Research on Trade Opening and RMB Real Effective Exchange Rate Volatility ——Based on the Perspective of Fixed Effects Panel Data Model

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Abstract — Based on China's economic reality, this article analyzes the impact of trade import and export on the real effective exchange rate of RMB under the background of economic globalization. Firstly, through a systematic study of relevant literature at domestic and abroad, the meanings of openness and RMB exchange rate and the general mechanism of the impact of a country's import and export trade on exchange rate are clarified. Secondly, based on the more optimized fixed effect model selected after Hausman test, and further descriptive statistics, correlation analysis, panel regression model and robustness test are used to carry out mathematical analysis on the influence of China's total import, total export and total import and export on RMB exchange rate. After that, based on the review of studies on the relationship between trade opening and RMB effective exchange rate, this article uses the annual data of 23 provinces and municipalities from 2013 to 2019 to build a two-vector autoregression model of import and export trade data and RMB real effective exchange rate. The results show that China's import and export trade in the short term will make RMB real effective exchange rate change, and gradually incline to stable, meanwhile, China's import volume has a greater and more significant impact than China's export volume. Finally, based on the conclusion of mathematical analysis and economic analysis, the author puts forward policy suggestions on exchange rate, trade and domestic economy.

Keywords — Trade openness; Real effective exchange rate of RMB; Exchange rate fluctuations

1 Introduction

With the introduction and development of the “Belt and Road”, the exchange rate changes have an indelible impact on China's import and export trade, the development of China's national economy, social stability, and the economic development of neighboring countries and regions.

The RMB exchange rate is the focus of the dispute between China and the United States. The

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RMB exchange rate is a core variable that affects the trade between the two countries. China's trade openness is an important factor affecting the changes in the RMB exchange rate. Investigating the impact of China's import and export trade on changes in the RMB exchange rate has more important and far-reaching significance.

2 Theoretical review and literature review

There have been many theoretical pieces of research on trade openness and effective exchange rates, which have mentioned the relationship between them to varying degrees. For example, Xie Fei and Liu Tingting (2019) used the BEER model to measure the degree of RMB real effective exchange rate misalignment and established a VAR model to conduct an empirical analysis of the two-way effect of the RMB real effective exchange rate misalignment and China’s import and export trade [1]. Jin Chaohui (2020) first adopted Redux. The model found that trade opening can suppress real exchange rate fluctuations under different shocks [2]. Yu Bo, Guan Chao and Dai Shugeng (2020) through a panel measurement model found that with the increase of RMB internationalization level, the improvement effect of RMB exchange rate depreciation on exports gradually increased, but the impact on imports was not obvious [3]. Qiu Juan, Lin Meng and Wang Bo (2020) established a VAR model to analyze the impact of China's import and export trade volume on the RMB exchange rate with selected monthly data. It shows that China's export trade has a more obvious impact on the changes in the RMB exchange rate, while the impact of China's import trade on the changes in the RMB exchange rate is not obvious [4]. Cesar Calderon, Megumi Kubota found that higher trade openness leads to more stable RERs while higher international financial integration generates more volatile RERs, but also found the ability of trade openness to smooth shocks to the RERs is mainly driven by manufacturing trade while non-manufacturing trade plays a limited role, and in most cases, negligible role. [5]

The above literature research results show that scholars' research on the relationship between trade opening and effective exchange rate is relatively mature, but the analysis of existing research is still not comprehensive. First of all, all data before 2019 are used, so the sample size is insufficient. Secondly, the fundamental economic variables of equilibrium real exchange rate of RMB in the theoretical model are mostly the same. The model mainly considers terms of trade, foreign exchange reserves, national trade openness, foreign direct investment (FDI) money supply (M2), etc., and rarely considers the gap between domestic and foreign interest rates and the relative rate of technological progress, so the model is not perfect enough. [6]

3 Empirical analysis

3.1 Establishment of an econometric model

1) Variable selection

a) RMB Real Effective Exchange Rate Index (reer)

The real exchange rate is mainly the price difference between services in different countries,

and it is also the key to adjusting the nominal exchange rate. In the research process of this article, the main measurement basis is the data after 2013, which is expressed as INreer. Mainly refers to the article "The Impact of RMB Exchange Rate on Import and Export Trade" from Zhang Mingqi's (2019), and the real effective exchange rate of RMB was selected as the explained variable.

b) China's trade dependency ratio (totaL、jk、ck)

China's trade dependency ratio is measured by the degree of trade dependence of each province (autonomous region, municipality), that is, the proportion of total import and export trade in GDP over the same period. Based on the database of the People's Republic of China, in millions of U.S. dollars, and before using annual data for analysis, seasonal adjustment is also required for the sequence, and based on the Eviews software, adjust it accordingly and generate the corresponding sequence to take the logarithm, which is LNtotaL, LNck and LNjk. Referring to practice of scholars Qiu Juan, Lin Meng, and Wang Bo (2020), the proportion of total import and export in GDP of the same period, the proportion of import in GDP of the same period and the proportion of export in GDP of the same period are selected as the explanatory variables of this article.

