# Relations between Statistical Capacity and Trade: Evidence from the Trade between China and Countries along the "Belt and Road"

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**Abstract.** With the promotion of trade liberalization and the development of the Internet, more and more enterprises are doing business and investing in the countries and regions along the "Belt and Road". This paper estimated an augmented gravity model of trade that specifically includes statistical capacity indicators as explanatory variable and measures the potential of China's iron and steel exports to the countries and regions along the "Belt and Road". The model was estimated by using bilateral exports from 63 countries and regions along the "Belt and Road" with data for the period 2013-2020 with the Poisson pseudo-maximum likelihood (PPML) method. Study found that the effect of the methodology assessment of statistical capacity and the source data assessment of statistical capacity on exports was positive and significant. The effect of the periodicity and timeliness assessment of statistical capacity was negative and significant. The effect of improving the number of tariff lines in the national nomenclature, the rate of common spoken language and the average of all Ad valorem duties were positive and significant.

**Keywords:** "One Belt, One Road"; transportation equipment; expansion gravity model; export potential; international trade

## 1 Introduction

China's initiative of building "One Belt, One Road" is based on improving the construction of "Five Links" and expanding cooperation with "One Belt, One Road" countries. Since steel is one of the most important industries subject to the U.S. foreign tax increase, major steel exporting countries, including China, are deeply affected, and countries along the "Belt and Road" account for a large share of China's exports and long-term steel demand is strong [8]. Nowadays the national statistical system has become an important part of the information system of a country, and the demand for statistical information from the government, enterprises and residents has been expanding and increasing [2]. This paper estimates an augmented gravity model of trade that specifically includes statistical capacity indicators as explanatory varia-


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ble and measures the potential of China's iron and steel exports to the countries and regions along the "Belt and Road".

The article is structured as follows. The second section presents the overview of the bilateral exports and the gravity models in international trade. The third section presents the empirical model, the data sources and the key variables. The fourth section presents the results of the estimation of the empirical model and provides a discussion. The final section presents the conclusions of this research.

## 2 Literature References

The gravity model of trade is a good measure of bilateral trade influencing factors and trade potential, and since the introduction of the gravity model of trade in the past decades, a large number of domestic and foreign scholars have used the gravity model to study and analyze bilateral trade issues. In the field of international trade, the gravity model is both empirically stable and theoretically based, and has been widely used in academic research and policy making [1]. Wu and Yang (2019) [6] study and analyze the impact of enterprises' autogenously constructed transnational trade networks from the perspective of networks overcoming information barriers and verify its dynamic impact on enterprises' export behavior. Wu and Tian (2019) [7] analyze the factors and potential of China's trade in wood forest products to countries along the "Belt and Road" with an extended gravity model. Shi (2020) [4] used multiple high-dimensional fixed-effects Poisson pseudo-great likelihood estimation to estimate an extended gravity model to analyze the impact of factors such as the level of technology and technological openness of importing countries, tariffs, and the degree of self-sufficiency of oil and gas on China's green product exports. Yin et al. (2020) [10] analyzed the influencing factors, export potential and export efficiency of China's construction machinery exports to countries along the "Belt and Road" with the help of stochastic frontier gravity model. Xu and Shi (2019) [9] estimated a reconstructed trade gravity model to empirically analyze the main factors affecting China's black tea export trade to countries along the "Belt and Road". Ren and Gu (2019) [3] quantitatively studied the influence mechanism of trade facilitation on China's silk export trade in the countries along the "Belt and Road" based on the construction of trade facilitation index.

The present study of gravity models of trade has been very rich. Many literatures uses frontier gravity models and augmented gravity models, but the research on statistical capacity to export is relatively lacking. Based on the existing literature, this paper focuses on analyzing the current situation and characteristics of bilateral trade. This paper also calculates the factors and trade potential of iron and steel exports with an augmented gravity model of trade.

