

# ***Impact of the Sino-US Trade War on Factor Endowment in the Guangdong-Hong Kong-Macao Greater Bay Area: A Perspective from Factor Endowment Theory***

**Kuo Bao<sup>1,a,\*</sup>**

<sup>1</sup>*RCF Experimental School, Beijing BJ 10010, China*

*a. baokuo@rdfzcygj.cn*

*\*corresponding author*

**Abstract:** This study chooses the Guangdong-Hong Kong-Macao Greater Bay Area as the research object to explore the impact of Sino-US trade barriers on the factor endowment of the region. Based on the factor endowment theory, this paper proposes a hypothesis, tests collinearity, and establishes a multiple linear regression model. The results show that the trade barriers between China and the U.S. cannot explain the changes in GBA's factor endowments since the fitting degree is low. The correlation test shows the substitution effect between factor endowments. Based on the data analysis results, Sino-US trade barriers did not affect the factor endowment of the GBA. The possible reasons are the trade deflection and the policy that restrict factor mobility.

**Keywords:** Sino-U.S. trade war, factor endowment, greater bay area

## **1. Introduction**

The Sino-US trade war is a typical example for exploring the impact of bilateral trade relations on the economy. The United States' confrontational policy against China began in December 2017 which is the beginning of the trade war. The U.S. passed the National Security Strategy. This was carried out against the background that the World Trade Organization granted China market economy status in 2017. This restricted the trade of some military items between the two countries [1]. In the following July 2018, the U.S. established a 25% tariff on 818 Chinese products, with a total import value of \$34 billion, at the same time, China implemented a policy of retaliation. Until January 2020, two countries signed the first-phase agreement, it slowed down the rising trade barriers between the two countries.

For situation of the U.S., trade barriers to China have ultimately affects the import of raw materials for local companies [2]. The trade war has also brought such as income inequality to other trading partners [3]. Existing research proves that the trade war creates a 2-sided loser situation [4], the trade barriers increase China's unemployment rate [5] and slow down economic growth [6]. In particularly, the Guangdong-Hong Kong-Macao Greater Bay Area, as one of China's main trade areas, has been greatly affected. This paper will explore the impact of Sino-US trade barriers on the factor endowments of the Guangdong-Hong Kong-Macao Greater Bay Area based on the factor endowment theory.

In the literature review, the factor endowment theory, and the impact of the trade war on the economy will be introduced. It will put forward reasonable assumptions based on the theory and raise research questions based on the research gap. The methodology will mainly introduce the sources of data used in this study and the data analysis method-multiple linear regression. The results section presents the results of the data analysis, it followed by reasonable explanations for the analysis results and research limitations in the discussion. This study will be summarized in the conclusion, the contribution and the outlook will be pointed out.

## **2. Literature Review**

### **2.1. Factor Endowment**

Based on the factor endowment theory, the factor endowment of a place determines the goods it imports and exports, and ultimately affects the regional economy. The difference in factor endowment may cause income inequality [7] and bring differences in industrial structure [8]. The GBA was established in 2015, in 2022, the total economic volume of the region has exceeded 1.3 billion yuan [9]. It has attracted investment and technical talents. The large number and diversified factor endowments make it an important exporter in China.

### **2.2. Impact of the Sino-U.S. Trade War**

According to an existing study, it has been revealed that trade barriers between China and the United States have resulted in trade deflection, yet they have not led to a trade depression in China. Furthermore, these barriers have primarily exerted a chilling effect on certain industries, including the steel industry [10]. However, another study contradicts these findings by highlighting that the trade war will bring about significant employment and economic development challenges for both nations [11]. The discrepancy between these studies can potentially be explained by the fact that the former study was conducted prior to the escalation of the trade war. Nonetheless, this disagreement confirms the undeniable economic impact of the trade war on both sides.

Xiong has confirmed the impact of factor endowments on regional income inequality and emphasized that international trade will have an impact on regional factor endowments, which can be explained by the attraction of factors to regions and the encouragement policies implemented [12]. Another study bears this out, with financial markets as well as the investment of fixed assets taking a hit amid the Sino-U.S. trade war [13]. These serious consequences of trade war led to significance of exploring the effect on regional economy.

### **2.3. Research Gap**

Helpman's research proved the feasibility of the factor endowment theory for the study of international trade, which can be used to explain the trade pattern of goods that do not require homogeneity [14]. Analyzing the impact of trade barriers on regional factor endowments is conducive to the implementation of policies to coordinate regional economic development and to predict trade patterns. However, there are research gaps in this field based on factor endowment theory. This research will take GBA as the research object to explore the effects of trade war on factor endowments.