c) Control variables

The fiscal shock refers to the practice of Fatas & Mhov (2013), and replaces it with the inflation rate (fla) of each province (autonomous region, municipality); the technical shock is based on the data of the right-age population (15-64 years old) and unemployment rate (jr) of each province (autonomous region, municipality), and calculated with the annual change; currency shocks are constructed in a similar way to fiscal shocks, replaced by local government actual consumption growth rate (grr).

d) Data Sources

In the research process, this article mainly analyzes import and export trade data and RMB real effective exchange rate based on the annual data of 23 provinces and municipalities from 2013 to 2019. The analysis in this part is based on the original data of import and export volume, exchange rate and index of the two countries, specifically involving China's Economic Data Center, General Administration of Customs, National Bureau of Statistics, PRC, etc. The data of other 11 provinces and municipalities are seriously missing, so they are excluded here. In order to eliminate heteroscedasticity factor, Eviews software is also used to take logarithm of the variables.

2) Model building

e) Hausmann test

Since mixed model (OLS), fixed effect model (FE) and random effect model (RE) can be used for panel data regression analysis, in order to find the most suitable model, Husman test should be performed on the required model before panel regression, the test results are shown in the following Table 1:

TABLE 1. Husman test results

	F statistic	***P values***
OLS	36.336	0
FE	31.361	0.043
RE	6.321	0.496

According to Hausman's test results, the F statistic value of the RMB effective exchange and the dependence of China's import and export trade is relatively large, and the P value is far less than 0.05, which is suitable for the fixed effect model. Therefore, the variable intercept fixed effect model is finally adopted for the model of the effective exchange rate of RMB and the dependence of China's trade.

The real effective exchange rate of RMB LNreer, the degree of trade dependence LNtotaL, LNck, LNjk. Financial shock LNfla, technology shock LNjr, currency shock LNgrr. In the empirical research process of this article, the specific model is as follows:

Model (1)：

$$LNreeri,t = \beta0 + \beta1LNtotali,t + \beta2LNflai,t + \beta3LNjri,t + \beta4LNgrri,t + Year + Ind + \varepsilon1$$

Model (2)：

$$LNreeri,t = \beta0 + \beta1LNcki,t + \beta2LNflai,t + \beta3LNjri,t + \beta4LNgrri,t + Year + Ind + \varepsilon2$$

Model (3)：

$$LNreeri,t = \beta0 + \beta1LNjki,t + \beta2LNflai,t + \beta3LNjri,t + \beta4LNgrri,t + Year + Ind + \varepsilon3$$

ε Represents the random disturbance term, b Represents the regression coefficient of each model, i Representative individual. This article is for 23 provinces and cities, t represents time, and the time span of this article is from 2013 to 2019. Year is a fixed time, and Ind is a fixed individual.

f) Panel regression results

The real effective exchange rate of RMB always maintains a cointegration relationship with import and export, export, import trade dependence, fiscal shock, technological shock and currency shock, but it is changed by many factors and eventually leads to the phenomenon of imbalance. Therefore, the analysis can be completed through panel regression of individual fixed effects, as detailed below.

g) Regression Analysis of Total Import and Export to RMB Exchange Rate

From the regression results in Table 2, it can be seen that the dependence of import and export trade and various control variables have obvious correlation coefficients with the real effective exchange rate of RMB; the correlation coefficient between the real effective exchange rate of RMB and the dependence of import and export trade is 0.484, indicating that the actual effective exchange rate of RMB is more obvious at the level of 0.1%, and the two sides have a more obvious positive correlation, which means that the real effective exchange rate of RMB increases by 0.1%, and the total trade will also increase by 4.84%. F value

passed the test of significance level, and the goodness of fit after adjustment was 52.4%, which indicates that the model fits well.

TABLE 2. Regression analysis results of import and export models

Variable	***Model (1)***
C	0.561*
	-1.866
LN*total*	0.484***
	-4.843
LN*ck*	
LNjk	
LNfla	0.286***
	-3.748
LNjr	-0.394**
	（-2.625）
LN*grr*	0.780**
	-2.589
F value	15.251***
Adj.R^2	0.524

Note: *, **, *** mean respectively significant at the significance level of 5%, 1%, and 0.1%

h) Regression Analysis of Total Export to RMB Exchange Rate

Table 3 shows that the export trade coefficient is 0.325, and it has passed the 0.1% significance level test. There is a positive relationship between the two. This shows that when the export trade dependence increases by 0.1%, the real effective exchange rate of RMB will also be increased by 3.25%. The F value passed the significance level test, and the adjusted goodness of fit was 19.6%. Nowadays, our country's export trade mainly relies on price to seize market share. When the export trade volume of various provinces and cities increases, international trade theory believes that domestic trade conditions will usually deteriorate, and changes in domestic price levels will lead to the appreciation of the RMB. The exchange rate of RMB has risen.

