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The role of the One-Belt One-Road initiative in China's exports and global value chains

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Keywords: *One-Belt One-Road; China; gravity trade models; global value chains*

Abstract

Research background: China is regarded as the "world factor" highly involved in international trade and plays an increasingly important role in the global value chains (GVC). Additionally, the "One-Belt One-Road" (OBOR) initiative was proposed by the Chinese government to further promote China in the international market.
Purpose of the article: The article explores the role of the OBOR in China's exports and global value chain. It aims at: 1) verifying how OBOR impacts the volume of China's export and value-added export to its partners. 2) checking whether or not OBOR strengthens the industrial connection between China and its participants at the GVC level. 3) examining the different roles of corridors in China's exports and GVC.
Methods: The empirical analysis is based on the augmented gravity model of international trade, which comprises China and its 197 partners in the period 2000–2018. The model is estimated for gross export as well GVC measured by domestic value added in export and the value contributed by a partner to China's exports.
Findings & value added: In general, there is a significant positive correlation between OBOR and the volumes of China's export, domestic value-added trade and the value of partner's contributed in China's export. However, some of the results are blurred by OLS and FE methods. The author points out that FE-PPML estimation methods are more adequate. Among the six economic corridors, Bangladesh-China-India-Myanmar (BCIM), China-Pakistan (CP) and China Indochina

Peninsula (CIP) were proven to play a prominent role in promoting China's export, DVA and strengthening the links of global value chains. It is worth noting that the China-Mongolia-Russian Federation (CMRF) corridor harms China's export and DVA trade, and at the same time promotes countries in its region that benefit from trade with China.

Introduction

Since the implementation of "reform and opening-up" in 1978, China has been actively integrating into the national market. Especially after it acceded to the World Trade Organization (WTO), its foreign trade has expanded rapidly. According to the WTO's estimation, its share in the world's export reached 13.2% in 2019, ranking first. However, after the subprime mortgage crisis in 2008, China's economic development changed from high-speed growth to medium high-speed growth (e.g. the GDP growth rate has decreased slowly from 10.636% in 2010 to 5.95% in 2019 based on World Bank Database). In order to cope with the problems of weak economic growth, gradual loss of labour cost advantages and overcapacity, the "One-Belt One-Road" initiative (OBOR) was proposed by the Chinese government in September 2013. OBOR's 65 countries can be divided into six economic corridors: Bangladesh-China-India-Myanmar (BCIM), China-Central West Asia (CCWA), China-Indochina Peninsula (CIP), China-Mongolia-Russian Federation (CMRF), China-Pakistan (CP) and New Eurasian Land Bridge (NELB) (OECD, 2018, pp. 9–12).

On the one hand, OBOR has made remarkable achievements in the field of trade since it was proposed. For example, the value of goods transported by CR express in 2020 reached $50 billion, which is 6.3 times that of 2016, based on a Chinese government report. Also, considering that China is regarded as the "world factor" highly involved in international trade[1], OBOR may impact China's bilateral trade (Yu, L. *et al.*, 2020). On the other hand, OBOR is also a cooperation platform that includes strengthening overseas investment, promoting RMB internationalization[2], and establishing the Asian Infrastructure Investment Bank to promote infrastructure construction and other measures (Huang, 2016, pp. 314–321). Moreover, factor endowments and comparative advantages between China and the countries

[1] China is the largest trading partner of more than 120 countries and regions based on the Chinese government report, and the share of Chinese export in global export is 13.94 % in 2018 based on the UN Comtrade database.

[2] It mainly includes: 1) promoting foreign exchange transactions between RMB and "OBOR" currencies. 2) International settlement of RMB 3) RMB becoming one of the important regional reserve currency. 4) Chinese commercial banks opening overseas branches and expand business.

along the OBOR are different and complementary in some respects, for example Southeast Asian countries have a strong demand for infrastructure construction, but they lack funds. In contrast, China has been the second-largest economy since 2010 and has rich experience in infrastructure construction. Thus, it seems to be a reasonable inference that OBOR affects the global value chain (GVC) (Ge *et al*., 2020). Due to the fact that China plays a vital role in the global trade and production network and OBOR is one of the most crucial foreign cooperation strategies, it seems to be valuable to explore the impact of OBOR on China's trade and GVC, both for China and countries[3] interested in participation or countries which are members of OBOR.

The existing literature on OBOR mainly focuses on trade rather than GVC and uses the limited number of countries and years covered, e.g. Guo *et al*. (2017, pp. 95–102), Ma *et al*. (2017, pp. 41–55), Foo *et al*. (2019), Yu, L. *et al*. (2020), Yu, C. *et al*. (2020). So we expand the analysis of GVC in the empirical part of this paper. The second contribution relates to extension of the research on OBOR, where we take into account its different corridors. Finally, we adopt an advanced gravity analysis model to solve the problems of zero trade, multilateral resistances, endogeneity and others limitation of the data.

The purposes of this study are: (1) examining the impact of OBOR on China's bilateral exports and GVC, (2) analysing and determining which routes (corridors) of OBOR are more important.

For the empirical research method, the authors draw on Yotov *et al*. (2016, pp. 9–54) and estimates the augmented gravity model of international trade, which comprises China and its 197 partners in 2000–2018. The global value chain (GVC) is measured by domestic value added, and the value contributed by a partner to China's exports.

The structure of this paper is as follows. Empirical literature dedicated to China's international trade and OBOR is reviewed in the next section. The third section describes the data together with the research methodology and is followed by the results of empirical analysis and discussion in section 4. Finally, the last section concludes the paper and suggests further research.

[3] OBOR is an open cooperation platform and 205 cooperation documents have been signed by 140 countries and 31 international organizations with China to build OBOR jointly as of 30 January 2021. ("Countries that have signed cooperation documents on co-construction of OBOR with China", 2020) Retrieved from https://www.yidaiyilu.gov.cn/gbjg/gbgk/77073.htm (19.03.2021).

