Research on the Relationship Between RMB Internationalization Index and Exchange Rate Based on VAR Model

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ABSTRACT. *With the development of China's economy, the internationalization of RMB has steadily advanced, and RMB has gradually become an internationally recognized currency for pricing, settlement and reserve. This paper uses VAR model, impulse response and variance decomposition to empirically study the quarterly data of China's 2013-2017 RMB Internationalization Index (RII) and USD/RMB exchange rate (ER). The results show that there is a long-term equilibrium relationship between the two indicators. And RII and ER promote each other, at the same time, RII stimulates ER more obviously. Finally, this paper analyzes the empirical results and the status quo of the internationalization of the RMB, and puts forward policy recommendations to promote the steady development of the internationalization of the RMB.*

KEYWORDS: *RMB Internationalization, Exchange Rate, VAR Model, Recommendations*

1. Introduction

Since the global financial crisis in 2008, the drawbacks of the US dollar-centered international monetary system have become more prominent. At the same time, China strengthened its strategic deployment of RMB internationalization. In recent years, the process of RMB internationalization has achieved many important results. In 2010, China successfully surpassed Japan and became the world's second largest economy after the United States. The international trade and capital scale continued to expand, laying the foundation for the RMB to become an international currency and helping it play an important role in international trade. With the construction of the AIIB and the continuous improvement of the "One Belt, One Road" strategy, China's role in the international political and economic arena has also been strengthened. The International Monetary Fund (IMF) officially included the RMB in the Special Drawing Rights (SDR) currency basket in 2016, which marked RMB

officially became the global reserve currency like the US dollar, the euro, the British pound and the Japanese yen.

As a quantitative indicator, the RMB Internationalization Index (RII) describes the actual use of the RMB in international economic activities, which rises in volatility and drives the adjustment of the foreign exchange market. On the one hand, the government regulates the value of RMB through monetary policy and exchange rate policy to promote the internationalization of RMB. On the other hand, the process of internationalization of RMB will also affect the change in the value of RMB, where the USD/RMB exchange rate is the most significant.

Jin Qi (2018) believes that the biggest obstacle to the current internationalization of RMB is that investors' lack confidence in RMB. The current task of the government is to solve the problem lies in maintaining the stability of RMB. It can be seen that exploring the long-term relationship and mechanism between the RII and the ER is of great significance for studying the process of RMB internationalization. This paper uses VAR model, impulse response and variance decomposition to empirically study the quarterly data of China's 2013-2017 RMB Internationalization Index (RII) and USD/RMB exchange rate (ER), aiming at promoting the internationalization of RMB.

2. The VAR model

The VAR model means that each equation in the system has the same variables to the right of the equal sign, and these right variables include the hysteresis values of all endogenous variables. An N-order unconstrained VAR model expression can be generally expressed as:

$$y_t = A_1 y_{t-1} + \cdots + A_N y_{t-N} + B_1 x_{t-1} + \cdots B_N x_{t-N} + \varepsilon_t$$

y_t represents an endogenous variable column vector, x_t representing exogenous variable vector, $A_1 \cdots A_N$ and $B_1 \cdots B_N$ are the coefficient matrix to be estimated, ε_t is error vector. Correlations between error variables within the error vector are allowed. But these error variables do not have autocorrelation, and have no correlations with $y_{t-1}, \cdots, y_{t-N}$ or $x_{t-1}, \cdots, x_{t-N}$.
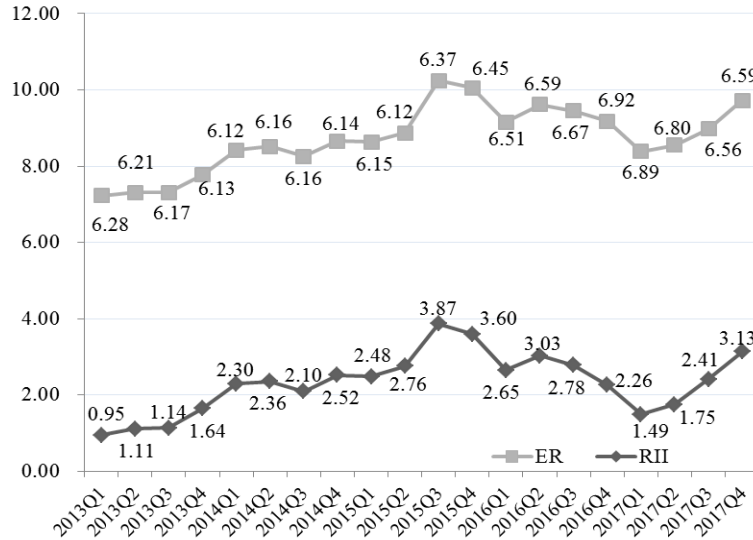
3. Data

Figure. 1 RII and ER's Changing trend

● **RMB Internationalization Index(RII)**

RII is compiled by the International Monetary Research Institute of Renmin University of China to dynamically characterize the international currency function of RMB in international trade settlement, international financial transaction pricing and international reserve currency. The RII Index establishes a three-level indicator system based on the global proportion of various functions of RMB (international pricing payment function and international reserve function), which is authoritative and scientific. The data in this paper comes from the "Internationalization of RMB Report" of the International Monetary Research Institute of Renmin University of China. As shown in Fig.1, the RII index rose from 0.95 in the first quarter of 2013 to 3.60 at the end of 2015, showing a rapid upward trend. Although the degree of internationalization of RMB has increased rapidly, compared with other major international currencies, the overall level is still relatively low.

