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The Empirical Analysis of the Influence of RMB Real Effective Exchange Rate to Chinese Balance of Payment

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Abstract

Ever since July 21st ,2005 China adopted the managed floating exchange rates which based on the supply-demand relationship of the market with reference to a basket of currencies, the value of RMB appreciates with fluctuations, which will undoubtedly have a significant influence to the BOP of China. Exchange rate is one of the most important factors affecting import and export trade. In this paper, the basic concepts of exchange rate and the impact of exchange rate on import and export trade theory is defined and introduced at first. Then co-integration test and Granger causality test are used to analyze the impact of RMB real effective exchange rate on China's import and export of goods, as a result, a long-term co-integration relationship between RMB real effective exchange rate and China's export is spotted, but there is no long-term co-integration relationship between real effective exchange rate and import. In the end, relative policies and suggestions are given.

Keywords

Real effective exchange rate, import and export trade, empirical analysis.

1. INTRODUCTION

The exchange rate represents the comprehensive value of a country's currency, which regulates the effective distribution of various factors of production resources in the global scope.Nowadays, foreign trade is the most frequent economic activity between a country and the outside world.It plays an important role in a country's economic development, and the exchange rate plays an important role in the world market.In late July 2005, the exchange rate system of our country was changed to a managed floating exchange rate.The value of RMB is adjusted on the basis of supply and demand with reference to the value of a basket of currencies.After the reform of the exchange rate system, the RMB appreciated all the way, and by January 2014, the maximum appreciation was 24.66%.According to the traditional trade theory, the appreciation of RMB leads to the rise of export commodity price, which leads to the decline of export volume, while the depreciation of RMB is the opposite, so the fluctuation of exchange rate will undoubtedly have a significant impact on a country's import and export trade.However, it is difficult to study this kind of influence completely only by observing several groups of data. We need to establish relevant measurement models through measurement tools to conduct more accurate and specific analysis.

According to the research conclusion, whether the Marshall Lerner condition is satisfied, i.e. whether the sum of import and export demand elasticity is greater than one, it can be divided into two factions. The following briefly introduces the research status of the two perspectives.

Paul Krugman, a foreign scholar, studied the effect of the real exchange rate of the US dollar on the import and export trade of the United States in 1989.His research found that the

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devaluation of the US dollar can affect US exports, and the decline of the exchange rate is not conducive to US foreign trade transactions.In addition, Doyle Eleanor used GARCH model to study the relationship between exchange rate changes and the export trade of Ireland and other countries.The results show that both nominal and real exchange rates play an important role in promoting Ireland's foreign trade.

The related researches of domestic scholars are as follows: Qianqian Lu and Guoqiang Dai[1] (2005) established a econometric model based on the monthly data from 1994 to 2003 to analyze how the real exchange rate changes in China affect China's import and export, and concluded that the sum of the absolute value of the elasticity of exchange rate of China's import and export demand exceeds 1.The rise of RMB real exchange rate can improve the export environment of China, but the effect is lagging behind.Mingdong Xu [2] (2007)studied the relationship between foreign trade and exchange rate on the basis of vector auto-regressive model by using the data of exchange rate and foreign direct investment from 1997 to 2006. He believed that China's foreign trade met Marshall Lerner condition, and the appreciation of RMB was not beneficial to China's trade environment, and the effect existed five months later.Jizhong Zhou[3] (2010) et al. Analyzed the dynamic effect of RMB real effective exchange rate on China's import and export balance.They think that China's foreign trade environment meets the theory of trade balance elasticity, but the impact of changes in monetary value lags behind.

Foreign related studies include: Rose and Andrew (2000) based on the relevant annual data of nearly 200 countries in 1970-1990 to establish a econometric model to study the impact of exchange rate on foreign trade of these countries.The conclusion is that the change of nominal exchange rate plays a subtle role in restraining a country's foreign trade.Sela et al. (2003) selected the relevant data from 1985 to 2001 as the sample data of the model to study the impact of tariffs, quotas and exchange rates on China's foreign trade.The conclusion is that exchange rate changes are not useful for foreign trade.

