CHINESE PORT INVESTMENTS AND THEIR EFFECTS ON BILATERAL TRADE

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Abstract: Although the Belt and Road Initiative (BRI) was announced by the People's Republic of China in 2013, its foundation has been under development for over 15 years. The Go Out Policy, officially introduced in 1999, paved the way for relationships that would later become the BRI. The initiative has two primary components: the Silk Road Economic Belt (SREB) and the 21st Century Maritime Silk Road (MSR). We examine completed port projects and an extended MSR, composed of all ports that are owned or operated by Chinese firms, to determine the effect of these institutional arrangements using a structural gravity model. Although both port contracts and completed port projects have a recognisable influence on bilateral trade with China, the agreements do not have the same persistent effects on trade flows. We find that the operation of foreign port terminals by Chinese SAEs modifies trade for host countries towards China, such that trade is diverted away from alternative trade partners.

Keywords: Bilateral Trade, Maritime Trade, Ports, Belt and Road Initiative (BRI), China, Gravity Model.

INTRODUCTION

The Belt and Road Initiative (BRI) comprises two parts: the Silk Road Economic Belt (SREB) and the 21st-Century Maritime Silk Road (MSR). The Chinese government has communicated that their aim for these projects is to promote the connectivity of continents and their adjacent seas, establish and strengthen partnerships among the countries, set up multi-tiered and composite connectivity networks, and realise diversified, independent, balanced, and sustainable development (Chinese Ministry of Foreign Affairs, 2017). Additional claims include the capacity to enhance cultural exchanges

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and mutual learning among the peoples of relevant countries. In addition to these features, the MSR has also been sold domestically as an initiative that will help to ensure the security of transport via sea routes (Fallon, 2015; Swaine, 2015). Although this project cannot demonstrate the validity of these claims, it does provide evidence of changes to world trade flows as a result of these agreements.

In this paper, we analyse the effects of completed infrastructure projects and varying port contracts on exports, imports, and total trade volumes with China, other network members, and the Rest of the World (RoW). Specifically, we concentrate on an extended MSR (which includes non-memorandum countries where Chinese SAEs own ports or have terminal contracts) and variations in levels of control. The analysis has been developed to determine whether China's growing influence over ports is recognisable in the trade flows of host economies. We also identify how this growing influence of ports affects global trade with China. In particular, we implement a newly developed bilateral dataset (BLOCS) to separately identify the effects of port acquisitions and operating agreements on bilateral trade using four measures of trade (Wu et al., 2022). Controlling for country-specific unobservables, we find large positive effects of the Chinese SAE port operation on bilateral trade with China. Estimates also suggest operating port terminals may also improve the strategic position of China in these trade relationships by diverting trade from other trade partners.

This paper contributes to the literature on trade regimes and trade costs by identifying the economic effects of China's growing influence over ports on bilateral trade flows. We do this by separately identifying whether ownership, terminal operating contracts, and infrastructure projects are different in terms of their global trade effects. The model is specified with respect to varying degrees of port control to estimate the effects of assumed reductions in transportation and other transaction costs on bilateral trade before and after such investment is made. Using a structural gravity model and incorporating a new and unique database, we find that the varying degrees of port control have different outcomes with respect to bilateral trade with China and that completed port projects, as defined below, temporarily increase trade with the RoW.

Our project employs a novel dataset of 60 port contracts and infrastructure project investments to estimate the effects of these interventions on bilateral trade flows over a 20-year period using four

measures of trade for robustness. The database also contains comprehensive observations on trade between all partners during the period of analysis (1999-2019). We separately identify the effects of a preferential trade agreement and the extended MSR trade network to evaluate similarities and test for interdependencies. We then separately identify the effects of terminal operating contracts and infrastructure investment to investigate their differences and look for evidence of their complementary nature.

RESEARCH DESIGN

The research design is an applied analysis of the assumed effects of reduced trade costs that controls for various prior estimation biases associated with gravity models. The contemporary structural gravity model accounts for prior estimation challenges and is underpinned by the fundamentals of international trade theory (e.g., Yotov (2022) for a more complete overview). With respect to the BRI, there have only been a few examples of empirical investigations using gravity models. To complement and contribute to this literature, we apply a structural gravity model to better understand the effects of this maritime trade network and how it might increase or decrease trade with China as well as with other trade partners.