Literature review

To promote economic and trade cooperation with other countries and foreign trade investment of enterprises, China had signed 21 free trade area agreements by the end of 2020.[4] Among them, the ASEAN-China Free Trade Area (ACFTA) has been promoted since 2001, and ASEAN became China's largest trading partner in 2020. Therefore, many studies on the impact of free trade areas on trade focus on this region. As early as three years after the negotiation of ACFTA, Roberts (2004, pp. 335–353) proved for the first time that the gravity model could be well applied to the analysis of trade flows in the areas covered by ACFTA. He also pointed out that the participating countries need to formulate positive strategies to promote the convergence of income levels to obtain maximum benefits of the agreement. Yang and Martinez-Zarzoso (2014, pp. 138–151) then analysed the trade data of four categories of goods from 31 countries between 1995 and 2010. They showed that ACFTA had a significant positive effect on the overall trade and the export of various categories of goods. As a supplement to the final product trade analysis and considering the growth of the proportion of intermediate products, Sheng *et al*. (2014, pp. 2251–2263) verified the positive impact of ACFTA on trade in parts and components. The results also showed that the closer the industrial ties with China, the greater the effect. Besides, Zhang and Wang (2015, pp. 411–420) obtained the trade potential index of China's exports to ASEAN members by introducing new economic scale variables based on industrial added value, intermediate imports and GDP in the gravity equation. The results showed that the new economic scale variables had more advantages, because intermediate products accounted for a higher proportion of trade between China and ASEAN, which was also proved by the unclear result of nominal effective exchange rate of RMB. Based on these literature results, we expect that ACFTA is an important factor affecting Chinese trade and as such should be added to the extended gravity equation.

Since OBOR did not introduce specific provisions (tariff reduction or lifting, rules of origin, certificates of origin, customs procedures and trade facilitation provisions, etc.) like trade agreements in the early stage, it advocated foreign investment (Sauvant & Chen, 2014, pp. 141–163) and established the Asian Infrastructure Investment Bank and the Silk Road Fund (Li & Jin, 2018, pp. 55–70). Some researchers try to analyse its effects from the perspective of investment. For instance, Du and Zhang (2018, pp.

[4] The information was summarized from the China free trade area service network under the Ministry of Commerce. Retrieved from http://fta.mofcom.gov.cn/index.shtml (24.03.2021).

189–205) revealed that after the implementation of OBOR, China's overseas investment, especially cross-border mergers and acquisitions, increased significantly. They pointed out that state-owned controlled assets occupied a significant position in infrastructure, while other purchasers mainly focused on non-infrastructure industries. Then Zhai (2018, pp. 84–92) examined the positive effect of OBOR on general welfare. Additionally, Wen *et al*. (2019, pp. 581–604.) confirmed that the potential four economic corridors of the Sino-EU trade under OBOR have more advantages than the traditional maritime trade routes. Abbas *et al*. (2019) specifically discussed the effect of the China Pakistan Economic Corridor. They found that it positively affects China and its neighbouring countries, especially Pakistan, in terms of employment, income and GDP. Finally, Yang *et al*. (2020) further confirmed that infrastructure investment under OBOR has a positive effect on the economic growth, welfare and foreign trade of most countries. Furthermore, OBOR also promotes China's industrial upgrading.

With the continuous development of OBOR-related projects, many researchers have gradually begun to analyse OBOR's effects on trade. Representative works include Guo *et al*. (2017, pp. 95–102), Ma *et al*. (2017, pp. 41–55), Foo *et al*. (2019), Yu L. *et al*. (2020), Yu C. *et al*. (2020), Liu *et al*. (2020), Kohl (2019, pp. 77–104) and Ge *et al*. (2020).

Guo *et al*. (2017, pp. 95–102) determined the main influencing variables based on the gravity model and compared China's oil import data in 2008-2012 and 2013–2015. They found that the countries along the OBOR gradually became the central source countries after implementing the initiative. Similarly, Ma *et al*. (2017, pp. 41–55) used the GMM method in the gravity model to confirm that OBOR promoted agricultural trade between China and Central Asian countries relying on some specific measures (green channel of agricultural products). Then, Foo *et al*. (2019) introduced two additional variables (total exports to the world and total imports from other countries other than the partner countries) in the gravity model from the level of bilateral trade. The significant positive effect of OBOR on the trade between China and ASEAN countries was verified by them. After that, Yu, L. *et al*. (2020) confirmed again that OBOR could promote China's export potential and showed that it was more prominent in capital intensive products or in the Commonwealth of Independent States (CIS) and South Asian countries. Besides, Yu, C. *et al*. (2020) verified the positive effects of OBOR on bilateral trade preferences between China and its partners and extended their research to different economic corridors of OBOR. Finally, Liu *et al*. (2020) analysed the impact of cultural and institutional distance on trade between countries along OBOR and China and found that these two kinds of distance hinder trade in which cultural difference is more sen-

sitive to the inhibition of trade, and that this effect has been alleviated after the implementation of OBOR. However, the above literature is limited to gross trade and has not discussed OBOR from the global value chain perspective. Moreover, the data of some studies do not cover a wide range of countries, e.g. they are limited to main China's partners in Ma *et al*. (2017, pp. 41–55), Foo *et al*. (2019) and Yu, L. *et al*. (2020).

As far as recent research is concerned, two studies considering GVC can be found. Kohl (2019, pp. 77–104), based on the value-added trade data from 64 countries in 2002–2011, concluded that: 1) OBOR reduces the cost of trade by promoting infrastructure and signing trade agreements, ultimately promoting trade and increasing welfare. 2) Russia and Southeast Asian countries benefit more than European countries under this initiative. Compared with the Regional Comprehensive Economic Partnership (RCEP) and Trans-Pacific Partnership (TPP), it has more influence effect. Ge *et al*. (2020) based their analysis on the global value chain participation index of 43 countries (17 OBOR countries and 26 non-OBOR countries) from 2000 to 2014. They found that the participation in GVC in OBOR countries was low and revealed that regional institutions played an important role in both OBOR and non-OBOR countries. Besides, industries that use intermediate inputs in production sporadically can improve GVC participation by strengthening government action and supervision, political stability, and other measures. However, considering that OBOR was proposed only at the end of 2013, and 2014 is generally regarded as its first year, both studies have limitations as to the sample period. The number of countries involved is not very large.