The domestic research in this field includes: Xing Gan and Yun Yin[4] (2016) used the econometric analysis method to study the monthly data of China from 1994 to 2015, and found that the relationship between the real exchange rate of RMB and China's foreign trade is not a simple linear relationship, but a parabolic one.His research shows that the change of effective exchange rate will experience the process of accelerating the rise, slowly reaching the peak and accelerating the decline.Jiankui He and Hong Ma[5] (2012) used VAR and VEC models to study the effect of RMB real effective exchange rate on China's foreign trade. They believed that the coefficients of import and export equation were not significant, the long-term change of foreign trade volume was more dependent on the actual income and demand of consumers, and the coefficients of import and export equation were negative in the short term.So they suggest changing the economic growth model instead of adjusting the exchange rate to influence the volume of import and export trade.

2. METHODOLOGY

In this paper, Eviews 6.0 is used to analyze the impact of RMB real effective exchange rate on China's total import and export volume.In order to prevent the false regression results, we first tested the macro data by unit and test. The results show that the three variables are first-order single integration. However, the co-integration test rejected the hypothesis that there is a long-term stable relationship between the import and the real effective exchange rate, and accepted it at the level of 5%Finally, the Granger causality test shows that the import and the real effective exchange rate are mutually Granger reasons at the level of 1%.

The theory of elasticity analysis puts forward that the exchange rate changes affect a country's trade balance by affecting the supply and demand price elasticity of import and export.Then economist Abalerner put forward a new theory:Marshall Lerner condition.His

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research complements the elastic analysis.Later, he did empirical analysis on the different situations from the theory, and formed the "J-curve effect theory".Since then, the theory of elastic analysis has been the theoretical foundation of foreign trade adjustment by making exchange rate policy in the world.

2.1. Marshall Lerner Condition

If D_1 is the exchange rate elasticity of export and D2 is the exchange rate elasticity of import, the Marshall Lerner condition can be expressed as follow:when $|D_1| + |D_2| > 1$, currency depreciation will improve the balance of payments of a country; $|D_1| + |D_2| < 1$, currency depreciation will worsen the balance of payments of a country; $|D_1| + |D_2| = 1$, currency depreciation has no effect on a country's balance of payments.Marshall Lerner condition is based on the following two bases: the first is that the domestic market plays a minor or unimportant role in the international economy, that is, the demand of foreign consumers for China's foreign trade mainly depends on the price of China's goods, and foreign consumers are relatively sensitive to the price of China's foreign trade goods; the second is that Marshall Lerner condition is not applicable to large trading countries, especially the proportion of foreign consumers.Countries with large market share in the world, therefore, devaluation of currencies of countries with small foreign trade volume can effectively improve their foreign trade environment.

2.2. J-curve Effect

"Time lag effect" refers to that even if a country's trade environment meets Marshall Lerner conditions, the effect of currency depreciation on foreign trade is initially negative, and then it can stimulate exports. Because its curve shape is similar to the letter J, it is also called "J curve effect".As shown in the figure below:

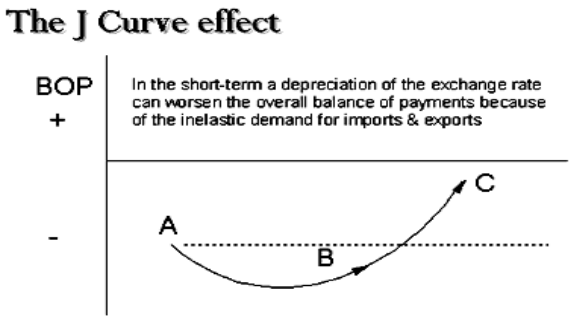

Figure 1. J-curve effect of currency depreciation

As shown in the figure 1, "J-curve effect" is divided into three stages.Stages A is the contract stage, Stages B is the conduction stage, Stages C is the quantity adjustment stage.In stage A, the price and scale of import and export commodities will not be affected by the exchange rate immediately and will change greatly.Because enterprises usually sign contracts ahead of time, the contracts that have been established and come into effect before will restrict the import and export enterprises to immediately change the transaction price and scale.In addition, the difference of settlement currency stipulated in the trade contract will also affect the profit and loss of the enterprise.The currency of foreign exchange is equally important to the trade balance after the exchange rate changes.Therefore, the import and export of A stage will suffer from adverse effects due to the devaluation of the domestic currency. In the transmission stage, when the time has passed, the previous contracts have been basically fulfilled. The transaction price and scale of the re signed contracts are measured according to the devalued purchasing power

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of currency.The positive effect of rising exchange rate on import and export began to appear, and the terms of trade were improved.Finally, in stage C, the impact of currency depreciation has been fully transmitted to the import and export trade volume, and the change of contract quantity is much higher than the change of price.The balance of trade balance has been improved more and more, and eventually the trade deficit has been eliminated and the surplus has been formed.