We therefore hypothesise that port terminal contracts indirectly reduce trade costs between China and its trade partners when their international ports have operating agreements with CSAEs. The assumption is that the transaction costs of trade diminish when operating a foreign port terminal in such a manner that it increases trade with the operator. Further research is necessary to identify the specific mechanisms of transmission; however, whether the agreements result in trade creation or diversion is identifiable in our empirical analysis. We also expected investment in port infrastructure to reduce more traditional trade costs, as defined in the micro-economic literature, and that these differences would be reflected in trade with other members and the RoW. The evidence for this is not convincing.

Motivation

With respect to this paper, focus has been placed on the interpretation of transaction costs as the hard costs that expand productive capabilities

rather than assumptions about human behaviour. The behaviour of the Chinese government is framed as an actor with incentives to reduce costs of contract development, management, and enforcement along preferred shipping routes. The assumption is that Chinese SAEs are indirectly reducing costs for domestic producers of all kinds amid increasing export competition and are less interested in reducing costs for their trade partners via technology transfer. Given these assumptions, it would be surprising if the extended MSR did not lead to more cross-border transactions between China and their host countries as the amount of control increased.

Baniya et al. (2019) use a gravity model to estimate the improvement in bilateral time savings on trade patterns. They find that the potential effects of reducing trade times along the BRI are large, increasing trade flows between participating countries between 2.8 percent and 11 percent. They also find that deeper trade agreements would magnify this impact and result in an increase in total exports of around 12 percent. This result highlights the potential complementary nature of trade cooperation and infrastructure cooperation.

Kohl (2019) uses the structural gravity approach to compare the impact of infrastructure investment in the BRI to that of FTA formation on supply-chain trade. The author identifies asymmetric benefits from infrastructure development; however, he estimates larger reductions in trade costs from the BRI when compared to the creation of traditional FTAs. More recently, Saeed et al. (2021) have used a gravity model to examine the potential effects of Chinese maritime networks on bilateral trade movements. Using 128 trading partners, they show that maritime network connectivity brought about by the BRI reduces the number of required transshipments, which enhances efficiency, thus reducing trade costs for the member countries. The research design has been developed to identify whether these trade cost reductions can be observed in both short-run and long-run changes to bilateral trade flows with China, other members of the maritime network, and the RoW.

METHODOLOGY

The identification strategy estimates the effects of varying institutional conditions between Chinese SAEs and large international ports on in- and out-

of-network trade flows. Our expectation is that the network of port contracts and infrastructure projects is insufficient as a replacement for broader and deeper institutional collaboration and that the effects of the extended MSR will favour Chinese interests. An increase in trade throughput in countries with a greater saturation of network partners would be evidence that trade costs were somehow reduced. The network is assessed in the standard Vinerian sense of a policy instrument capable of generating trade creation or trade diversion (Krugman et al., 2022; Viner, 1950). Our hypothesis is that the effects of membership in this trade network will differ from the effects of membership in a preferential trade agreement and, moreover, that the predicted effects will vary depending on the nature of the contractual agreement. In addition, the characteristics of trade agreements matter (Wu, 2006).

The type of contract and level of institutional control are also predicted to be a determinative factor in whether being a member of the trade network leads to trade creation or diversion. As the level of control increases, the resulting reduction in the transaction costs of doing business with Chinese firms should lead to an increase in trade with China, whereas investments in port construction should increase trade with the RoW. Using the structural gravity model as a foundation for analysis controls for size and distance between trading pairs while providing reliable estimates on the effect of policy changes. The flexible structure allows for the integration of BLOCS data to estimate the predicted effects of Chinese SAE port contracts and completed infrastructure development projects on bilateral trade between members of the extended MSR, with China, and with the RoW.

Data

The agreements are first divided into two categories: 1) port contracts; and 2) port projects. These are not mutually exclusive categories, as many operating agreements include construction projects and Chinese SAEs can own and operate the same port; however, each country has its own unique constellation of contracts and construction agreements. This paper then identifies three types of Chinese SAE port contracts, with increasing magnitudes of control: 1) ownership (partial ownership of the port itself); 2) partial operation (partial ownership of a company or companies that have acquired terminal operating agreements in the country); and 3) all terminals

(partial ownership of a company or companies that operate all terminals in a host country). According to the research design, ownership and operating agreements are considered forms of controlling interest, whereas port projects are considered infrastructure investments. This distinction makes it possible to separately identify the effect of an infrastructure project and compare it to that of controlling interest. Additionally, it makes it possible to investigate whether there are complementary effects.

