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Analysis of the Impact of Foreign Exchange Reserves and RMB Exchange Rate

——Empirical Analysis based on VAR Model

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Abstract

In this paper, by selecting relevant data of China's foreign exchange reserves and the exchange rate of RMB to USD from 1999 to 2018, a VAR model of foreign exchange reserves and RMB exchange rate is established, and the dynamic relationship between foreign exchange reserves and RMB exchange rate indicators is empirically demonstrated using generalized impulse response and variance decomposition analysis. The empirical results show that there is a long-term equilibrium relationship between my country's foreign exchange reserves and the RMB exchange rate, that is, the growth or decline of foreign exchange reserves will cause the RMB exchange rate to rise or fall to a certain extent, but it is not significant in the short term. On this basis, suggestions suitable for Chinese foreign exchange scale setting are put forward.

Keywords

RMB exchange rate; Foreign exchange reserves; VAR model.

1. Introduction

Foreign exchange reserves refer to the foreign exchange portion of the international reserve assets held by the government of a country, and are assets held by a national monetary authority and can be exchanged for foreign currencies at any time [1]. With the continuous development of my country's foreign trade, the scale of my country's foreign exchange reserves has also grown larger. According to data released by the People's Bank of China, as of the end of October 2019, China's foreign exchange reserves reached $3.1 trillion, an increase of $2.95 trillion from 1999, a nearly 20-fold increase. Such drastic changes have also had a great impact on my country's economic development, and the RMB exchange rate has always been closely linked to Chinese foreign exchange reserves. Xu Chengming (2001) established a long-term equilibrium and short-term change model of Chinese foreign exchange reserves using the modeling method of cointegration theory, and concluded that there is a long-term equilibrium relationship between the RMB exchange rate and foreign exchange reserves [2]. Sun Yin (2010) used monthly data from 2005 to 2009 in China, and used multiple regression analysis to verify that the most important factor affecting the short-term changes in the RMB exchange rate is the amount of foreign exchange reserves, and the exchange rate of RMB will appreciation with the amount of foreign exchange reserves increasing [3]. Ma Xian (2004) found out the measurement model of China's foreign exchange reserve scale through empirical analysis, and concluded that due to China's managed floating exchange rate system, the change in foreign exchange reserve scale and exchange rate cannot show an effective linear correlation [4]. This article uses the VAR model to analyze the dynamic relationship between Chinese foreign exchange reserves and the RMB exchange rate, and proposes countermeasures and suggestions on the relevant conclusions.

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2. Model and data

This paper uses the vector autoregressive model proposed by Sims in 1980 as the main research method, referred to as the VAR model. The annual data of Chinese foreign exchange reserves and RMB exchange rate for a total of 20 years from 1999 to 2018 are selected to establish a VAR model of foreign exchange reserve scale and RMB exchange rate. All data are derived from the People's Bank of China and the State Administration of Foreign Exchange. The variable definition is shown in Table 1.

Table 1. variable definition table

Variable short name	Variable definitions	Variable short name	Variable definitions	Variable short name	Variable definitions
FR	foreign exchange reserves	FR1	Foreign exchange reserves after first-order difference	FR2	Foreign exchange reserves after second-order difference
ER	RMB exchange rate	ER1	RMB exchange rate after first-order difference	ER2	RMB exchange rate after second - order difference

3. Empirical analysis

3.1 Unit root test

The stability of the data or the co-integration between the variables is the foundation of the VAR model. If the data is stable, the VAR model can be directly used. If the data is not stable, the data must be stabilized by the logarithmic difference method. Therefore, the unit root test is performed on the time series data first, and the test results are shown in Table 2. It can be seen that the two variables tend to be of the same order at the second order difference.

Table 2. Unit Root Test

variable name	ADF value	P value	Stationarity
FR	-2.370080	0.1645	Unstable
FR1	-2.015069	0.2782	Unstable
FR2	-4.836922	0.0018	stable
ER	-1.262819	0.6228	Unstable
ER1	-2.266614	0.1921	Unstable
ER2	-4.110825	0.0064	stable

3.2 Determine the optimal lag order

Although FR and ER are both non-stationary time series, if there is a cointegration relationship between variables of the same order, the conditions for establishing a VAR model are still met. Before verifying the cointegration relationship of variables, first determine the best lag order of the VAR model. According to the principle of the information criterion, it can be seen from Table 3 that the optimal lag order is selected as the second order.