3. EMPIRICAL ANALYSIS

3.1. Establishment and Description of the Model

According to the view of western economics, the volume of foreign trade depends on the price of foreign trade goods and the real income of domestic and foreign residents.Referring to the research of famous domestic scholars, this paper selects the following Douglas function to analyze the interaction between foreign trade and RMB real effective exchange rate.The equation is expressed as:

Outlet: $X_t=A(REER_t)^{\alpha}(GDP_t^*)^{B}$

Import: $M_t=B(REER_t)^{\theta}(GDP_t)^{\omega}$

The letter t in the formula represents time, GDP_t represents China's national income level, and GDP_t * represents the national income level of China's trading partners. X_t and M_t represent the import and export trade volume of each period, $REER_t$ represents the actual effective exchange rate of RMB, α represents the elasticity of export exchange rate, β represents the income elasticity of exports, θ represents the elasticity of exchange rate of imports, and ω represents the income elasticity of imports.To control the variables, it is assumed that the actual income of all consumers is constant, so that the exchange rate becomes a key factor in changing foreign trade prices. To eliminate the possible heteroscedasticity of the model, taking the logarithm of the above formula, we get:

Outlet: $\ln(X_t)=\ln A+\alpha\ln(REER_t)+\mu_1$

Import: $\ln(M_t)=\ln B+\theta\ln(REER_t)+\mu_2$

μ_1 and μ_2 are the error terms of export and import respectively.

3.2. Data Selection and Description

The real effective exchange rate index is the nominal effective exchange rate weighted by the relative price level or cost index of the country and other major countries.The rise in the real effective exchange rate index indicates an increase in the purchasing power of the currency, while the decline indicates a decrease in the purchasing power of the currency.To eliminate the adverse effect of inflation on the value of money, the real effective exchange rate can more fully reflect the intrinsic value of the country's currency.Therefore, this paper chooses the real effective exchange rate as the empirical variable.The real effective exchange rate index of RMB comes from the monthly data published on the website of the world clearing bank (https://www.bis.org). Since July 21, 2005, China has implemented the floating exchange rate system with reference to a basket of currencies. In order to eliminate human interference, 138 monthly data from August 2005 to January 2017 are selected as the sample data.The import and export value of China's goods comes from the monthly data published on the website of the National Bureau of statistics of China (https://www.stats.gov.cn/).

3.3. Unit Root Test - ADF Test

If we directly regress the non-stationary data, we will get the wrong conclusion of pseudo regression. So we first test the stability of lnREER, lnM and lnX time series. In this paper, we use

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ADF test to judge whether there is unit root in the series.The inspection tool is Eviews6.0. The inspection results are as follows:

Table 1. Results of variable stability test

variable	T Statistics	1% critical value	P value	conclusion
lnREER	-3.164	-4.027	0.0962	Nonstationary
lnM	-2.258	-4.034	0.4530	Nonstationary
lnX	-2.909	-4.033	0.1635	Nonstationary
△lnX	-2.747	-2.584	0.0036	stable
△lnREER	-7.815	-2.582	0.0000	stable
△lnM	-3.401	-2.583	0.0008	stable

Note: Sequences with △ are differential sequences. The selection of lag term, trend term and intercept term follow the principle of AIC and SC minimum.

It can be seen that lnREER, lnM and lnX all accept the original hypothesis at the level of 1%, indicating that they are not stable.After the difference, the t-values of △ lnREER, △ lnM and △ lnX are all less than the minimum value at the significance level of 1%, that is to say, the alternative hypothesis is accepted, which shows that the three first-order difference sequences △ lnREER, △ lnM and △ lnX are all first-order integers, and there may be a long-term co-integration relationship between them.

3.4. Co-Integration Test - Engle-Granger Method

In this paper, Engle-Granger co-integration test is used for co-integration test, and regression analysis is made for the possible relationship.After that, ADF test was performed on the sequences.If the alternative hypothesis of unit root is accepted at the significance level, it indicates that there is a long-term relationship between the data.On the contrary, there is no long-term relationship.