## 3 Methodology, Data and Variables

The gravity model of trade refers to the fact that bilateral trade flows are proportional to the economic size of two countries and inversely proportional to the distance be-

tween two countries. After later scholars' research and extension of the gravity model, more factors have been incorporated into the gravity model of trade, such as adding dummy variables and system variables [5]. In this paper, on the basis of the gravity model of trade, we study the influencing mechanism and impact of statistical capacity and other variables on China's iron and steel exports, and select some countries along the "Belt and Road" as samples to conduct regression analysis on panel data. The model is set up as shown in equation (1).

$$\begin{aligned} \ln tv_{ijt} = {} & \beta_0 + \beta_1 \ln mas_{jt} + \beta_2 \ln sda_{jt} + \beta_3 \ln pta_{jt} \\ & + \beta_4 \ln gdp_{jt} + \beta_5 \ln dis_{ijt} + \beta_6 \ln nt_{jt} \\ & + \beta_7 \ln aad_{jt} + \beta_8 \ln er_{jt} + \beta_9 \ln csl_{ijt} \\ & + \beta_{10} \ln and_{ijt} + \beta_{11} \ln cont_{ijt} + \tau_t + \delta_{ij} + \varepsilon_{ijt} \end{aligned} \tag{1}$$

$\ln tv_{ijt}$ denotes exports from China ($i$) to an importing country (region) $j$ in year $t$; $\ln mas_{jt}$ is the methodology assessment of statistical capacity of importer $j$ in year $t$. $\ln sda_{jt}$ is the source data assessment of statistical capacity of importer $j$ in year $t$. $\ln pta_{jt}$ is the periodicity and timeliness assessment of statistical capacity of importer $j$ in year $t$. $\ln gdp_{jt}$ is the logarithm of GDP for importer $j$ in year $t$. $\ln dis_{ijt}$ denotes distance. $\ln nt_{jt}$ is an index that measures the number of tariff lines in the national nomenclature. $\ln aad_{jt}$ is an index that measures the average of all Ad valorem duties. No Ad valorem equivalents for non-AV duties are included. $\ln er_{jt}$ is the average annual exchange rate of the national currency to the US dollar. $\ln csl_{ijt}$ denotes common spoken language. $land_{ijt}$ is a variable indicating whether the country is landlocked. $cont_{ijt}$ is a variable indicating whether the country i and the country j are neighbouring.

After a careful review of the literature and upon taking into account various options, I have decided to utilize the PPML estimator for a semi-mixed effects model. This paper also conducted VIF tests for all variables, and the variance inflation factors for all variables were less than 5. The mean value of VIF was 2.21, ruling out the possibility of multiple co-linearity.

## 4 Econometric Results and Discussion

This paper estimates the augmented gravity model of trade from 2013-2020 panel data by stata 15, and the gravity model is regressed using Poisson's pseudo great likelihood estimation method (PPML), while mixed panel OLS and GLS are used to test the robustness of the regression results. The actual bilateral exports are then compared with the predicted values from the PPML estimation to measure the potential of China's iron and steel exports to the countries along the “Belt and Road”.

### 4.1 Main Results

The PPML estimation for the gravity model can be applied to models with nonlinear characteristics and, like the OLS estimation, dummy variables can be included, while the interpretation of the parameter estimates is consistent with that of the OLS estimation. The regression results are shown in Table 1 and Table 2. In the next four models, we test for the impact of statistical capacity to on China's iron and steel exports.

**Table 1.** Statistical Capacity and Trade

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| lnmas | 0.0417*** | | | 0.0421* |
| | (2.73) | | | (1.74) |
| lnsda | | 0.0058 | | -0.0188 |
| | | (0.67) | | (-1.62) |
| lnpta | | | 0.0994*** | 0.0677 |
| | | | (2.68) | (1.35) |
| _cons | 2.6895*** | 2.8390 | 2.4248*** | 2.4677*** |
| | (41.85) | (81.54) | (14.87) | (13.86) |
| $R^2$ | 0.0137 | 0.0005 | 0.0112 | 0.0199 |

*Significant at 10%; **significant at 5%; ***significant at 1%. Estimated using STATA Version 15.

**Table 2.** PPML Regression Results

| | (1) |
|---|---|
| lnmas | 0.0700** |
| | (2.40) |
| lnsda | 0.0788** |
| | (2.17) |
| lnpta | -0.130* |
| | (-1.93) |
| lngdp | 0.00534 |
| | (1.30) |
| lndis | -0.108*** |
| | (-4.88) |
| lnnt | 0.0636*** |
| | (2.75) |
| lnaad | 0.0552*** |
| | (5.74) |
| lner | -0.00605* |
| | (-2.00) |
| lncsl | 3.524 |
| | (1.39) |
| land | -0.242*** |
| | (-11.34) |
| cont | 0.0691*** |

| | |
|---|---|
| | (4.42) |
| _cons | 3.213*** |
| | (7.84) |
| n | 123 |

*Significant at 10%; **significant at 5%; ***significant at 1%. t statistics in parentheses.

