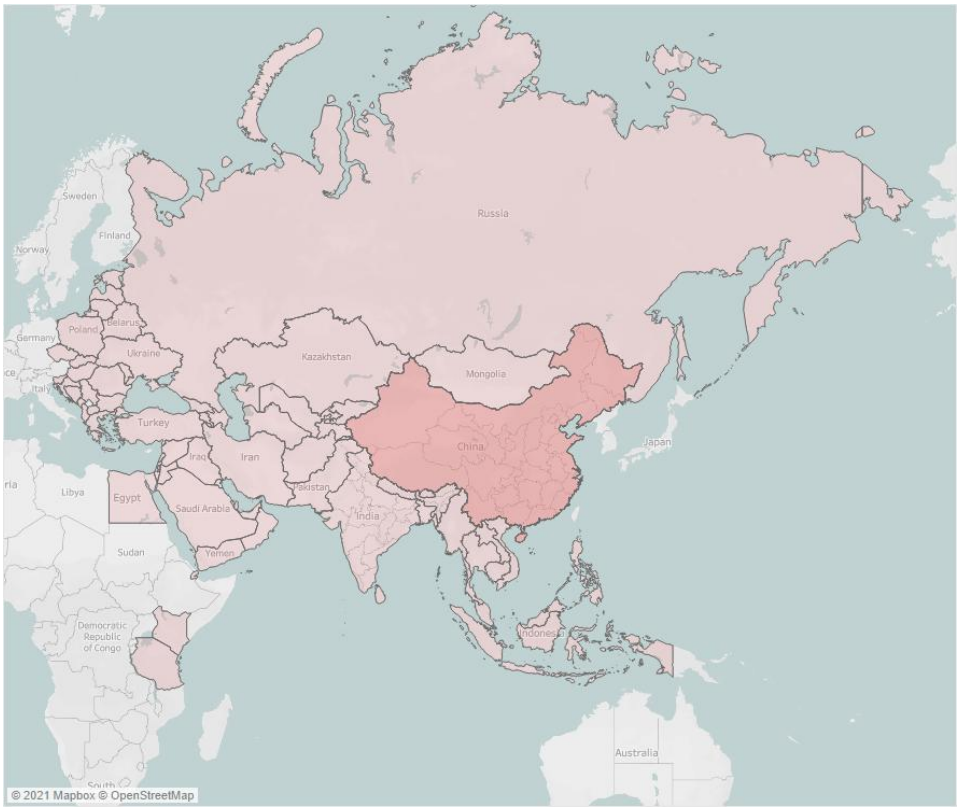

Figure 4:Treatment Groups in Red

[15] De Soyre F., Mulabdic A., Murray S., Rocha N., Ruta M.(2018) How Much Will the Belt and Road Initiative Reduce Trade Costs? World Bank Group.

3.2 DID Model

To obtain the first difference in DID model, which is the difference in the bilateral comprehensive trade costs of the treatment group between pre and post BRI period is given by:

$$E(Tradecost_{ij1} - Tradecost_{ij0}|BRI_{i=1}) = E(Tradecost_{ijt}|BRI_{i=1}, Post_{t=1}) - E(Tradecost_{ijt}|BRI_{i=1}, Post_{t=0}) \quad [1]$$

where $Tradecost_{ijt}$ denotes the bilateral comprehensive trade cost of the two economies i and j in period t(t=2004-2018).*BRI* is the dummy variable for treatment, $BRI_{i=1}$ shows that both countries are from the treatment group. $Post_{t=1}$ shows the post BRI period, and $Post_{t=0}$ shows the pre BRI period.

To control for the time effect, the second difference, which is the change of the control group:

$$E(Tradecost_{ijt}|BRI_{i=0}, Post_{t=1}) - E(Tradecost_{ijt}|BRI_{i=0}, Post_{t=0}) \quad [2]$$

where $BRI_{i=0}$ shows that both countries are from the control group.