3.4.1 real effective exchange rate and export

According to the unit root test, both lnX and lnREER are first-order integers sequences. The following regression equations can be obtained by OLS regression with Eviews6.0:

lnX=6.601088+1.532742lnREER

(0.536852) (0.115327)

(12.29592) (13.29035)

(0.0000) (0.0000)

R-squared=0.564986 Adjusted R-squared=0.561787

Durbin-Watson stat=0.679575 F-statistic=176.6335

It can be seen from the regression results that R2 = 0.5650 and R2 = 0.5618 after correction, indicating that the goodness of fit is not very high and the fitting effect is not very good, because only one real effective exchange rate index is used to explain the export variables; the p value of lnREER and coefficient of constant term are close to 0, indicating that the variables are highly correlated; the elasticity of export exchange rate is 1.532742 greater than 1, indicating that the export change is related to the exchange rate change.The F statistic of the equation is 176.6335, and the p value is close to 0, indicating that the equation is significant as a whole; D.W = 0.679575, indicating that there is a high auto-correlation in the residual.

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Then unit root test is carried out to verify the long-term relationship between exchange rate and export. The inspection results are as follows:

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-3.546110	0.0389
Test critical values:	1% level	-4.033727	
	5% level	-3.446464	
	10% level	-3.148223	

Figure 2. Residual ADF test results (export)

The results show that the T value is minus 3.443855, and the probability is 0.0389, which is smaller than the critical value of minus 3.446464 with 5% significance level. So this series is stable at 95% confidence level, which shows that RMB real effective exchange rate has a long-term relationship with exports at 5% significance level.

3.4.2 real exchange rate and import

As for the export analysis, first of all, the OLS regression before the co-integration of the real exchange rate index and the import value is carried out, and the following regression equation can be obtained:

lnM=7.179975+1.367801lnREER

(0.603542) (0.129654)

(11.89640) (10.54964)

(0.0000) (0.0000)

R-squared=0.4500449 Adjusted R-squared=0.446006

Durbin-Watson stat=0.494724 F-statistic=111.2949

It can be seen from the regression results that R^2 = 0.4500 and R^2 = 0.4460 after correction, the goodness of fit is not very high, indicating that the fitting effect is not very good, also because only a real effective exchange rate index is used to explain the import variables; the p value of lnREER and coefficient of constant term are close to 0, indicating that the variables are highly correlated, and the elasticity of import exchange rate is 1.367801, indicating that the change of import to exchange rate is relatively high.The F statistic of the equation is 111.2949, P value is close to 0, which indicates that the equation is also significant as a whole; D.W = 0.494724, which indicates that there is a high auto-correlation of the import residual.

ADF test is also conducted for OLS residual of import volume, and the conclusion is as follows:

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.807914	0.1973
Test critical values:	1% level	-4.033727	
	5% level	-3.446464	
	10% level	-3.148223	

Figure 3. Residual ADF inspection (imported)

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According to the test results, P value is 0.1973, t statistic is -2.807914, which is larger than the critical value of significance level of 10% -3.148223. Therefore, there is unit root in OLS residual data, so there is no long-term co-integration relationship between RMB real effective exchange rate and import.

3.5. Granger Causality Test

After studying the relationship between import value, export value and exchange rate, the next step is to use Granger causality test. Granger causality test was carried out for lnREER, lnX and lnM, and the results are shown in the following figure:

Table 2. Granger causality test results of variables

Original hypothesis	Freedom	f-statistic	P value	conclusion
lnREER is not the Grainger cause of lnM	130	2.40923**	0.0194	Reject the original hypothesis at 5%
lnM is not the Granger cause of lnREER	130	1.98250*	0.0549	Reject the original hypothesis at 10%
lnREER is not the Granger cause of lnX	134	5.96458***	0.0002	Reject the original hypothesis at the level of 1%
lnX is not the Granger cause of lnREER	134	8.92416***	0.0000	Reject the original hypothesis at the level of 1%

Note: * means significant at 10%, * * means significant at 5%, and * * means significant at 1%; The lag period is determined according to the optimal lag period determined by VAR model, and the lag period of lnX and lnREEER is four; The lag period of lnM and lnREER is eight.