Overall, we find that with the expansion of the influence of OBOR, more and more researchers began to focus on this field. However, most studies are still limited to trade rather than GVC. In addition, due to the lack of data, the samples covered by the existing literature are limited. Finally, according to Yotov's latest research on the gravity model, we find that the gravity models used in previous papers did not solve data defects well.

Consequently, it is valuable to examine the impact of OBOR on China's international trade by using an advanced gravity model and increasing the number of countries and employing recent data, as well as taking into account both gross trade and GVC.

Research method

Data source and descriptive statistics

The data used in this paper comprises a bilateral trade data set and a global value chain data set.

The sample of bilateral trade data set covers China and its 197 partners from 2000 to 2018. Among the variables utilized in further empirical analysis: data on exports come from WITS; gravity variables[5] were obtained from CEPII; GDP and GDP per capita from the World Bank. The information about participation in ACFTA was obtained from the official ACFTA website, involvement in OBOR is based on OECD (2018, pp. 9–12), and membership in WTO was integrated from WTO website (2000–2015) and CEPII (2016–2018).

Since the 1980s, different processes and links in the production process have been scattered around the world through outsourcing and subcontracting. To adapt to this change, Gereffi *et al*. (2001, pp. 1–8) analysed the distribution of production activities in global space and proposed the global value chain concept based on the global commodity chain (Gereffi & Korzeniewicz, 1994). Global value chain refers to all kinds of value-added activities, such as design, manufacturing, marketing, delivery, consumption, after-sales service, and finally recycling, carried out by different countries or entities from other countries (Heuser & Mattoo, 2017; Kordalska & Olczyk, 2021, pp. 35–52; Cieślik *et al*., 2019, pp. 481–502; Nikulin *et al*., pp. 357–375).

Firstly, from the perspective of value-added trade, we divide China's exports into 16 parts according to the backward link proposed by Wang *et al*. (2013). The data about domestic value-added (DVA), DVA embodied in final exports and DVA in intermediate exports were obtained from the ADB-MRIO2018 database of UIBE GVC Indicators[6]. Then this was merged with gravity variables, GDP, GDP per capita and other variables from the same sources and the first GVC data set was obtained that comprises China and its 60 partners (31 OBOR countries) in 2010–2017.

[5] The gravity variables including contiguity, bilateral distance, colonial relationship, same country before and a common language.

[6] DVA embodied in final exports (DVA_FIN) can be obtained directly, DVA in intermediate exports (DVA_I) can be obtained from DVA in intermediate exports used by the direct importer to produce local final products (DVA_INT) plus DVA in intermediate exports used to produce intermediates that are re-exported to third countries for the production of local final products (DVA_INTrex), and finally DVA_FIN plus DVA_I to obtain DVA.

Then, to explore whether the countries participating in OBOR have closer production ties with China, the value contributed by a partner country in China's total exports was used from the UNCTAD-Eora Global Value Chain Database, merging other variables. The second GVC data set sample covers China and its 177 partners from 2000 to 2018. The summary statistics and detailed descriptions of all variables are shown in Table 1.

Figure 1 presents China's export trends and the growth rate of export. Generally, China's export has grown nearly tenfold from 2000 to 2018. Especially in the ten years after China has acceded to the WTO in 2001, it has maintained a growth rate of more than 17%, except for the time of the subprime mortgage crisis in 2009. However, it is particularly noteworthy that China's exports have shown a medium and low growth rate since 2012, providing a trade background for the proposal of OBOR strategy. Although OBOR was put forward in 2013, China's exports still had negative growth in 2015 and 2016. That also explains why previous researchers did not pay special attention to its trade effect.

To enable a detailed analysis of China's exports, Figure 2 shows the proportion of China's exports to its major trading partners in the total exports. The primary partners are Australia (AUS), Germany (DEU), the United Kingdom (GBR), Hong Kong (HKG), India (IND), Japan (JPN), South Korea (KOR), Malaysia (MYS), Russia (RUS), Singapore (SGP), Thailand (THA) and the United States (USA). Overall, the proportion of these 12 countries decreased from 73.43% in 2000 to 59.53% in 2018 and the United States kept the largest share. For non-OBOR countries, except Australia, it increased from 1.38% to 1.9%, for others it decreased or remained at a similar level from 2000 to 2018. Among them, Japan now has only one-third of its original share in 2000 (a decrease from 16.72% to 5.90%).

On the contrary, we find that the shares of countries along OBOR had nearly doubled except Singapore (a decrease from 2.31% to 2.00%). India's proportion has seen the most significant increase, from 0.63% to 3.08%, i.e. is now almost five times higher.

Figure 3 presents the share of different economic corridors in China's exports. First, the share of OBOR countries in China's exports increased from 12.56% in 2000 to 26.06% in 2018. Combining it with Figure 2, it can also be noted that the countries along the OBOR play an increasingly important role in China's export. As far as economic corridors are concerned, the China-Indochina Peninsula (CIP), which largely overlaps with the ASEAN region, had the largest share of 10.7% in 2018. Additionally, Bangladesh-China-India-Myanmar (BCIM) had the fastest growth (from 1.45% to 4.43%). In contrast, China-Mongolia-Russian Federation (CMRF)

and New Eurasian Land Bridge (NELB) have the smallest share, which is 2.2% and 2.60%, respectively.

Finally, many researchers believe that total exports cannot fully reflect international trade status, especially countries' involvement in global value chains. Figure 4 describes the trend of the domestic value added in China's exports from 2010 to 2017. On the whole, domestic value added is represented by a curve similar to export in Figure 1. Except for negative growth in 2015 and 2016, it achieved stable growth (39.2% compared with 2010). From the perspective of final products and intermediate products, the proportion of DVA embodied in intermediate exports increased from 43.01% in 2010 to 47.05% in 2017, which also reflects the increase of China's participation in GVC.