So, the treatment effect of BRI, the difference in difference, can be obtained by Equation [3]:

$$\delta = E(Tradecost_{ijt}|BRI_{i=1}, Post_{t=1}) - E(Tradecost_{ijt}|BRI_{i=1}, Post_{t=0}) - [E(Tradecost_{ijt}|BRI_{i=0}, Post_{t=1}) - E(Tradecost_{ijt}|BRI_{i=0}, Post_{t=0})] \quad [3]$$

Thus, the study sets the DID empirical model as follows:

$$Tradecost_{ijt} = \beta_0 + \beta_1(BRI_{ij}) + \beta_2(Post_t) + \beta_3(BRI_{ij} * Post_t) + \varepsilon_{ijt} \quad [4]$$

where $Tradecost_{ijt}$ is the bilateral trade cost between country i and j in time t. BRI_{ij} is the dummy variable for treatment, it equals to 1 if both countries are from treatment group, and it equals to 0 if both countries are from control group. $Post_t$ equals to 1 if the year is equal to or after 2014, and 0 otherwise. ε_{ijt} is the error term that captures random disturbance items.

I choose year 2014 as the starting year for the BRI. Even though the BRI was announced in the end of 2013, most of the projects have been carried out starting from 2014.

IV.Data

This paper uses the ESCAP-World Bank Trade Cost Database, which includes yearly panel data of bilateral trade costs for 208 economies as trade partners and is reported from 1995 to 2018 for 3 sectors including agriculture, manufacturing, and the total sector that is defined as the sum of agriculture and manufacturing goods.[16] It is built on trade and production data collected in those countries and computed the symmetric bilateral trade costs are computed using the Inverse Gravity Framework. This Framework estimates trade costs for each country pair using bilateral trade and gross national output data. The units are in ad valorem terms, which shows the additional percentage of the value of goods that was involved trading goods between country pairs as compared to when two countries trade the goods within borders. For example, the ad valorem comprehensive trade cost for Thailand-China country pair for manufacturing goods in 2009 was 82.67%, which shows that trading manufacturing goods between Thailand and China involved additional costs amounting to 82.67% of the value of goods as compared to the countries trading within their borders.

The comprehensive bilateral measure of trade costs in this database captures all the costs related in trading internationally with another global partner relative to trading domestically. It includes not only international transport costs and tariffs, but also direct and indirect costs such as differences in languages, currencies and import and export procedures. The bilateral comprehensive trade cost is defined as follows[17]:

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[16] The World Bank(2021). ESCAP World Bank: International Trade Costs. Retrieved from https://databank.worldbank.org/source/escap-world-bank-international-trade-costs#.

[17] The World Bank(2017).ESCAP-WB Trade Cost Database: Explanatory Note for Users. Retrieved from https://www.unescap.org/sites/default/d8files/Trade%20Cost%20Database%20-%20User%20note.pdf

$$\tau_{ijkt} \equiv \left(\frac{t_{ijkt}t_{jikt}}{t_{iikt}t_{jjkt}}\right)^{\frac{1}{2}} - 1 = \left(\frac{X_{iikt}X_{jjkt}}{X_{ijkt}X_{jikt}}\right)^{\frac{1}{2(\sigma_k - 1)}} - 1; \text{ at sector k, time t} \quad [6]$$

where τ_{ij} is geometric average trade costs beween country i and country j, t_{ij} is international trade costs from country i to country j,t_{ii} is international trade costs of country i, X_{ij} is international trade flows from country i to country j, X_{ii} is international trade of country i, and σ_k is the sector-specific elasticity of substitution between goods in the sector.

The yearly panel data gives out bilateral comprehensive trade costs in 3 sectors. It includes the cost of agricultural goods, manufacturing goods, and the total trade costs which are defined as the sum of the first two goods. The data I use begins in 2004 and ends in 2018. I included 21,559 country pairs, and in total, there are 323,385 observations. I label the treatment and control group, and create a unique ID with each pair of bilateral trade partners. I then set up the panel data according to year and panel ID. There are 32,925 observations (2,195 country pairs for 15 years) that are in the treatment group, and the rest are in the control group. There are 107,795 observations that are in the post treatment period.

Some of the trade cost data are missing for various countries in different years. For comprehensive bilateral trade cost of total goods, there are 121,216 observations for trade costs. The mean comprehensive bilateral trade cost is 289.96%, which shows that on average, trading between two countries involves additional costs amounting to approximately 289.96% of the value of goods, as compared to when countries trading within their borders. There is a minimum of 2.15% overall and a maximum of 2,195.49%.

For comprehensive bilateral trade costs in agricultural goods, there are 68,827 observations for trade costs. The mean trade cost is 333.13%, with a minimum of 3.75% and a maximum of 2,217.65%.