Table 1 presents the results from estimating different versions of equation (1). The results obtained show that our target variable, the statistical capacity, is positively correlated with trade. According to the results in column 1 and column 3 of Table 1, the methodology assessment of statistical capacity and the periodicity and timeliness assessment of statistical capacity are decisive for the exporting regions. According to the results in column 4 of Table 1, the effect of methodology assessment of statistical capacity on exports is positive and significant, although slightly lower than the effect of improving the methodology assessment of statistical capacity in column 1.

According to the results in Table 2, the methodology assessment of statistical capacity, the source data assessment of statistical capacity and the periodicity and timeliness assessment of statistical capacity is decisive for the exporting regions. The effect of improving the number of tariff lines in the national nomenclature and the average of all Ad valorem duties are positive and significant. Results also show that an improvement in distance and average annual exchange rate of the national currency have a positive and significant correlation with regional exports and the results are in accordance with results using trade among nations.

In addition, the statistical capacity shows positive and statistically significant coefficients and has, therefore, a positive relation with exports.

### 4.2 Robust Test

Table 3 shows the regression results of the gravity model estimated based on the PPML method, the mixed panel OLS method, and the GLS method.

**Table 3.** Results of Gravity Model Regression

| | **ppml** | **ols** | **gls** |
|---|---|---|---|
| lnmas | 0.0700** | 1.068** | 1.068** |
| | (2.40) | (2.25) | (2.37) |
| lnsda | 0.0788** | 1.528*** | 1.528*** |
| | (2.17) | (2.79) | (2.94) |
| lnpta | -0.130* | -2.402* | -2.402** |
| | (-1.93) | (-1.93) | (-2.03) |
| lngdp | 0.00534 | 0.0948 | 0.0948 |
| | (1.30) | (1.16) | (1.22) |
| lndis | -0.108*** | -1.570*** | -1.570*** |
| | (-4.88) | (-3.27) | (-3.44) |
| lnnt | 0.0636*** | 1.249*** | 1.249*** |
| | (2.75) | (2.93) | (3.09) |
| lnaad | 0.0552*** | 0.992*** | 0.992*** |
| | (5.74) | (4.83) | (5.09) |
| lner | -0.00605** | -0.0649 | -0.0649 |
| | (-2.00) | (-1.07) | (-1.12) |
| lncsl | 3.524 | 111.2* | 111.2* |

| | | | |
|---|---|---|---|
| | (1.39) | (1.72) | (1.81) |
| land | -0.242*** | -4.050*** | -4.050*** |
| | (-11.34) | (-14.50) | (-15.27) |
| cont | 0.0691*** | 1.285*** | 1.285*** |
| | (4.42) | (3.61) | (3.80) |
| _cons | 3.213*** | 20.58** | 20.58*** |
| | (7.84) | (2.47) | (2.60) |
| n | 123 | 123 | 123 |

*Significant at 10%; **significant at 5%; ***significant at 1%. t statistics in parentheses.

As shown in Table 3, the regression results using the mixed panel OLS method and GLS method are generally consistent with the results of the gravity model in existing studies, i.e., China's exports of iron and steel to countries along the “Belt and Road” are positively proportional to the nominal GDP of the importing countries and inversely proportional to the geographical distance between the two capitals. According to the results in column 2 and column 3 of Table III, the effect of the methodology assessment of statistical capacity and the source data assessment of statistical capacity on exports is positive and significant. The effect of the periodicity and timeliness assessment of statistical capacity is negative and significant. The effect of improving the number of tariff lines in the national nomenclature and the average of all Ad valorem duties are positive and significant. The main conclusions remain largely unchanged.

### 4.3 Export Potential Measurement

For the measurement of China's iron and steel export potential to the countries along the “Belt and Road”, the actual bilateral exports are compared with the predicted values derived from the model through the PPML estimation method. If the export potential coefficient is greater than 1, it means that China's export potential has been fully realized. If the export potential coefficient is less than 1, it means that it still has the potential for China to expand its exports. The export potential coefficients of China's iron and steel exports to the regions along the “Belt and Road” are shown in Table 4.