The gravity model of trade

Considering the broad application of the gravity model in the literature and its outstanding performance in analysing trade flows, an empirical analysis on the basis of the gravity model was conducted also in this study. Based on the previous studies and above-mentioned descriptive statistics on trade and GVC, the following hypotheses can be proposed:

Hypothesis 1: *OBOR plays a positive role in promoting China's international trade.*

Hypothesis 2: *China's domestic value added in export is higher when partners are members of OBOR.*

Hypothesis 3: *A partner will contribute more value to China's total exports when it is a member of OBOR.*

Hypothesis 4: *In the economic corridor of OBOR, some corridors are more critical in China's international trade because of its smooth progress.*

Based on Newton's law of gravity, Tinbergen (1962) and Anderson (1979, pp. 106–116) found that trade between two countries is directly proportional to their economic scale and inversely proportional to their distance. Based on Borchert *et al*. (2020), the general formula can be written as:

$$X_{ij,t} = \frac{E_{j,t}Y_{i,t}}{Y_t}\left(\frac{t_{ij,t}}{P_{j,t}\Pi_{i,t}}\right)^{1-\sigma} \quad (1)$$

where: *i* represents the exporter, *j* is the importer, and t denotes a time subscript. $X_{ij,t}$ is the trade flow from *i* to *j* at time *t*, $Y_{i,t}$ is the value of output in *i* at time *t*, $E_{j,t}$ means the expenditure in *j* at time *t*, $t_{ij,t}$ represents the bilateral trade frictions between *i* and *j* at time *t*, $\Pi_{i,t}$ is outward multilateral resistances, and $P_{j,t}$ is inward multilateral resistances.

Following this formula, the augmented version of the gravity model in the log-log form is estimated:

$$\begin{gathered} lnX_{rp,t} = \alpha + \beta_1 lnGDP_{r,t} + \beta_2 lnGDP_{p,t} + \\ +\beta_3 lnGDPpc_{r,t} + \beta_4 lnGDPpc_{p,t} + \beta_5 lnDist_{rp} + \beta_6 Lang_{rp} + \\ +\beta_7 Contig_{rp} + \beta_8 Colony_{rp} + \beta_9 Smctry_{rp} + \beta_{10} WTO_{rp,t} + \\ +\beta_{11} ACFTA_{rp,t} + \beta_{12} OBOR_{rp,t} + \epsilon_{rp} \end{gathered} \quad (2)$$

where: $\ln X_{rp,t}$ is log of China's exports to partner at time *t* (US$1000); $lnGDP_{r,t}$ and $lnGDP_{p,t}$ are log of China's and partner's GDP (current US$) at time *t*; $lnGDPpc_{r,t}$ and $lnGDPpc_{p,t}$ are log of China's and part-ner's GDP per capita (current US$) at time *t*; $lnDist_{rp}$ is log of distance between China and partner's capitals (km); Langrp is a dummy variable which takes the value of 1 if trading partners share a common or pri-mary language with China, 0 otherwise; Contigrp is a dummy variable which takes the value of 1 if trading partners share a common border with China, 0 otherwise; $Colony_{rp}$ is a dummy variable which takes the value of 1 if trading partners were ever in a colonial relationship with China, 0 otherwise; $Smctry_{rp}$ is a dummy variable which takes the value of 1 if trading partners were united with China in the past, 0 otherwise; $WTO_{rp,t}$ is a dummy variable which takes the value of 1 if all the trad-ing partners and China are members of WTO at time *t*, 0 otherwise; $ACFTA_{rp,t}$ is a dummy variable which takes the value of 1 if all the trad-ing partners and China are members of ACFTA at time t, 0 otherwise; $OBOR_{rp,t}$ is a dummy variable which takes the value of 1 if all the trad-ing partners and China are members of OBOR at time *t*, 0 otherwise.

Estimation of the gravity model can pose some challenges, in order to limit the potential problems, the procedures proposed by Head and Mayer (2014, pp. 131–195) and Yotov *et al.* (2016, pp. 9–54) were strictly followed. First of all, the inward and outward multilateral resistances problem (Relative transaction cost[7]) proposed by Anderson and van Wincoop (2003,

[7] It is determined by weighted average trade cost and the average "resistance" faced by

pp. 170–192) needed to be solved. There are two possibilities to solve this issue. One is to include fixed effects on reporter and partner as recommended by Feenstra (2015). The other is the inclusion of the fixed effect of reporter-time and partner-time as proposed by Olivero and Yotov (2012, pp. 64–92). However, it should be noted that in the study presented in this paper China is a constant reporter, so there is only a need to impose a fixed effect on the partner or partner-year. Secondly, to solve the problem with zero trade flows (Silva & Tenreyro, 2006, pp. 641–658) and heteroscedasticity (Yotov *et al*. 2016, pp. 9–54), it is recommended to use the Poisson Pseudo Maximum Likelihood (PPML) estimator as the regression method. To match the fixed effect and the PPML, Correia *et al*. (2020, pp. 95–115) proposed a new PPML estimator that deals with the zeros while controlling for multiple fixed effects (FE-PPML). In order to limit the impact of macroeconomic background (e.g. economic cycles), time fixed effect should be used in the regressions (Yang & Martinez-Zarzoso, 2014, pp. 138–151). In addition, the standard error will be underestimated if clustering in data with multiple aggregation levels is ignored. Since the distance between capitals is unique for each country pair (a kind of clustering), the errors in the regression analysis need to be clustered (Shepherd, 2016, pp. 17–30). Finally, to solve the endogenous problem of trade policy, Yotov *et al*. (2016, pp. 9–54) suggest imposing a fixed effect on the country pair.

However, the disadvantage of FE-PPML is that the fixed effect will absorb other variables. For example, the pair-fixed set will absorb all bilateral time-invariant covariates. Also, exporter-time and importer-time fixed effects will absorb the size variables and all other observable and unobservable country characteristics which change over time.