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Table 3.Test result of optimal lag order

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-207.7870	NA*	4.82e+09	27.97160	28.06600*	27.97059
1	-203.7984	6.381734	4.88e+09	27.97312	28.25634	27.97010
2	-197.7195	8.105171	3.86e+09*	27.69594*	28.16797	27.69091*
3	-196.6773	1.111684	6.35e+09	28.09031	28.75116	28.08327

3.3 Johansen cointegration test

The Johansen cointegration relationship test was carried out to avoid the phenomenon of "false regression" and to test whether there was a long-term cointegration relationship between the two variables. The test results are shown in Table 4. It can be seen that when the confidence level is 0.05, there is at least one cointegration relationship between the variables FR2 and ER2, which means there is a long-term correlation between the two.

Table 4. Johansen Cointegration Test Results

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.564547	19.10304	15.49471	0.0137
At most 1 *	0.357358	6.632507	3.841466	0.0100

Trace test indicates 2 cointegrating eqn(s) at the 0.05 level

3.4 AR root test

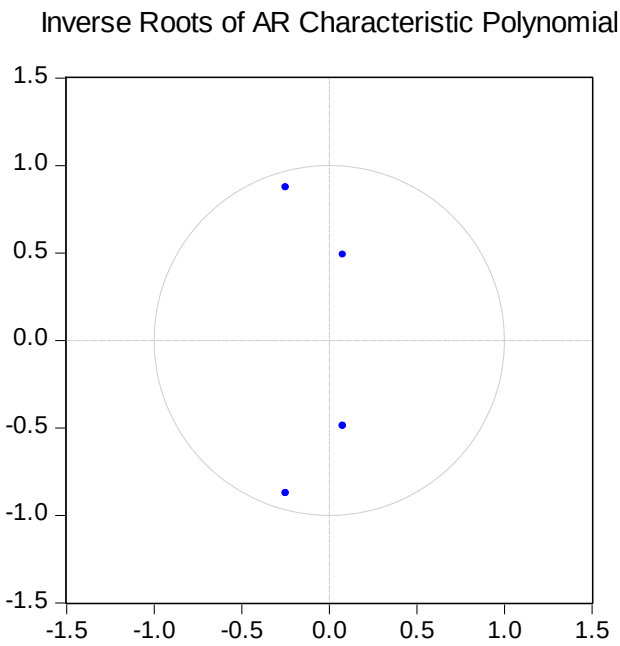

Fig 1. AR root model reciprocal test chart

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If the reciprocal of all root modules of the VAR model is less than 1, that is, all fall within the unit circle, then the model is stable. It can be seen from Figure 1 that all blue dots fall within the unit circle, so the AR root test passes and the VAR model is stable.

3.5 Granger causality test

In order to verify whether there is a short-term correlation between variables, the Granger causality test was conducted on variables FR2 and ER2. The probability p value of the test results was greater than 0.05, so the variable FR was not the Granger cause of the variable ER, that is, there was no short-term correlation between them. However, the long-term cointegration relationship between the two variables is verified, which indicates that the foreign exchange reserve has little impact on the RMB exchange rate in the short term. Because of China's floating exchange rate system, there is no effective correlation between the change of foreign exchange reserve scale and exchange rate in the short term.

Table. 4 Granger causality test

Null Hypothesis:	Obs	F-Statistic	Prob.
FR2 does not Granger Cause ER2	16	2.73031	0.1089
ER2 does not Granger Cause FR2		1.21384	0.3339

3.6 Analysis of impulse response function

Impulse response analysis can be used to analyze the dynamic correlation among variables and variables themselves in time. In this paper, the lag order of 40 periods is selected for analysis. The analysis results are shown in Fig. 2. It can be seen that the response value of FR2 to ER2 reaches the maximum value in the fifth period, and then gradually tends to be stable in the later reflection period. This shows that, on the whole, the impact of RMB exchange rate on the scale of foreign exchange reserves lasts for a long time, and the increase of exchange rate has a certain role in promoting the expansion of Foreign Exchange scale.