TABLE 3. Regression analysis results of import and export models

Variable	***Model (2)***
C	-0.041*
	（-1.254）
LN*ck*	0.325***
	-3.254
LNfla	0.192
	-0.502
LNjr	0.854
	-0.924
LNgrr	0.524
	-0.396
F value	16.257***
Adj.R^2	0.196

Note: *, **, *** mean respectively significant at the significance level of 5%, 1%, and 0.1%

i) Regression Analysis of Total Import Value to RMB Exchange Rate

Table4 shows that the real effective exchange rate of RMB and the import trade coefficient is 0.387, and the P value is 0.0000 through the significance test, which is lower than 0.01. The significance test is passed, which means that there is a significant difference between the import trade and the real effective exchange rate of RMB. It's a positive relationship. The estimated coefficient of the unemployment rate is -0.315, and the P value of its significance test is 0.019, which is less than 0.05, which means that there is a clear negative correlation between the unemployment rate and the real effective exchange rate of RMB. The F value passed the significance level test, and the adjusted goodness of fit was 22.4%. Therefore, import trade has a greater impact on the RMB exchange rate.

TABLE 4. Regression analysis results of import and export models

Variable	***Model (3)***
C	2.049**
	-1.493
LNjk	-0.387***
	-3.874
LNfla	0.229
	-0.598
LNjr	-0.315**
	（-2.100）
LNgrr	0.624
	-0.471
F value	22.521***
Adj.R^2	0.224

Note: *, **, *** mean respectively significant at the significance level of 5%, 1%, and 0.1%

j) Robustness test

The RMB real effective Exchange rate Index (REER) was replaced by THE CFETS exchange rate index for robustness test. See Table 5 for specific results. The results of robustness test show that the explanatory variables of total import and export trade, total import and total export are significantly positively correlated with the CFETS exchange rate index variable in all models. The results show that under the joint action of all explanatory variables, RMB exchange rate will be adjusted upward. The conclusion can support the research hypothesis, so each model passed the robustness test.

TABLE 5. Regression analysis results of export model

Variable	***Model (1)***	***Model (2)***	***Model (3)***
	coefficient		
C	0.331*	-0.021*	1.529**
	-1.856	（-1.364）	-1.654
$DLNtotal_{t-1}$	0.358***		
	-4.643		
$DLNck_{t-1}$		0.255***	

		-3.852	
$DLNjk_{t-1}$			0.374***
			-3.965
$DLNfla_{t-1}$	0.197***	0.154	0.123
	-3.654	-0.445	-0.532
$DLNfr_{t-1}$	-0.374**	0.745	-0.312**
	（-2.565）	-0.854	（-2.085）
$DLNgrr_{t-1}$	0.452**	0.544	0.656
	-2.747	-0.376	-0.466
F value	13.387***	15.447***	16.754***

4 Conclusion

Based on the analysis of monthly data of import and export trade volume and RMB real effective exchange rate of provinces and cities from 2013 to 2019, this article establishes an individual fixed effect panel regression model and draws the following conclusions: At the significance level of 10%, there is a long-term co-integration relationship between RMB real effective exchange rate and China's import and export trade. Both China's export volume and China's import volume are the real effective exchange rate of RMB granger. China's import and export trade in the short term will make RMB real effective exchange rate change, and gradually incline to stable, at the same time, China's import trade, compared with China's export trade volume of the impact of RMB real effective exchange rate is larger and more significantly, China's export trade of the influence of the RMB exchange rate is not big, and the impact time is relatively short, but also the magnitude is relatively small.

References：

[1] Xie Fei, Liu Tingting. Research on the two-way effect of RMB exchange rate misalignment with import and export trade[J]Reform,2019,000(003):128-138.

[2] Jin Chaohui. Does trade liberalization reduce the real effective exchange rate fluctuation of RMB? [J]. International Finance Research, 2020, No.404(12):75-85.

[3] Yu Bo,Guan Chao and Dai Shugeng. RMB Internationalization, Exchange Rate Volatility and Bilateral Trade——Analysis based on the national panel threshold model of "One Belt One Road"[J]. Statistics and Information Forum, 2020,35(07): 57-65

[4] Yu Bo, Lin Meng and Wang Bo. Analysis of the impact of China's import and export trade on the exchange rate of RMB[J]. Technology and industry, 2020,20(05) :1-7+14

[5] Does higher openness cause more real exchange rate volatility? [J]. Cesar Calderon; Megumi Kubota. Journal of International Economics. 2018(01):876-934

[6] Policy Volatility, Institution, and Economic Growth [J]. Antonio Fatas; Ilian Mihov. Review of Economics and Statistics. 2013(2):50-72