Results

Firstly, OLS and FE methods were used to examine the effect of OBOR on China's exports (Table 2). To deal with the influence of macroeconomic background (business cycle) and clustering, the time fixed effect is implemented and the clustering variable distance is added. Besides, considering multilateral resistance and endogenous problems, a fixed effect is used to partner countries in the second OLS analysis. The GDPs of China and its partners show a positive effect on China's exports, while distance hinders exports. China exports more to countries with who it shares a common

the exporter. Among them, weighted average trade cost is the relative difference between 1) their bilateral trade barrier and 2) importer's resistance to import with all regions (Bacchetta *et al*., 2012, pp. 103–120).

language and has a neighbourly or colonial relations with. However, OBOR turns out not to be a statistically significant determinant of trade under these methods.

Next, Table 3 shows the results of using FE-PPML to solve zero trade flow problems (Silva & Tenreyro, 2006, pp. 641–658) and heteroscedasticity (Yotov *et al*., 2016, pp. 9–54). Compared with the unclear results from Table 2, statistically significant positive correlation results are obtained for WTO, ACFTA and OBOR. The effect of OBOR is relatively weak. Specifically, $\beta = 0.287$ means that if a partner country is a participant of OBOR, China's exports to that partner will be higher by 287 US dollars at a significance level of 1% ($\beta \times 1000$, ceteris paribus).

To investigate the relationship between OBOR and domestic value added (DVA) in China's exports, DVA embodied in final exports (DVA_FIN) and DVA embodied in intermediate export (DVA_I) are selected as dependent variables, and the results are summarised in Table 4. Since the database includes only China and its 60 partners (31 OBOR countries) from 2010 to 2017, some of the results of this study do not seem to be very significant. However, OBOR is positively correlated with three types of DVA, while WTO is negatively correlated with them. Based on the analysis of the results of implementing fixed effects on partner countries, it has been found that OBOR has a higher result in DVA_I than DVA and DVA_FIN. The coefficient of 0.233 means that if the partner country is a participant in OBOR, China's DVA embodied in intermediate exports will be 233,000.00 US dollars higher at a significance level of 1%.

For verifying whether OBOR will strengthen China's production ties with participating countries, this study accounts for the impact of OBOR on the value contributed by partner countries in China's total exports (VCp_IN_Er). The logic behind this idea is — the larger the value of this variable, the greater the country's value in intermediate products imported by China. In other words, it means that China's production ties with this country are closer. The most results of Table 5 show that there is a positive correlation between OBOR and VCp_IN_Er. For instance, if coefficient β equals 0.138, it means that if a partner country is a participant of OBOR, it will contribute 138 US dollars more to China's total export at a significance level of 1% ($\beta \times 1000$, ceteris paribus).

Finally, the study explores the importance of different economic corridors shown in Table 6. For gross exports, it is found that BCIM, CIP, and CP are positively correlated with China's exports at a significance level of 1% or 5%. It means that if a country is a member of any of these 3 economic corridors, China will export more to it. Take CP a□a□example; if a cou□try is a CP member, China's exports will be 182 US dollars more. Then, it is

found that BCIM, CCWA and CP have positive effects on DVA and have statistical significance. Similar results are obtained for DVA-FIN and DVA_I. In particular, the results for the CMRF are found to be negative, which means that the domestic value added of China's exports to the economies from the corridor is reduced. In the last part, positive results are obtained in all economic corridors, but only BCIM, CIP and CMRF are significant. Combined with the results of CMRF in exports and domestic value added, it has been found that the countries from this economic corridor will contribute more value to China's exports. However, it is negatively correlated with China's exports and domestic value added of exports. In other words, members of CMRF benefit from their bilateral trade with China. Because of the limitations of value-added data in time and number of countries, CIP has no significant effect on domestic value added, but it is positive. Overall, BCIM, CIP and CP have been found to be more critical for China's international trade.

Discussion

In Table 2, the gravity model's traditional variables (GDP & distance) show consistent results with the conjecture of existing literature (like Tinbergen, 1962; Anderson, 1979, pp. 106–116). Similar to results of Foo *et al*. (2019) considering other additional variables like the common language, neighbourhood and colonial relations are also obtained. After taking the specific regression methods suggested by Yotov, the results in Table 3 are significant. This also shows that the gravity model and the chosen regression method are appropriate here. Although we expand the country and time of our research, we find evidence of a positive impact of OBOR on China's export which is also expressed in Yu C. *et al.* (2020) and Foo *et al.* (2019). For the GVC part, we con-duct the research taking into account two aspects: value added trade and value contributed by partner countries in China's total exports. The results obtained (Table 4 & Table 5) proved the positive impact of OBOR on GVC again, which is consistent with Kohl (2019, pp. 77–104) and Ge *et al.* (2020). Compared with these two articles, we make two contributions in this part: on the one hand, we increase the time period and sample of countries covered. On the other hand, we con-firm that OBOR has a more substantial effect on the added value of intermediate goods exports than the final product export.

The literature review shows that some studies dedicated to OBOR covered only China and a limited number of trading partners. At the same time, we find that the trading countries selected by these studies highly coincide

with some economic corridors in OBOR. (e.g. Abbas *et al*. (2019). They confirmed the positive impact of CP on economic growth and employment; for example, Ma *et al*. (2017, pp. 41–55) proved that OBOR promotes agricultural trade between China and Central Asian countries; Foo *et al.* (2019) obtained positive results of OBOR on ASEAN countries, where it is similarly equal to CIP. Therefore, we consider extending the research on OBOR to its different corridors. The results in this part prove that BCIM, CIP and CP are more critical for China's international trade and GVC, which is in accordance with Abbas *et al*. (2019), Foo *et al.* (2019) and Yu C. *et al.* (2020).

Overall, our contribution is: (1) We take into account the higher number of countries and time covered. (2) We extend the research on OBOR to GVC and its corridors. (3) We employ an advanced gravity model and methodology to solve the data's problems (zero trade, multilateral resistances, endogeneity, heteroscedasticity and others).