## **3. Methodology**

### **3.1. Data Collection**

All the data in this study is collected from the official statistics websites. The data of Guangdong Province adopts the completion of fixed asset investment and real estate development provided by

Guangdong Statistical Information Network [15]. The Hong Kong Special Administrative Region adopted the data from the Census and Statistics Department of Hong Kong [16]. The Macao Special Administrative Region adopted the data provided by the Macao Statistics and Census Bureau [17]. This paper uses the tariff data between China and the U.S. provided by PETERSON INSTITUTE FOR INTERNATIONAL ECONOMICS from 2018 on each other economy and other countries [18].

### 3.2. Measure of Factor Endowments and Trade Barriers

In this study, indexes are set for the three factors to measure the change of factor endowments in the GBA. Since the statistical data comes from different websites, the raw data of some indexes cannot be kept consistent. The labor force index is set as the average non-unemployment rate<sup>1</sup> [19] for each region [20]. The capital index calculated as the average growth rate of fixed assets [21]. For land index, the data of Guangdong province uses the percentage growth of real estate investment, Hong Kong uses average number of workers per site, and Macau uses the growth rate of completed buildings [22]. The three values are multiplied by the adjusted coefficient. Since the usable land of Guangdong is larger than that of Hong Kong and Macau, the coefficients of Guangdong, Hong Kong and Macau are 0.5, 0.3 and 0.2 respectively.

Trade barriers are calculated as U.S. tariffs on Chinese exports minus China tariffs on US exports. The trade barrier for each season is the average of net tariffs for each month of that season.

### 3.3. Multiple Linear Regression

This paper assumes that trade barriers will have a simultaneous impact on the 3 factors of GBA. In order to explore this relationship, this study chooses to use multiple linear regression.

$$L + K + N = \beta_0 + \beta_1 x_1 + \epsilon \quad (1)$$

The left-hand side of equation (1) is three factor endowments indexes, L K and N stand for labor index capital index and land index respectively. The  $x_1$  on the right-hand side is the trade barrier index.

In this study, the pre-processing of the original data was completed through the spreadsheet, and the multiple linear regression, the correlation test that used to test multi-collinearity and the figure were completed through the R language.

## 4. Results

In order to detect the collinearity of the variables in equation (1), this study used the Spearman coefficient for correlation test. Table 1 shows the correlation coefficients among the variables.

Table 1: Spearman coefficient for variables.

	Trade_barriers	Land_index	Capital_index	Labour_index
Trade_barriers	+1.000	-0.089	+0.177	-0.516
Land_index	-0.089	+1.000	+0.946	-0.253
Capital_index	+0.177	+0.946	+1.000	-0.452
Labour_index	-0.516	-0.253	-0.452	+1.000

<sup>1</sup> (1 minus the average unemployment rate)

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It can be seen from the results that trade barriers have a weak negative correlation with land endowment, a positive weak correlation with capital endowment, and a negative correlation with labor endowment. In other words, as trade barriers increase, land endowment will not change significantly, while capital endowment will increase, and labor endowment will decrease. This may be due to the transactions of land are less mobile than capital and labour.

In addition, it is worth noting that there is a significant positive correlation between land endowment and capital endowment. What is more, there is a negative correlation between capital endowment and labor endowment. These suggest the substitution and complementary effect between factors.

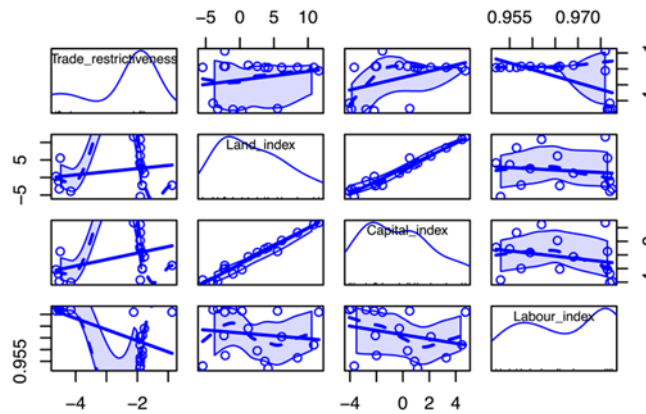


Figure 1: Correlation diagram for variables.

Figure (1) presents the matrix diagram among the variables in equation (1), and the same correlation results can also be seen from the figure. It is obvious that there is a positive relationship between capital and land, apart from this, labour and trade barriers show certain relationship.