For comprehensive bilateral trade cost in manufacturing goods, there are 108,873 observations for trade costs. The mean trade cost is 274.01%, with a minimum of 0.79% and a maximum of 1,979.70%.

V. Results

Countries with lowest average total trade cost are mostly developed countries such as Belgium, Estonia, France, Germany, etc. Countries with the highest average total trade costs are less developed countries. The average comprehensive total trade cost for one single country is calculated by averaging all the country pairs for one country. For example, to calculate the average for China is to aggregate the total trade cost of all country pairs with China such as bilateral trade cost between China and United States, and between China and the United Kingdom, etc.. Then I take an average to find the average comprehensive bilateral trade costs for China as a single country.

Table 1:Countries with Lowest and Highest Average Total Trade Cost

Country	*Average Total Trade Cost (%)*	*Country*	*Average Total Trade Cost (%)*
Belgium	149.57	Chad	490.65
Estonia	169.22	Tonga	467.48
Vietnam	170.79	Brunei Darussalam	465.51
France	177.42	Rwanda	449.74
Germany	177.46	Zimbabwe	441.4

Looking at the country pairs, and estimate the average trade costs over years, the country pairs that have lowest average total trade cost are also mostly country pairs

that involves two developed countries. Average change per year is relatively stable with only minor changes. The country pairs that have highest average total trade cost are mostly country pairs that involves two less developed countries.

Table 2:Country Pairs with Highest and Lowest Average Total Trade Cost

	Country/Region Pair	*Average Trade Cost (%)*	*Average Change Per Year (%)*
Lowest Average Total Trade Cost	Belgium-Netherland	15.00	-2.24
	Germany-Netherland	17.31	-2.18
	China-Hongkong	19.68	-0.79
	Estonia-Latvia	20.61	-2.75
	Nigeria-Niue	25.09	Only has one year data
Highest Average Total Trade Cost	Netherland-UK	27.75	-1.45
	Belgium-France	28.52	-1.58
	Belgium-Germany	29.20	-1.40
	Estonia-Finland	29.43	-2.23
	Czech Republic-Germany	29.96	-2.29

I utilized both a sample data to try it out and the full data set of total trade costs for the model. The first scenario is to construct a small sample from the full data set dropping all the missing trade cost values. I dropped all the country pairs that do not have a full yearly trade cost observation from 2008 to 2018. There are 3,349 country pairs left in a span of 11 years, a total of 36,839 observations. I have 16,745

observations that are post-BRI. 7,095 observations are in the treatment group (645 country pairs). The second scenario is to keep all the missing trade costs and the data set is as described in the data section. Table 3 shows the Difference-in-Difference results for equation [4] in the two situations described.

Table 3:Difference-in-Difference Results for Total Trade Costs

	1st Scenario:(Sample) Drop Missing Trade Cost Data	*2nd Scenario: Keep All Missing Trade Cost Data*
BRI	-52.61***	-176.95***
	(24.95)	(31.68)
post	-12.86***	-22.96***
	(1.46)	(1.39)
BRI*post	-3.76***	-4.59***
	(1.55)	(1.25)
P value for BRI*post	0.02	0.00
_cons	254.80***	405.47***
	(1.04)	(23.00)
N	36,839	121,216
R^2	0.84	0.85

Note:***,**, and * respectively indicate that the regression coefficient is significant at the statistical level of 1%, 5%, and 10%.standard errors are in the parenthesis.

Table 4 shows the DID model results for agriculture goods and manufacturing goods.

Table 4:Difference-in-Difference Results for Agriculture and Manufacturing Trade Costs

	Agriculture Trade Cost	*Manufacturing Trade Cost*
BRI	-254.98***	-205.78***
	(58.96)	(34.96)
post	-34.50***	-17.29***
	(1.99)	(1.42)
BRI*post	-14.14***	-5.15***
	(1.65)	(1.24)
P value for BRI*post	0.00	0.00
_cons	513.73***	442.26***
	(54.59)	(22.12)
N	68,827	108,873
R^2	0.83	0.85

Note:***,**, and * respectively indicate that the regression coefficient is significant at the statistical level of 1%, 5%, and 10%.standard errors are in the parenthesis.