An infrastructure project dummy, indicating the year a port project (MSR_pro_{ij}) was developed, and the logged value of investment (MSR_inv_{ij}) are used to determine if infrastructure projects have a measurable effect on bilateral trade flows with China and whether or not the size of that project matters. Both lead and lagged variables were generated to check for reverse causality as well as anticipatory and long-run effects.

This study employs bilateral observations that begin in 1999 and end in 2019. As recommended by Yotov et al. (2016), the 20-year period was lagged to analyse bilateral country pairs in non-consecutive years. The BLOCS database provided exports (FOB) and imports (CIF) from the Direction of Trade Statistics (DOTS) data as well as aggregate trade data from both the World Trade Flows (WTF) and Bilateral Product Trade Flows (BACI) databases. Traditional Gravity Characteristics data from CEPII were also included in robustness checks that estimate less constrained models (Wu et al., 2022). The Preferential Trade Agreement (PTA) dummy from Mario Larch's Regional Trade Agreements Database (Egger and Larch, 2008) was introduced to separately identify and control for the joint effects of port influence and membership in PTA. Using four measures of international trade for the analysis provides contextual analysis on relationships with imports, exports, and total trade between pairs. Employing both the WTF and BACI estimates of total trade offers an additional level of robustness to the findings.

Model

A generic structural gravity model has been modified to assess the effects of port influence on trade. In this model, $X_{ij,t}$ denotes nominal trade flows at non-consecutive year t; the term $\pi_{i,t}$ denotes the set of time-varying source-country dummies; $X_{j,t}$ denotes the set of destination-country dummies; and

μ_{ij} denotes the set of country-pair fixed effects. These variables control for outward resistances, inward resistances, and unobservables.

$$X_{ij,t} = exp\ [\pi_{i,t} + \chi_{j,t} + \mu_{ij} + \beta_1 MSR\_n_{ij,t}] \times \varepsilon_{ij,t} \quad (1)$$

In this specification, all internal trade costs are set to one, and all international fixed effects (μ_{ij}, $j \neq i$) are estimated relative to the intra-national fixed effect (μ_{ij}) (Anderson and van Wincoop, 2003; Yotov et al., 2022). The specification is estimated using a pseudo-poisson maximum likelihood (PPML) estimator and uses country-pair fixed effects to absorb trade costs. The coefficient β_1 identifies the predicted effects of varying Chinese port contracts and completed infrastructure projects on trade with China, partners in the trade network, and the RoW by changing the sample of trade partners.

To determine whether the observed effects complement existing trade agreements and to account for the partial effects of such agreements on total trade, we separately identify their effects and estimate whether they are jointly significant. We also estimate the total and partial effects of port control and a completed port project. This is denoted by the interaction between β_1 MSR_n_{ij} and β_1 MSR_m_{ij} in equation 3.

$$X_{ij,t} = exp\ [\pi_{i,t} + \chi_{j,t} + \mu_{ij} + \beta_1 MSR\_n_{ij,t} + \beta_2 PTA_{ij,t} + \beta_3\ (MSR\_n_{ij,t} * PTA_{ij,t})] \times \varepsilon_{ij,t} \quad (2)$$

$$X_{ij,t} = exp\ [\pi_{i,t} + \chi_{j,t} + \mu_{ij} + \beta_1 MSR\_n_{ij,t} + \beta_2 MSR\_m_{ij,t} + \beta_3\ (MSR\_n_{ij,t} * MSR\_m_{ij,t})] \times \varepsilon_{ij,t} \quad (3)$$

The robustness of these results is then tested with lead and lagged variables to account for the possibility of reverse causality as well as anticipatory, long-run, and non-linear effects. If port control or investment is exogenous to trade flows in the years prior to the agreement, β_1 and β_2 will be insignificant in equation 4, or otherwise signify a pre-existing relationship.

$$X_{ij,t} = exp\ [\pi_{i,t} + \chi_{j,t} + \mu_{ij} + \beta_1 MSR_{ij,t} + \beta_2 MSR_{ij,t+4} + \beta_3 MSR_{ij,t+6}] \times \varepsilon_{ij,t} \quad (4)$$

To control for non-linear effects and identify whether these effects remain significant in the long run, lagged variables are included on non-consecutive years up to 12 years (see equation 5). A linear combination of the coefficients is then estimated and tested for significance to predict the overall total effect

of Chinese port control during the period of analysis while controlling for other unobservables.