Conclusions

This paper explores the impact of the "One-Belt One-Road" initiative on China's international trade and global value chain. Also, considering different construction progress of each economic corridor and its economic scale in OBOR, the analysis is extended to include the economic corridor perspective. China implemented OBOR mainly by setting up the Silk Road Fund and the Asian Infrastructure Investment Bank in the early stage. It has been encouraging Chinese enterprises to strengthen overseas investment and also simultaneously using other measures. Therefore, early studies were more focused on outward investment, welfare, income and employment. With the continuous improvement of infrastructure and new trade routes, researchers became more interested in the impact of OBOR on international trade. The existing research papers mainly focus on bilateral trade, and only few on value-added trade and global value chain or economic corridors. Also, the data used in these few studies often pertain to just a few countries and are outdated. As far as the author knows, there has been no discussion on the impact of OBOR and its economic corridors from the perspectives of bilateral trade and global value chains.

To achieve the goal of this paper, three data sets were integrated. Specifically, data on bilateral trade (China and 197 countries from 2000 to 2018), the value-added data set (China and 60 countries in 2010–2017) and data on value contributed to China’s export (China and 177 countries from 2000 to 2018). According to the statistical analysis and previous literature, an

augmented gravity model is employed as the research method and the following assumptions are made: 1) *OBOR plays a positive role in promoting China's exports, DVA in exports and the value contributed by a participant in China's total export.* 2) *Some corridors are more critical for China's international trade.*

Our results reveal that 1) OBOR has played a positive role in both China's exports and real exports (domestic value added in exports). In addition, joining OBOR will also help to improve the value of a partner's contribution to China's total exports. In other words, OBOR not only promotes China's exports and domestic value-added exports but also strengthens the industrial ties between the Member States and China. However, some results under OLS and FE methods are not robust. In contrast, FE-PPML shows its unique advantages. 2) At the economic corridor level, BCIM, CIP and CP are critical in China's international trade and the global value chain. It is worth noting that CMRF harms China's export and domestic value-added trade and positively affects the value of contribution to China's exports. This shows that countries in the region of CMRF benefit from China's trade exchanges.

The main contribution of the presented study is exploring the impact of OBOR and its different economic corridors on China's exports and its value-added trade from a global perspective. This study is helpful in 1) understanding the extent of the positive effect of OBOR in international trade; 2) clarifying the role of OBOR in deepening the industrial links between China and participating countries; 3) introducing the differences of various economic corridors and pointing out the weak areas for the promotion of OBOR; 4) strengthening the confidence of member countries or countries interested in joining OBOR.

The main limitations of this study are as follows: 1) Although the data of value-added trade has improved compared with other studies, it has limitations in terms of the number of countries and period covered. 2) The study is conducted at the aggregate level without distinguishing different sectors. 3) Although Covid-19 has caused significant damage to the global supply chain and logistics, its impact on China's position in international trade and OBOR promotion has not been estimated in this paper because of the lack of data.

Finally, implications for future research on the issues discussed in the paper can be divided into two aspects: 1) Extending the study to specific industries, between specific countries or regions. 2) Considering that research on trade can also be started from the dimension of bilateral trade variety, it can be verified whether and how OBOR affects export variety between country pairs. 3) Considering China's "Zero Covid" policy helped

China quickly resume production and expand its foreign trade in the initial stage of the epidemic (e.g., based on a China government report, CR Express transported 1.46 million TEUs of goods with an increase of 29% in 2021). Then, with the reopening of countries in the second half of 2021, it is still unknown whether China's "Zero Covid" will weaken China's comparative advantage, hinder foreign trade and accelerate the transfer of the industrial chain.

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Annex

Table 1. Descriptive statistics

Variable	N	Mean	SD	Min	Max
Log of exports of China to partner	3730	12.819	2.904	0.300	19.989
China's domestic value-added embodied in its export to partner (millions of US$)	480	18804.49	38932.53	21.104	3.03e+05
China's domestic value-added embodied in its intermediate export to partner (millions of US$)	480	8584.425	14559.97	8.922	1.06e+05
China's domestic value-added embodied in its final export to partner (millions of US$)	480	10220.06	25288.22	9.017	1.97e+05
The value contributed by a partner country in China's total exports (thousands of US$)	3363	1.19e+06	4.31e+06	3.034	5.79e+07
Log of China's GDP	3731	29.150	0.820	27.823	30.242
Log of partner's GDP	3570	23.786	2.423	16.553	30.654
Log of China's GDP per capita	3731	8.142	0.791	6.866	9.187
Log of partner's GDP per capita	3570	8.415	1.573	4.718	11.685
Log of distance between China and partner's capitals	3731	8.997	0.532	6.696	9.868
$Lang_{rp}$: 1 if trading partners share a common or primary language with China, 0 otherwise	3731	0.020	0.141	0.000	1.000
$Contig_{rp}$: 1 if trading partners share a common border with China, 0 otherwise	3731	0.081	0.274	0.000	1.000
$Colony_{rp}$: 1 trading partners were ever in a colonial relationship with China, 0 otherwise	3731	0.005	0.071	0.000	1.000
$Smctry_{rp}$:1 if trading partners were united with China in the past, 0 otherwise	3731	0.015	0.123	0.000	1.000
WTO: 1 if all the trading partners and China are members of WTO at time t, 0 otherwise	3731	0.709	0.454	0.000	1.000
ACFTA: 1 if all the trading partners and China are members of ACFTA at time t, 0 otherwise	3731	0.046	0.209	0.000	1.000
OBOR: 1 if all the trading partners and China are members of OBOR at time t, 0 otherwise	3731	0.082	0.274	0.000	1.000

Notes: Own estimation based on data sourced from WITS/UN Comtrade, UIBE GVC Database/ ADB-MRIO2018, UNCTAD-Eora Global Value Chain Database, World Bank, CEPII, WTO, OECD business and finance outlook 2018 and the official websites of ASEAN and ACFTA.
Specifically, data on bilateral trade (China and 197 countries from 2000 to 2018), the value-added data set (China and 60 countries in 2010-2017) and data on value contributed to China's export (China and 177 countries from 2000 to 2018).