**Table 4.** 2013-2020 Export Potential Coefficient

| year | ASEAN | West Asia | South Asia | Central Asia | CIS | CEE |
|---|---|---|---|---|---|---|
| 2013 | 1.01673 | 1.05772 | 0.94856 | — | 0.99814 | 0.95776 |
| 2014 | 1.03387 | 1.07183 | 0.89432 | 0.90808 | 1.01148 | 0.95080 |
| 2015 | 1.03325 | 1.06739 | 0.92868 | 1.12907 | 1.00386 | 0.94737 |
| 2016 | 1.02956 | 1.07867 | 0.95584 | 1.03161 | 1.00648 | 0.95850 |
| 2017 | 1.00828 | 1.04679 | 0.99356 | 1.03588 | 0.96670 | 0.97595 |
| 2018 | 1.00204 | 1.01367 | 1.03158 | 1.16797 | 0.98171 | 0.97043 |
| 2019 | 0.97969 | — | — | 0.97946 | 1.06323 | 0.98843 |
| 2020 | 0.99243 | 0.99966 | 0.97186 | 0.97685 | — | 1.01334 |

As shown in Table 4, for each country or region along the "Belt and Road", China's iron and steel generally have the potential to expand its exports. The overall trend of China's iron and steel export potential coefficient is increasing, indicating that China's iron and steel exports to the "Belt and Road" countries are expanding year by year. The export potential coefficients of South Asia, CIS and CEE regions have increased to more than 1, indicating that China's export potential for iron and steel is being better utilized. Due to economic and cultural factors in ASEAN, West Asia and Central Asia, China's exports of iron and steel have the potential to expand. With the opening of more lines of China-EU trains, China's exports of iron and steel to ASEAN, West Asia and Central Asia will have more potential to expand.

## 5 Conclusions

This paper is based on the basic situation that China's iron and steel industry is developing rapidly and the infrastructure construction of countries along the “Belt and Road” is deficient. This paper focus on analyzing the current situation and characteristics of bilateral trade and calculating the factors and trade potential of bilateral trade with an augmented gravity model of trade. Study finds that the effect of the methodology assessment of statistical capacity and the source data assessment of statistical capacity on exports is positive and significant. The effect of the periodicity and timeliness assessment of statistical capacity is negative and significant. The effect of improving the number of tariff lines in the national nomenclature, the rate of common spoken language and the average of all Ad valorem duties are positive and significant. The results of the export potential measurement with the PPML model show that China's iron and steel exports to South Asia, CIS and CEE regions are adequate, while China's iron and steel exports to ASEAN, West Asia and Central Asia still have the potential to expand and need to be tapped. Based on the problems found in the analysis of this paper, this paper believes that China's exports of iron and steel to the regions along the "Belt and Road" should be expanded in the following ways.

China should strengthen communication and cooperation with countries along “Belt and Road” to bring into play the market potential. China should not only actively use the iron and steel export market and railroad transport advantages with ASEAN and countries in the whole Asian region, but should also pay attention to the iron and steel export potential with CIS countries and Central and Eastern European countries, increase communication and cooperation with European countries, deepen the international cooperation mechanism between China and Europe, and promote the signing of relevant agreements.

China has to improve the tariff item setting with the countries along the “Belt and Road”. To a certain extent, the number of tariff items set reflects the results of trade negotiations between the two countries. If the tariff is set too high, the cost of trade between countries will rise, which may lead to a decline in trade volume and is not conducive to the expansion of openness. But if the tariff is set at a relatively low level, foreign goods will crowd out the market share of domestic enterprises, and some domestic related industries in the early stage of development will be affected. The appro-

priate number of tariff items can help promote China's exports of iron and steel to regions along the "Belt and Road".

Give full play to the language advantage and increase cultural exchanges. For the countries along “Belt and Road” with a high proportion of Chinese-speaking population, China should give full play to its linguistic advantages and strengthen the economic and human resources exchanges between the two countries. For countries with a low percentage of Chinese-speaking population, China should pay attention to the differences between the two countries in terms of cultural customs, play the Chinese overseas Chinese communication ties, and carry out exchanges and cooperation in the form of trade adapted to local production and business models, so as to bring into play the export potential of Chinese iron and steel.

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