$$X_{ij,t} = exp\,[\pi_{i,t} + \chi_{j,t} + \mu_{ij} + \beta_1 MSR_{ij,t} + \beta_2 MSR_{ij,t-4} + \beta_3 MSR_{ij,t-6} + \beta_6 MSR_{ij,t-12}] \times \varepsilon_{ij,t} \quad (5)$$

Did Chinese SAEs target partners that already had higher trade volumes with China? Or were projects completed at ports where Chinese firms were already doing a lot of business? Using this procedure properly accounts for possible reverse causality between existing trade with China to assess the exogeneity of project contracts or completed projects. Are there non-linear effects? Or do the effects change over time? The lagged variable experiment can identify non-monotonic relationships and phasing-in effects, and the linear combination of estimates can assess whether the overall effect is persistent and significant.

RESULTS AND DISCUSSION

Our research indicates that investment projects, property acquisitions, and operating agreements for port terminals by Chinese SAEs are not equivalent events. This indicates that not all participation in the trade network is created equal. As the level of control increases, as shown by contractual agreements, trade increases with China and away from the RoW (including other members of the trade network). This differs from the effects of completed port projects, where, as the level of investment increases, so does trade with the rest of the world (excluding other members of the trade network) and with China (at least temporarily). Thus, the level of investment and institutional cooperation negotiated by China within the MSR and its network make a difference in bilateral trade between partners.

Comparing Trade Agreements to Trade Networks

Do countries along the MSR trade network with port contracts trade more among themselves in the same way members of a trade agreement do when total economic costs are reduced? The short answer is no; we find that a port contract does not predict an increase in trade between other members of the network. Table 1.A indicates that there are no increases in trade between network partners that have ownership or operating contracts with Chinese

SAEs; this implies that there is no significant reduction in costs between these partners. Next, Table 2.B answers the question of whether or not overall trade increases for members with port contracts. There is no measurable effect on overall trade for members of the trade network, regardless of whether or not China is included in the estimation.

Table 1- Trade Between Countries with Port Contract and Trade with China[1]

Trade among PTA Members and Trade between Countries with Port Contracts								**(1.A)**
	EXPORTS DOTS	**IMPORTS DOTS**	**WTF TRADE**	**BACI TRADE**	**EXPORTS DOTS**	**IMPORTS DOTS**	**WTF TRADE**	**BACI TRADE**
PTA Dummy	0.064**	0.063*	0.046	0.057**				
MSR Dummy					-0.009	-0.021	-0.020	0.014
All Trade after Signing a Port Contract (Including and Excluding China)								**(1.B)**
MSR All Trade	0.015	0.032	-0.004	0.020				
All No China					-0.024	-0.005	-0.020	-0.031
All Trade after Completing a Port Project (Including and Excluding China)								**(1.C)**
Project All Trade	0.058	0.124***	0.078**	0.120*				
All No China					0.018	0.035	0.031	-0.061
Trade with China among Countries with Completed Port Projects								**(1.D)**
Project Only China	0.009	0.026	-0.003	0.103**				
Log Investment					-0.003	0.005	-0.002	0.014*

[1] Tables 1-4 report the "Total Effect" as a linear combination of estimates from lagged dummies over a 12-year period. The lag and lead variables are created from the variables of interest in bold. Each sub-table (A – E) represents a single experiment that compares two unique specifications. All models are specified using a PPML estimator, and estimations are generated with export and import data from DOTS and total trade data from WTF and BACI. Results are not estimated in consideration of intra-national trade effects as domestic trade data is not available for all countries during the period of analysis. This implies there may be a slight upward bias in the estimations due to globalisation.

Trade with China after Completing a Port Project (Log Investment in Millions)								(1.E)
Log Investment	0.003	0.017	0.004	0.033***	-0.000	0.008	-0.002	0.016**
INV_LEAD.4	0.004	0.008*	0.006	0.017**				
INV_LEAD.6	0.009	0.019***	0.009	0.029***				
INV_LAG.4					-0.012	-0.011	0.000	-0.016*
INV_LAG.6					0.000	0.000	0.000	0.000
INV_LAG.8					0.000	0.000	0.000	0.000
INV_LAG.10					0.000	0.000	0.000	0.000
INV_LAG.12					0.000	0.000	0.000	0.000
Total Effect	-	-	-	-	-0.012	-0.003	-0.002	0.001
Rmse	0.238	0.244	0.242	0.285	0.238	0.245	0.242	0.285
N	232702	260392	238918	207563	232702	260392	238918	207563