Table 2: Results of multiple linear regression.

Coefficients	Estimate	Std. Error	t value	Pr(> t )
(Intercept)	7.474	4.419	1.691	0.111
Trade_barriers	1.845	1.536	1.202	0.248

As shown from table 2, the coefficient of trade barriers or the estimated value of  $\beta_1$  is 1.845 and the intercept  $\beta_1$  is 7.474 with error 1.536 and 4.419 respectively. The t value is 1.691 and 1.202 which is great enough to show the significance of relationship between trade barriers and factor endowments.

Table 3: R-squared of multiple linear regression.

Multiple R-squared	Adjusted R-squared
0.0878	0.02699

Table 3 present the multiple R-squared 0.0878 which means the change in trade barriers can explain 8.78 percent of change in factor endowments, the adjusted R-squared is 0.02699 which shows

the multiple linear regression overestimate the casual relationship among the model. Possible explanations for the low fit will be discussed in the discussion.

## 5. Discussion

### 5.1. Trade Deflection & Restricting Policy

The results of multiple linear regression show that Sino-US trade barriers are not the driving factor for changes in factor endowments in the GBA. The possible explanation for this is that the factor endowments may also be affected by trade between China and other trading countries. In addition, the decline in domestic demand caused by the epidemic and policies that restrict factor movement may also become potential factors.

According to the data provided by the World Bank [23], the percentage of China's export to the GDP decreased by 0.7 percent in 2019 and then increased till 2022, which shows that the trade barriers between China and the U.S. did not have a major impact on China's exports pattern, this is consistent to the previous literature. Although some industries such as the steel, have been greatly affected by the trade war, the export of other commodities has not declined. Since the GBA has not exported commodities that have a chilling effect there is no large production change. The impact to the factor endowments is not obvious is acceptable since there is no change in the trade pattern. Furthermore, the "first phase" of the trade war coincides with epidemic, thus it is possible that factor endowments are affected by the epidemic prevention and corresponding policy.

After China was affected by US trade barriers in 2018, the stimulus policy implemented by China shifted from the demand-side to the supply-side policy, and the government more focused on long-term growth [24]. This change has a significant impact on regional factor endowments, which means that to balance the losses brought by the Sino-US trade war to the GBA, local governments have implemented a series of protective measures that have affected the changes in factor endowments.

### 5.2. Limitation

The present study encompasses several limitations primarily attributed to the lack of precise data. One notable limitation is the absence of data for Hong Kong spanning from 2018 to 2020. This data gap may introduce deviations when assessing changes in GBA land endowment, potentially affecting the accuracy of measurements. Furthermore, the unavailability of the official unemployment rate for Guangdong Province necessitates reliance on data from the other two regions to reflect changes in labor endowment. Additionally, the absence of monthly data for Guangdong Province constrains the sample size for regression analysis. Moreover, in terms of index design, this study employs the rate of change in endowments, which may result in overlooking the volume change of factor endowments and potentially impacting the study's outcomes.

Furthermore, it is noteworthy that while this study considers the trade barriers faced specifically by China's exports, it does not encompass the trade barriers encountered by GBA. As a result, the research scope may limit the overall accuracy of the study's results. Additionally, it is crucial to acknowledge that the outbreak of the epidemic during the initial stage of the Sino-US trade war may have had a significant impact on regional factor endowments. As such, future research should consider incorporating this aspect to enhance the robustness of the study's findings.

## 6. Conclusion

This paper mainly explores the impact of Sino-US trade barriers on the factor endowments of GBA and establishes a multiple linear regression model. The low fitting degree of the data analysis results suggests that the hypothetical relationship is not obvious. The insignificant relationship is possibly

due to China's trade deflection and policies restricting the mobility of factors. More importantly, the emergence of the epidemic may also be a potential factor.

This study contributes to the understanding of the impact of trade wars on the regional economy, research aids in addressing the consequences of trade barriers on certain region and to make suggestion for policymaking. In addition, all the data in this study are from the official website, which provides empirical significance and contributes to the method of analyzing the change of the regional factor endowment. Overall, due to the limitations mentioned in the previous section, the impact of trade barriers on regional factor endowment is not obvious. To make the investigation of influencer of regional factor endowments more accurate, future research could consider factors other than trade barriers, such as the epidemic and trade deflection. Moreover, detailed data is desired to increase the sample size, this is significant since it would lead to precise result for the analysis.

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