Table 2. Estimation results of the gravity model for exports, OLS/FE

	lnexport		
	OLS	**OLS**	**FE**
	(1)	**(2)**	**(3)**
$lnGDP_{r,t}$	0.723***	0.839***	0.839***
	[0.098]	[0.085]	[0.082]
$lnGDP_{p,t}$	0.994***	1.308***	1.308***
	[0.045]	[0.283]	[0.276]
$lnGDPpc_{p,t}$	-0.263***	-0.535*	-0.535*
	[0.067]	[0.292]	[0.284]
$lnDist_{rp}$	-0.319	-0.168	
	[0.194]	[0.865]	
$Lang_{rp}$	1.495***	0.931	
	[0.336]	[0.587]	
$Contig_{rp}$	0.256	1.388	
	[0.336]	[1.233]	
$Colony_{rp}$	1.203**		
	[0.495]		
$Smctry_{rp}$	0.871	-0.06	
	[0.568]	[0.627]	
$WTO_{rp,t}$	0.499**	0.014	0.014
	[0.233]	[0.098]	[0.095]
$ACFTA_{rp,t}$	0.549**	-0.251*	-0.251*
	[0.242]	[0.151]	[0.146]
$OBOR_{rp,t}$	-0.186	-0.066	-0.066
	[0.120]	[0.078]	[0.076]
year	yes	yes	yes
Partner effects		yes	
Cluster (Dist)	yes	yes	yes
N	3570	3570	3570
R2	0.84	0.97	0.82

Notes: FE: fixed effects estimations when panel id=Reporter x Partner, * p<0.10, ** p<0.05, *** p<0.01

Table 3. Estimation results of the gravity model for exports, fast Poisson estimation under the high-dimensional fixed effect

	exports				
	(1)	**(2)**	**(3)**	**(4)**	**(5)**
$WTO_{rp,t}$	1.194***	0.044	2.089***	1.194***	0.044
	[0.111]	[0.084]	[0.332]	[0.179]	[0.147]
$ACFTA_{rp,t}$	1.370***	0.323**	0.624*	1.370***	0.323*
	[0.169]	[0.137]	[0.330]	[0.128]	[0.169]
$OBOR_{rp,t}$	0.748***	0.287***	0.195	0.748***	0.287***
	[0.047]	[0.030]	[0.285]	[0.079]	[0.064]
year		yes			yes
Partner effects	yes	yes		yes	yes
Cluster(Rep#Par)			yes	yes	yes
N	3730	3730	3730	3730	3730

Notes: * p<0.10, ** p<0.05, *** p<0.01

Table 4. Estimation results of the gravity model for domestic value added, fast Poisson estimation under the high-dimensional fixed effect

	DVA		**DVA_I**		**DVA_FIN**	
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
$WTO_{rp,t}$	-0.058	-0.162*	-0.004	-0.098	-0.04	-0.147
	[0.110]	[0.096]	[0.131]	[0.096]	[0.103]	[0.104]
$OBOR_{rp,t}$	0.173***	0.055	0.233***	0.06	0.099*	0.025
	[0.040]	[0.066]	[0.039]	[0.079]	[0.052]	[0.069]
year		yes		yes		yes
Partner effects	yes	yes	yes	yes	yes	yes
Cluster(Rep#Par)		yes		yes		yes
N	480	480	480	480	480	480

Notes: * p<0.10, ** p<0.05, *** p<0.01

Table 5. Estimation results of the gravity model for the value contributed by a partner country in China's total exports, fast Poisson estimation under the high-dimensional fixed effect

	$VC_p\_IN\_E_r$				
	(1)	**(2)**	**(3)**	**(4)**	**(5)**
$WTO_{rp,t}$	1.064***	0.074	1.981***	1.064***	0.074
	[0.101]	[0.049]	[0.388]	[0.126]	[0.056]
$ACFTA_{rp,t}$	1.401***	0.344***	0.705*	1.401***	0.344***
	[0.179]	[0.090]	[0.375]	[0.085]	[0.117]
$OBOR_{rp,t}$	0.420***	0.138***	-0.201	0.420***	0.138***
	[0.051]	[0.021]	[0.281]	[0.072]	[0.044]
year		yes			yes
Partner effects	yes	yes		yes	yes
Cluster(Rep#Par)			yes	yes	yes
N	3363	3363	3363	3363	3363

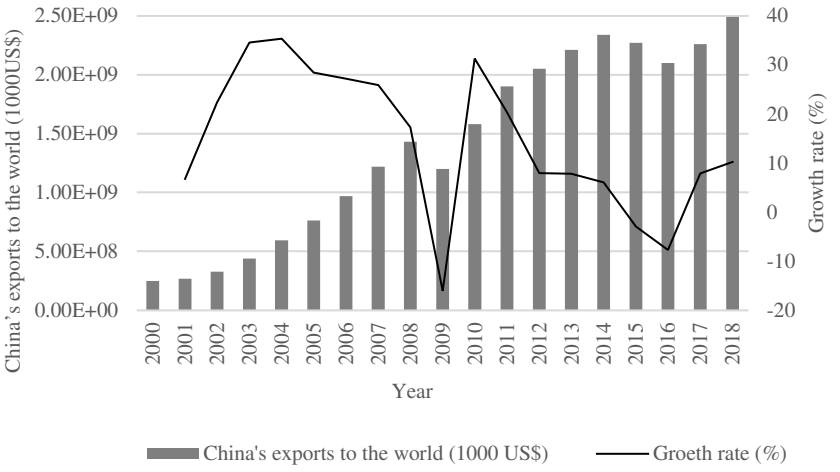
Notes: * p<0.10, ** p<0.05, *** p<0.01

Table 6. Estimation results of the gravity model, various economic corridors among independent variables, fast Poisson estimation under the high-dimensional fixed effect