** p < 0.10, ** p < 0.05, *** p < 0.01*

Tables 1.C–-1.E show the expected effects of a completed infrastructure project on trade with all countries and on trade with China, using dummies in the year of completion. The lagged model then estimates the expected increase in total trade with China using the log of investment in millions. Results of the lead and lag analysis suggest that the increases in trade with China may be due to project requirements rather than a reduction in trade costs, as the effects are significant prior to completion and turn negative four years after completion. The linear combination of estimates is insignificant, meaning there is little evidence of persistence, and the marginal increase in trade from project investment does not continue after the project is completed. This is an unexpected result, as gains from trade are considered to be a primary motivation for large maritime infrastructure projects. Despite this unfavourable outcome, there is evidence of temporary increases in total trade during the time of construction, and this has the potential to generate a positive economic shock in host economies.

Comparing Varying Levels of Control

Table 2.A illustrates that operating control of a port terminal is significant while controlling interest in the port itself is not. This is an indication that trade cost reduction is being facilitated by operational control rather than the control of operating costs by port owners. The results of Table 2.A indicate that the expected effect of an agreement that gives controlling interest to a Chinese SAE is an increase in total trade with China of about 21% and that exports to China are expected to increase at a greater rate than imports. Table 2.B indicates that indeed, controlling interest in all port operations is likely to be more significant and result in higher levels of trade with China.

Table 2- Trade with China after Ownership and Operating Agreements

Trade with China after Ownership Contract and Terminal Operation Contract								**(2.A)**
	EXPORTS DOTS	IMPORTS DOTS	WTF TRADE	BACI TRADE	EXPORTS DOTS	IMPORTS DOTS	WTF TRADE	BACI TRADE
Ownership	0.019	0.041	0.030	0.038				
Operation					0.176***	0.113**	0.053	0.194***
Trade with China after Terminal Operation Contract (Partial and All Terminals)								**(2.B)**
Partial Operation	0.119**	0.029	0.009	0.131**				
All Terminals					0.223***	0.198***	0.128***	0.195***
Trade with China after Signing a Terminal Operating Contract								**(2.C)**
Partial Operation	0.131***	0.042	0.021	0.129**	0.119***	0.056	0.032	0.091
PART_LEAD.4	0.047**	0.054***	0.020	-0.031				
PART_LEAD.6	0.017	0.025	0.049	0.008				
PART_LAG.4					0.038	-0.008	-0.002	0.096
PART_LAG.6					-0.029	0.001	-0.039	0.003
PART_LAG.8					-0.017	-0.054**	-0.030	-0.037
PART_LAG.10					-0.022	-0.025	-0.021	0.002
PART_LAG.12					-0.045	-0.066	-0.090	-0.026
Total Effect					0.043	-0.096	-0.150	0.130

Trade with China after a Terminal Operating Contract in All Terminals (2.D)

All Terminals	0.247***	0.241***	0.171***	0.226***	0.221***	0.198***	0.129***	0.198***
ALL_LEAD.4	0.112**	0.094***	0.120***	0.097***				
ALL_LEAD.6	-0.037	0.033	0.027	-0.000				
ALL_LAG.4					0.074*	0.019	-0.021	-0.012
ALL_LAG.6					-0.048	-0.020	0.005	-0.054
ALL_LAG.8					0.124***	0.020	0.063**	0.101***
ALL_LAG.10					0.068**	0.059*	0.068*	0.057*
ALL_LAG.12					0.126	0.034	-0.014	0.007
Total Effect	-	-	-	-	0.566***	0.311***	0.230*	0.298**
Rmse	0.238	0.244	0.242	0.285	0.238	0.245	0.242	0.285
N	232702	260392	238918	207563	232702	260392	238918	207563

** p < 0.10, ** p < 0.05, *** p < 0.01*

Both exports and imports to and from China will increase after a contract has been signed, although the total effect on exports to China is expected to be much higher during the period of analysis—76% for exports compared to 36% for imports (Table 2.D). This implies that Chinese firms bring in more goods than they send to the host countries after the operating agreements are signed and is evidence that a large extent of the cost savings will be experienced by the Chinese.

Table 2.D reports the estimated effects of having all port terminals operated by firms in which a Chinese SAE has a controlling interest. The absence of significance six years prior indicates that the contracts were exogenous to existing trade flows prior to the commencement of contract negotiations. This phasing in analysis offers details into the lead time on agreements. In the case of all terminal controls, the total effect on bilateral trade is positive and significant. The similarity in coefficients between the unlabeled estimates implies that the findings are robust.