According to the test results, at the 1% significance level, the original hypothesis of "lnREER is not the Granger cause of lnX" and "lnX is not the Granger cause of lnREER" is rejected, indicating that export is the Granger cause of the real effective exchange rate index, and the real effective exchange rate is also the Granger cause of export; at the 5% significance level, the original hypothesis of "lnREER is not the Granger cause of lnM" is rejected.The hypothesis indicates that lnREER is the Granger cause of lnM; at the 10% significance level, the original hypothesis that lnM is not the Granger cause of lnREER is rejected, indicating that lnM and lnREER have Granger causality at the 10% level.

3.6. Impulse Response Analysis

From the above analysis, we know that there is no long-term co-integration relationship between import and RMB's real effective exchange rate, while there is a long-term co-integration relationship between export and real effective exchange rate, but how long does it take for the change of the real effective exchange rate to be transferred to the export amount? Next, we will determine the time lag between exchange rate fluctuation and export through impulse response. The following figure shows the impulse response of the real effective exchange rate sequence lnREER and the export amount sequence lnX:

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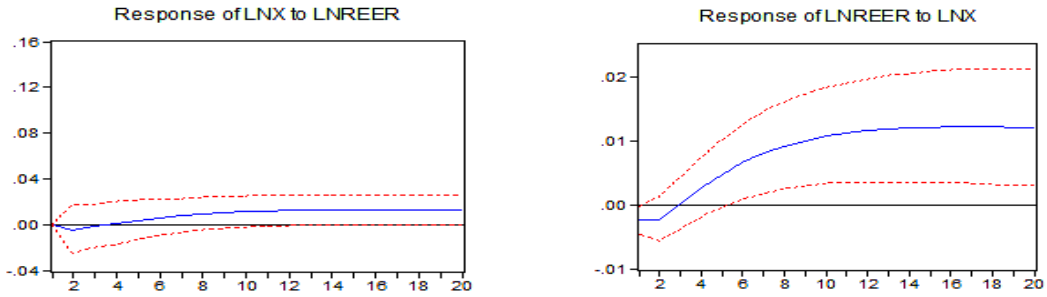

Figure 4. Pulse response of lnREER to lnX

Figure 4 shows that for a standard error shock to lnREER, the shock response of lnX to lnREER starts to be zero, then presents a negative shock wave effect, and reaches the maximum negative effect in the second phase.The force then rises and reaches zero again in the fourth phase.In the 13th period, it reached the peak, and the impact tended to be stable.In addition, a standard error shock is given to the variable lnX, and the effect on the variable lnREER is initially shown as a negative shock wave effect.Then gradually improve.It reached 0 in the third phase and peaked in the 13th phase.This shows that the effect of RMB real effective exchange rate on China's commodity exports is "J-curve effect", with a time lag of about one year.

4. CONCLUSION

This paper uses the methods of co-integration test and pulse response to analyze the relationship between the real effective exchange rate of RMB and China's foreign trade, and draws the following conclusions:

1. The elasticity of the export exchange rate is 1.532742, which indicates a 1% change in the effective exchange rate and a 1.532742% change in the export volume. The elasticity of the import exchange rate is 1.367801, which indicates that the effective effective exchange rate changes by one unit, and the import value changes by 1.367801 units. The sum of the absolute value of the elasticity of the import and export exchange rate is equal to 2.900543> 1, indicating that China meets the Marshall-Lerner condition. The depreciation of the real effective exchange rate of the RMB can improve China's foreign trade revenue and expenditure. Therefore, the real effective exchange rate of the renminbi can be changed through monetary policy to change the balance of China's foreign trade.

2. There is a "J-curve effect" on the impact of the real effective exchange rate of the RMB on China's merchandise exports. Based on previous scholars' analysis of China's trade environment, this conclusion is reasonable. It is generally believed that the reason for the lag effect of exchange rate transmission is the rigidity of the prices of imported and exported commodities.

3. The test shows that there is no long-term equilibrium relationship between the real effective exchange rate of RMB and imports, and the real effective exchange rate has little effect on imports. There is a long-term co-integration relationship between the real effective exchange rate of RMB and exports. The real effective exchange rate of RMB has a significant effect on China's exports.

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