VI. Discussion

6.1 Validity

i. No Other Similar Policy Shock

From 2013, there are no similar global projects taking place in the Belt and Road area that may affect the region in the same way. Even more, over the past three years, China has been scaling down subsidies for train traffic between China and Europe. Financial support could not be more than 50 per cent of freight costs in 2018, no more than 40 per cent in 2019, and no more than 30 per cent in 2020, until subsidies are eliminated in 2022. This forces China-European Union rail freight transport to grow independently from financial schemes. Therefore, there are limited factors that would affect the areas other than the BRI in bilateral trade.

ii. Endogeneity Problem

A concern is that China may choose countries, and countries may choose themselves to sign the Memorandum of Understanding to participate in the BRI. Therefore, instead of using the Memorandum of Understanding as the measure of treatment to obtain the treatment group who participate in the Belt and Road Initiative, I include countries that are along the BRI region in the treatment group following De Soyres(2018). In this case, I am arguing that the treatment group is mostly determined by geographical location rather than other economic and political reasons.

iii. Parallel Trend Assumption

One assumption of using the DID method is that the treatment group and the

control group have a common trend before the treatment. If the BRI never existed, there would be no systematic difference in the trend of changes in the bilateral comprehensive trade cost between countries that are in the treatment group and the control group over time.

For the sample that drops all the missing values for total bilateral trade costs, the figure shows that before 2013, the control group and the treatment group have similar patterns. After, the total bilateral trade costs for treatment group decrease more, especially after 2016. The figure of the parallel trend for the sample is shown below.

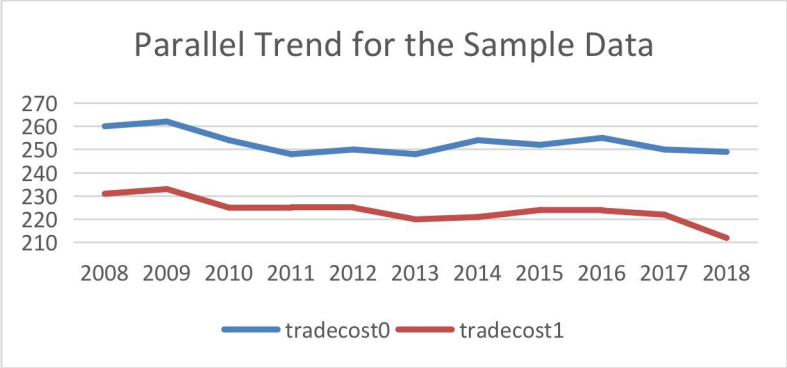

Figure 5: Parallel Trend for the Sample Data of Total Trade Cost

For the full data, it shows similar results as the sample.

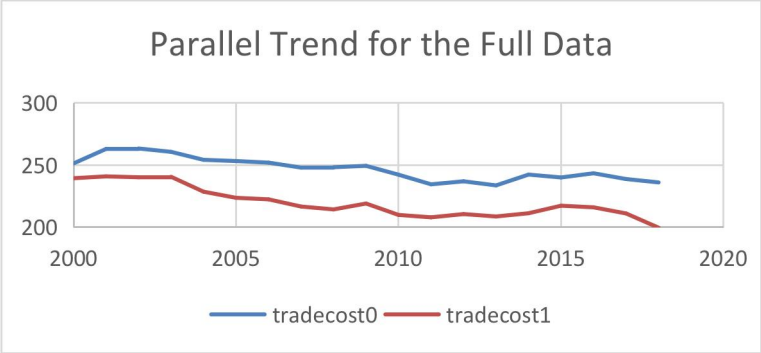

Figure 6:Parallel Trend for the Full Data of Total Trade Cost

where Tradecost0 is the trade cost for the control group, and tradecost1 is the trade cost for the treatment group. From the graph, I would argue that there is a parallel trend for treatment and control group from 2000-2013.

iv. Placebo Test

I randomly assign the BRI treatment to countries as treatment groups by taking the first 5,995 observations and the last 990 observations as treatment groups (a total of 6,985 observations which is similar to the original treatment size) in the sample I constructed. I then construct the false treatment variables to estimate the DID, the estimates of false treatment DID term is 0.32, which is close to 0, and with a P-value of 0.84, statistically insignificant. It shows completely different results from the original results.

I also move the time node to 2010, and assign the false time variables to estimate the DID. The estimates of false treatment DID term is 0.25, which is close to 0, and with a P-value of 0.90, statistically insignificant.