Comparing Port Contracts to Port Projects

What happens to trade with countries that are not China or other countries that are also within the trade network? Although pricing data would be necessary to confirm whether China was shifting trade away from low-cost providers, we can assess in-network trade flows and trade with the RoW to get an idea of how being a part of the trade network is affecting trade with other partners. As reported in Table 1, trade among members with port contracts, *including* China, is unaffected, and the same is true overall for trade for host countries, whereas port projects significantly increase all trade, *including* China, but not when China is *excluded*. Restricting the analysis to investigate the effects of being a part of the tradework, excluding China, provides a clearer picture of how port contracts and port projects affect trade between the network members.

Table 3- Trade with Between Network Partners

Trade between Countries with Port Contracts or Completed Projects (Excluding China) (3.A)								
	EXPORTS DOTS	IMPORTS DOTS	WTF TRADE	BACI TRADE	EXPORTS DOTS	IMPORTS DOTS	WTF TRADE	BACI TRADE
MSR No China	-0.057***	-0.067***	-0.042**	-0.050*				
Project No China					-0.081**	-0.112***	-0.063**	-0.037
Trade between Countries with Port Contracts (Excluding China)								**(3.4.B)**
MSR No China	-0.076***	-0.070***	-0.050**	-0.053	-0.055***	-0.057***	-0.039**	-0.051*
noCN_LEAD.4	-0.023	-0.042***	-0.032**	-0.044*				
noCN_LEAD.6	-0.026	-0.030*	-0.016	-0.024				
noCN_LAG.4					-0.016	-0.023	-0.028	-0.011
noCN_LAG.6					-0.016	-0.044***	0.009	-0.017
noCN_LAG.8					0.001	0.025*	0.001	-0.009
noCN_LAG.10					-0.022	-0.025*	-0.008	-0.051**
noCN_LAG.12					-0.018	0.000	-0.031	0.007
Total Effect	-	-	-	-	-0.127***	-0.123***	-0.095*	-0.13**

Trade between Countries with Completed Port Projects (Excluding China) (3.4.C)

Project No China	0.111***	0.074*	0.062	0.060	-0.087***	-0.113***	-0.076***	-0.074**
noCN_LEAD.4	-0.053**	-0.079***	-0.065***	-0.031				
noCN_LEAD.6	-0.049*	-0.035	-0.051**	-0.070**				
noCN_LAG.4					0.009	-0.009	0.186***	0.222***
noCN_LAG.6					0.120**	0.128***	-0.032	-0.092
noCN_LAG.8					-0.091**	-0.084*	-0.068	-0.110**
noCN_LAG.10					0.035	0.037	0.000	-0.020
noCN_LAG.12					0.000	0.000	0.000	0.000
Total Effect	-	-	-	-	-0.015	-0.041	0.009	-0.074
Rmse	0.238	0.244	0.242	0.285	0.238	0.245	0.242	0.285
N	232702	260392	238918	207563	232702	260392	238918	207563

** p < 0.10, ** p < 0.05, *** p < 0.01*

Although the results for port projects are also somewhat unreliable, they offer more evidence that gains from trade may be related to project requirements. The negative sign on the lead variables can be interpreted as low trade between network partners prior to completing the project, with a sudden burst of activity in the years surrounding the completion of the project. There are positive effects among trade partners in the 4 years after completion, but they eventually turn negative, and the total effects are insignificant. This is further evidence that the trade created from the port projects was temporary in nature during the period of this analysis.

The final step in this procedure is to estimate the effects of a port contract and project contract on trade with the RoW. A member of the MSR trade network that allows Chinese SAEs to operate terminals in all of its ports is expected to see a 19% ([exp(0.175)- 1] × 100) reduction of its exports to the rest of the world over the 12-year period (see Table 4). On the contrary, there are no significant long-term effects of completed infrastructure projects. This is further evidence that Chinese trade thus increases at the expense of trade

diversion; additionally, the magnitude of exports being higher and more consistently significant means that these effects are being driven more by China buying than by China selling.