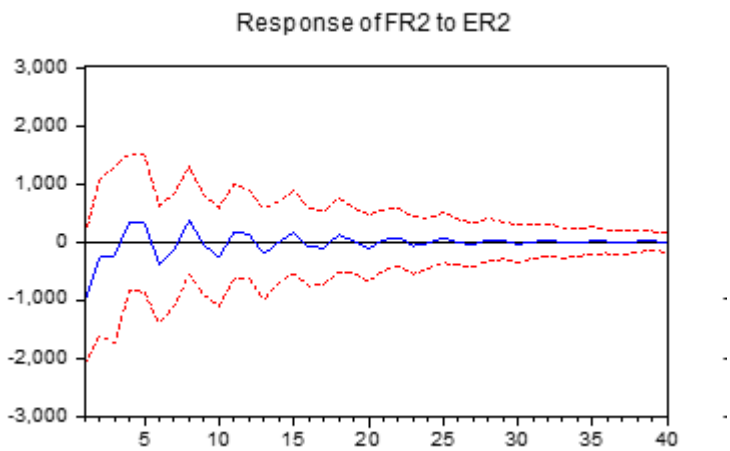

Fig. 2 Analysis results of impulse response function

3.7 Variance decomposition

The variance decomposition based on VAR model is to evaluate the importance of different structural shocks by analyzing the contribution of each structural shock to the change of endogenous variables.

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It can be seen from Fig.3 that the increase of RMB exchange rate has a certain role in promoting the expansion of foreign exchange reserve scale, and it has reached stability after the 10th period. The contribution rate of RMB exchange rate to the fluctuation of foreign exchange reserve is stable at about 43%.

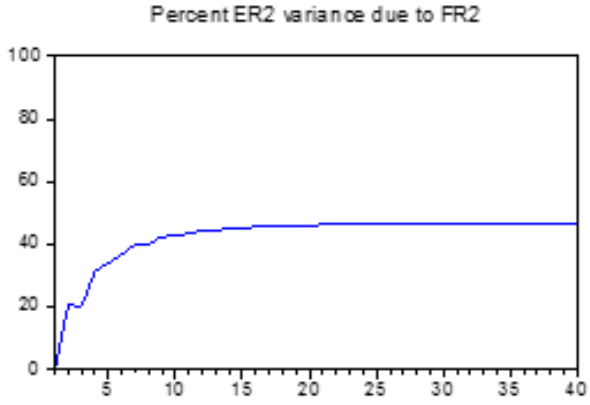

Fig. 3 Variance decomposition result

4. Research conclusions and recommendations

4.1 Conclusion

This paper studies the correlation between the scale of foreign exchange reserves and the fluctuation of RMB exchange rate. The results show that RMB exchange rate has a certain impact on China's foreign exchange scale, and promotes the expansion of Foreign Exchange scale in the long term. Based on the above analysis, we can use the relationship between foreign exchange reserves and RMB exchange rate to control the scale of China's foreign exchange on a stable basis.

4.2 Policy suggestion

First, China should improve the RMB exchange rate mechanism as soon as possible, control the RMB exchange rate at a reasonable and balanced level in combination with the existing domestic monetary policy, and adjust the RMB exchange rate timely in combination with the current situation of China's economic development, ensure that the RMB exchange rate is suitable for China's economic level, maintain the flexibility and stability of the RMB exchange rate, and reasonably control the scale of China's foreign exchange.

Second, China's large-scale and unbalanced foreign exchange reserves make China's economic development form grim. In order to solve this problem, China should adjust the proportion of foreign exchange reserves, establish the RMB foreign exchange market, and realize the diversification of foreign exchange reserve investment channels, the diversification of currency types and the diversification of comparison structure. In addition, China can make use of large-scale foreign exchange reserves to expand the import of high-tech commodities and ease trade disputes.

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