6.2 Interpretation of model results

i. Total Trade Cost Result

For the sample data set, the constant of model result is statistically significant and different from zero. Comprehensive bilateral total trade cost between country pairs in the control group has an additional ad valorem equivalent trade cost of 254.8% compared to countries trading within their country before implementation of the BRI. The coefficient before the BRI (β_1) is -52.61 and statistically significant. Before the BRI, the treatment and the control group had different average bilateral trade cost. The average comprehensive bilateral trade cost for the control group is subject to an additional ad valorem equivalent trade cost of 52.61% compared to the treatment group.The coefficient before post (β_2) is -12.86 and statistically significant. The average comprehensive bilateral trade cost in the control group declines 12.86% post intervention.The bilateral comprehensive trade cost between country pairs that are in the treatment group is 3.76% lower comparing to the bilateral comprehensive trade cost between country pairs that are in the control group.

For the full data set, the results are very similar with the sample results. The comprehensive bilateral total trade costs between country pairs that are in the treatment group is 4.59% lower compared to the bilateral comprehensive trade cost between country pairs that are in the control group.

The sample shows less total comprehensive trade costs reductions. It might be because most missing trade cost country pairs are those smaller and less developed countries with weaker infrastructure to begin with. And the sample is left with larger and more developed countries. Therefore, the result makes sense when adding less

developed countries to the sample, the trade costs would decrease more after the implementation of the BRI. Adding on more infrastructures for smaller countries would influence the trade costs more compared to larger countries that may already have better infrastructures.

ii. Agricultural and Manufacturing Goods Trade Cost Model Results

The magnitudes of both agricultural and manufacturing comprehensive trade costs are larger than the total trade cost. For agriculture goods, the comprehensive bilateral trade cost between country pairs that are in the treatment group is 14.14% lower compared to the comprehensive bilateral trade cost between country pairs that are in the control group. For manufacturing goods, the comprehensive bilateral trade costs between country pairs that are in the treatment group is 5.15% lower compared to the comprehensive bilateral trade cost between country pairs that are in the control group.

Comprehensive bilateral trade costs for agricultural goods decreases relatively more compared to that of manufacturing goods after the implementation of the BRI. This seems plausible since agricultural goods require more care in terms of temperature, handling, and etc along the shipments. And improving speed on the road can greatly decrease the costs.

The results for total, agricultural, and manufacturing goods show that after the implementation of the BRI, the comprehensive bilateral trade cost decreased. In particular, agricultural goods have more decreases compared to manufacturing goods.

The results are in parallel with other research studies that show decreases in trade costs and increases of exports because of reductions in trade cost.

VII. Conclusion

The Difference-in-Difference estimates show that after the implementation of China's Belt and Road Initiative, the comprehensive bilateral trade cost for both agricultural goods and manufacturing goods decreased. And the total comprehensive bilateral trade costs which are defined as the sum of trade costs for agricultural and manufacturing goods also decreased. The total comprehensive bilateral trade costs for the BRI economies is 4.59% lower compared to that of non-BRI economies. The decrease is more for agricultural goods at 14.14%, and the decrease of comprehensive bilateral trade costs for manufacturing goods is 5.15%. The bilateral trade costs reductions for agricultural goods are more than that of manufacturing goods. The results seem plausible since agricultural goods may require additional care in shipments, thus benefiting more from reduction in overall shipment time. The results are also parallel with other research studies that find reductions in trade cost and increases in exports under the BRI.

This paper mainly contributes to the literature in two ways. First, it adds new evidence to the literature on the reduction of trade cost after implementation of the BRI. Secondly, it is a first look to quantify the comprehensive bilateral trade costs reduction in agriculture, manufacturing, and total goods which are the sum of the first two. The paper fills in the gap to consider the all-inclusive bilateral trade costs which do not only consider change in shipment times, but also take into account of other direct and indirect costs such as tariff, differences in language, and reduction in custom procedures.

The results, even if it is not fully up to date, may suggest that the Belt and Road Initiative has rightly targeted at lowering trade costs in the region. New infrastructure projects and trade facilitation policies are still constantly being carried out, as well as old projects that were under implementation may finish later. Lower trade costs seems promising in the future. More research could be done to understand the change since 2018 when my data ends. Understanding how Covid-19 affects the results would be interesting when more data becomes available. At the same time, most of the literature up until now evaluates how trade might be created as a consequence of a reduction in transportation costs estimated only by looking at distance. More research could be done to estimate trade gains with the comprehensive bilateral trade cost reduction analyzed in this paper since distance is not the only element that impacts trade.

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