Table 4 – Trade with Rest of World Excluding China

Trade with the RoW (Excluding China) after All Terminals Contract and Port Project (3.5.A)								
	EXPORTS DOTS	IMPORTS DOTS	WTF TRADE	BACI TRADE	EXPORTS DOTS	IMPORTS DOTS	WTF TRADE	BACI TRADE
All Terminals RoW	-0.110***	-0.131***	-0.082***	-0.080**				
Project RoW			0.050**	0.074***	0.050**	-0.013		
Trade with RoW (Excluding China) after and Before a Port Contract (3.5.B)								
All Terminals RoW	-0.079	-0.097**	-0.089**	0.000	-0.106***	-0.134***	-0.084***	-0.091**
RoW_LEAD.4	-0.079***	-0.024	-0.065**	-0.054*				
RoW_LEAD.6	0.054	-0.028	-0.017	0.020				
RoW_LAG.4					0.004	0.020	0.067*	0.081*
RoW_LAG.6					0.074	0.025	0.006	0.072*
RoW_LAG.8					-0.078**	-0.018	-0.018	-0.042
RoW_LAG.10					-0.034	-0.030	-0.038	-0.025
RoW_LAG.12					-0.034	0.040	0.007	0.041
Total Effect	-	-	-	-	-0.175*	-0.097	-0.062	0.036
Trade with RoW (Excluding China) after and Before a Port Project (3.5.C)								
Project RoW	-0.131***	-0.095***	-0.094***	-0.055	0.051**	0.066***	0.059***	0.003
RoW_LEAD.4	0.012	0.035*	0.035*	-0.011				
RoW_LEAD.6	0.002	-0.016	0.001	-0.058*				
RoW_LAG.4					0.012	0.042*	-0.152***	-0.131***
RoW_LAG.6					-0.126***	-0.118**	0.043	0.064

RoW_LAG.8					0.063*	0.058	0.040	0.078*
RoW_LAG.10					-0.019	-0.032	0.000	0.030
RoW_LAG.12					0.000	0.000	0.000	0.000
Total Effect	-	-	-	-	-0.019	0.016	-0.010	0.044
Rmse	0.238	0.244	0.242	0.285	0.238	0.245	0.242	0.285
N	232702	260392	238918	207563	232702	260392	238918	207563

** p < 0.10, ** p < 0.05, *** p < 0.0*

Agreeing to and completing an infrastructure development project predicts a temporary increase in all trade, including trade with the RoW and trade with China. Inconsistent signs on coefficient values in the lag and lead analyses reveal a steadily decreasing effect during project duration. The absence of lagged or total effects during the 12 years after project completion indicates these effects are temporary. This is evidence that increases in trade are not a result of sustainable reductions in trade costs and could be the result of project requirements or anticipatory effects. To better understand the robustness of this outcome, future analysis can estimate the variation in completed infrastructure projects.

Tables 1–4 outline a series of experiments designed to identify the unique effects of varying participation in the extended MSR trade network, controlling for a variety of fixed effects assumptions. These results indicate that signing an operating contract for terminal control predicts an increase in trade with China and a decrease in trade with the RoW.

Complementarity of Preferential Trade Agreements and Trade Networks

When including China in the trade network and controlling for membership in the same PTA, the BACI data predicts an increase in total trade; however, when both partners are members of the extended MSR and the same PTA, these trade gains are lost and the net effect is slightly negative (Table 5.A). This brings into question the propositions from several authors that the BRI has the

capacity to act as a regional trade agreement (e.g., Baniya et al., 2019) and is further evidence that cost savings tend to be on the side of China.

The results reported in Tables 5.B and 5.E indicate that the total effect of the interaction between an operating contract and a completed construction project is expected to be negative, if significant at all. Table 5.G provides evidence that this is even the case when estimating bilateral trade with China. The only relationship where the combined net effect does not turn negative is in those ports where operating contracts have been secured for all terminals. This is further evidence that trade increases from port contracts and completed projects originate from different mechanisms and are separate, non-complementary events.

Table 5 – Joint Effects of PTAs and Agreements[2]

Joint Effects of Trade among PTA and Trade between Countries with Port Contracts (5.A)				
	EXPORTS DOTS	IMPORTS DOTS	WTF TRADE	BACI TRADE
MSR Dummy	0.007	-0.001	-0.011	0.056*
PTA Dummy	0.069***	0.070**	0.049	0.062**
MSR_{ij}*PTA_{ij}	-0.034	-0.042	-0.021	-0.071*
Joint Effects of Trade between Countries with Port Contracts and Completed Projects (5.B)				
MSR Dummy	-0.005	-0.014	-0.016	0.016
Project Dummy	-0.023	-0.005	-0.01	0.051
MSR_{ij}*MSR_pro_{ij}	-0.046	-0.088*	-0.051	-0.042
Joint Effects of Trade among PTA and Trade between Countries with Completed Projects (5.C)				
Project Dummy	-0.059*	-0.066**	-0.058**	0.079**
PTA Dummy	0.062**	0.062*	0.044	0.058**
MSR_pro_{ij}*PTA_{ij}	0.020	0.005	0.050	-0.080