	exports	**DVA**	**DVA_I**	**DVA_F**	$VC_p\_IN\_E_r$
	(1)	**(2)**	**(3)**	**(4)**	**(5)**
$BCIM_{rp,t}$	0.372***	0.072*	0.051	0.081	0.207***
	[0.067]	[0.037]	[0.042]	[0.053]	[0.040]
$CCWA_{rp,t}$	0.131	0.101**	0.112**	0.089**	0.061
	[0.085]	[0.046]	[0.056]	[0.045]	[0.054]
$CIP_{rp,t}$	0.374***	0.16	0.13	0.149	0.088*
	[0.145]	[0.125]	[0.144]	[0.101]	[0.046]
$CMRF_{rp,t}$	-0.178	-0.198***	-0.207***	-0.169**	0.155***
	[0.117]	[0.067]	[0.076]	[0.067]	[0.058]
$CP_{rp,t}$	0.182**	0.294***	0.186***	0.395***	0.056
	[0.092]	[0.024]	[0.039]	[0.019]	[0.045]
$NELB_{rp,t}$	-0.048	-0.064	-0.04	-0.122	0.063
	[0.149]	[0.129]	[0.065]	[0.229]	[0.042]
year	yes	yes	yes	yes	yes
Partner effects	yes	yes	yes	yes	yes
Cluster(Rep#Par)	yes	yes	yes	yes	yes
N	3730	480	480	480	3363

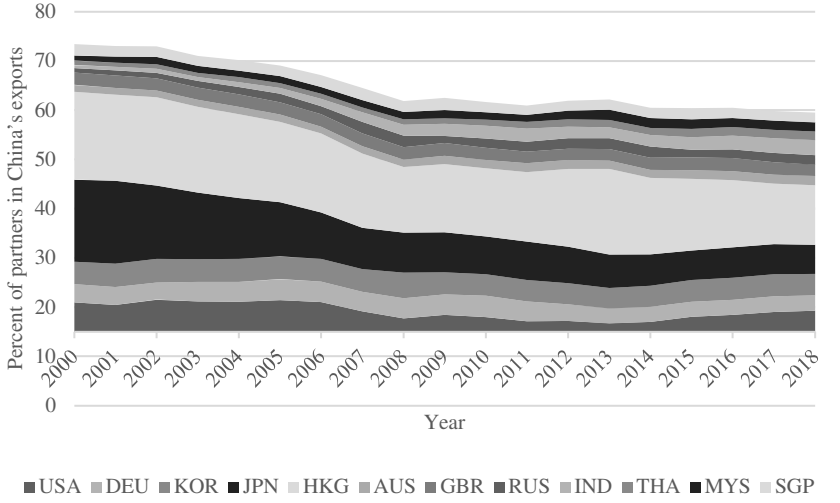
Notes: This table is a summary of the parameters of each economic corridor from different regressions, where corridors are not included simultaneously but one by one. The additional variables include WTO and ACFTA, not included in the table due to space constraints. * p<0.10, ** p<0.05, *** p<0.01

Figure 1. The trend and growth rate of China's exports to the world



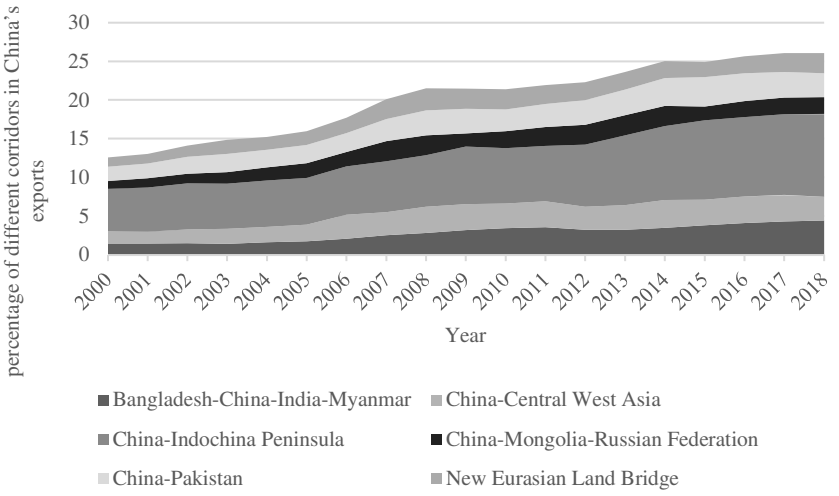
Source: own elaboration based on data from the UN Comtrade database extracted through WITS.

Figure 2. The proportion of major trading countries in China's total exports



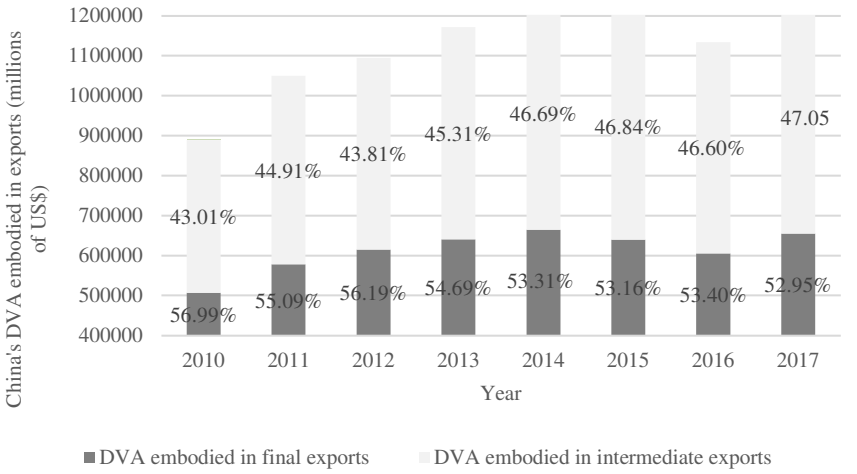
Source: own elaboration based on data from the UN Comtrade database extracted through WITS.

Figure 3. The proportion of OBOR's different economic corridors in China's total exports



Source: own elaboration based on data from the UN Comtrade database extracted through WITS.

Figure 4. The trend of China's domestic value added



Note: The initial value of the ordinate is 400 (billions of US $)

Source: own elaboration based on data from the ADB-MRIO2018 database of UIBE GVC Indicators.