[2] Table 5 reports the partial and total partial effects of varying interactions. Each sub-table (A-G) represents a single estimation of joint effects, controlling for all additional fixed effects from prior estimations. All models are specified using a PPML estimator, and estimations are generated with export and import data from DOTS and total trade data from WTF and BACI. Results are not estimated in consideration of intra-national trade effects as domestic trade data is not available for all countries during the period of analysis. This implies there may be a slight upward bias in the estimations due to globalisation.

Joint Effects of Trade among PTA and Trade between Countries with All Terminal Contracts				(5.D)
All Terminals	-0.241**	-0.179	-0.236*	-0.249*
PTA Dummy	0.063**	0.063*	0.045	0.056**
MSR_atc_{ij}*PTA_{ij}	0.158	0.192	0.249	0.188
Joint Effects of Trade between Countries with All Terminal Contracts and Completed Projects				**(5.E)**
All Terminals	-0.105	-0.039	-0.037	-0.053
Project Dummy	-0.055*	-0.068**	-0.049*	0.043
MSR_atc_{ij}*MSR_pro_{ij}	-0.025	0.105	0.064	-0.188**
Joint Effects of Trade among PTA and Trade with China After an All Terminals Contract				**(5.F)**
All Terminals only China	0.261***	0.237***	0.109***	0.226***
PTA Dummy	0.056**	0.056	0.042	0.047*
MSR_atc_{ij}*PTA_{ij}	-0.093	-0.098	0.017	-0.077
Joint Effects of Trade with China After an All Terminals Contract and a Completed Project				**(5.G)**
All Terminals only China	0.233***	0.219***	0.119***	0.225***
Project Dummy only China	0.007	0.026	-0.008	0.135**
MSR_atc_{ij}*MSR_pro_{ij}	-0.041	-0.078	0.052	-0.209***
Rmse	0.238	0.244	0.242	0.285
N	232702	260392	238918	207563

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

The results in Table 5 can be interpreted as an absence of evidence for a number of claims regarding the complementary nature of increased interconnectivity and infrastructure development with preferential trade agreements and other network agreements. This means that being a part of the same PTA has little to no effect on expected increases in bilateral trade with China after allowing Chinese SAEs to run your port. It also means that allowing Chinese SAEs to complete a maritime infrastructure development project may provide a positive temporary economic shock from increased trade with China

and the RoW, but the effects on gains in bilateral trade with China from terminal control are non-complementary and will reduce the overall effect.

CONCLUSION

There are still a number of open questions concerning how an economy can benefit from participating in this maritime trade network and what risks might be involved. It appears the most plausible answer is that joining China's maritime trade network makes it easier to do business with Chinese SAEs and Chinese firms in general. Host economies are expected to see positive effects from these relationships in terms of welfare gains from greater trade, increased commerce, and cheaper goods, but it appears to be at the expense of institutional lock-in and a loss of diversity in trade partners.

The results seem to indicate that prior to signing an operating agreement, there is anticipatory trade with China and that there are lasting effects on total trade with China after the contract has been signed. From these results, one can infer that participation in a port contract with China will reduce the total economic costs of trade with China. As predicted by accepted trade literature, this increases total trade with China and can have positive economic effects; however, the length and nature of these agreements may also improve the strategic position of China in these trade relationships and come with long-term consequences.

The log of investment in millions provides evidence that the larger the investment, the greater the increase in trade with China. As the level of investment increases, so does trade with China; however, these results appear to be temporary, whereas the effects of terminal operating contracts appear to be persistent. Trade gains from infrastructure projects come from either the RoW or China and fade away or turn negative over time. If these agreements were to reduce average trade costs to all trade partners or trade between network partners, the standard trade effect should be reflected, and thus, trade should increase for all partners after the project is completed.

In this context, the operation of a country's port terminals by firms with Chinese SAE interests does not appear to create new trade with China; rather, trade is modified. The negative and significant coefficients on trade among network partners, excluding China, are evidence that trade is being diverted from other countries in the network towards China. These partners trade less

with each other than prior to the agreement. This can have adverse economic effects if the trade is diverted away from low-cost providers.

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