● **USD/RMB exchange rate(ER)**

The exchange rate refers to the ratio or price of a country's currency to another country's currency. Exchange rate's changes have a direct regulatory effect on a country's import and export trade. The exchange rate used in this paper is USD/RMB exchange rate. Due to the close trade links between China and the United States in 2013-2017, the USD/RMB exchange rate can simplify research and be representative. The exchange rate data of this article is from the Information Network of the Development Research Center of the State Council. Fig.1shows that the USD/RMB exchange rate generally has an upward trend, and the fluctuation

range was similar to that of RII. But the actual relationship between RII and ER could not be clarified, which needs further research in the VAR model.

4. Empirical analysis

4.1. Empirical result

This paper constructs a binary VAR model of RRI and ER. The VAR model is obtained by using EViews6.0 software as follows:

$$\begin{bmatrix} RII_t \\ ER_t \end{bmatrix} = \begin{bmatrix} 0.96 \\ 0.06 \end{bmatrix}\begin{bmatrix} RII_{t-1} \\ RII_{t-1} \end{bmatrix} + \begin{bmatrix} -0.06 \\ 0.01 \end{bmatrix}\begin{bmatrix} RII_{t-2} \\ RII_{t-2} \end{bmatrix} + \begin{bmatrix} -3.02 \\ 0.81 \end{bmatrix}\begin{bmatrix} ER_{t-1} \\ ER_{t-1} \end{bmatrix} + \begin{bmatrix} 2.76 \\ 0.07 \end{bmatrix}\begin{bmatrix} ER_{t-2} \\ ER_{t-2} \end{bmatrix} + \begin{bmatrix} 2.10 \\ 0.55 \end{bmatrix}$$

4.2. Stability test—ADF test

To establish a VAR model, a stability test to ensure the stability of the data should be done first. We selected a lag order of 1, a first-order difference to the RII variable, and a second-order difference to the ER variable. The results of the stability test are shown in Tab.1.

Table 1 Stability test

Variable	t-Statistic	1% significant level	5% significant level	Lag order	Stability
RII	-3.2464	-3.8877	-3.0521	1	Stable
ER	-3.1251	-3.9228	-3.0659	1	Stable

It can be seen from Tab.1 that the t statistic values of RII and ER are smaller than the values at the 5% significant level. Therefore, the variables have good stability and can be used for the construction of the VAR model.

4.3. Granger causality test

On the basis of the stability test, Granger causality test is needed to verify the direction and relationship between RII and ER. The test results are shown in Tab.2.

Table 2 Granger causality test

Null hypothesis	F-statistic	Probability	Test result
ER does not Granger Cause RII	3.1809	0.0751	Accept
RII does not Granger Cause ER	3.0330	0.0830	Accept

As can be seen from Tab.2, the probability that ER does not Granger Cause RII is 0.075, So we accept the null hypothesis at a level of 5% significance. We can accept the hypothesis that RII does not Granger Cause ER.

4.4. AR eigenvalue test

In order to check whether the data has hysteresis, the AR test is performed on the VAR model, and the result is shown in Fig.2.
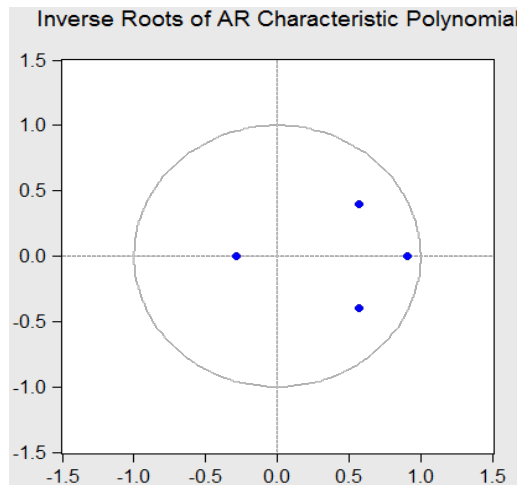

Figure. 2 AR unit root test

As shown in Fig.2, the reciprocal values of all roots of the variable are in the unit circle, indicating that the VAR model is stable, that is, there is no hysteresis in the data. So the impulse response function analysis can be performed.

5. Impulse response function analysis

In order to accurately analyze the degree of mutual contrast between RII and ER, we respectively applied a positive standard deviation information impact to RII and ER, and observed the response trajectory of RII and ER under impact, as shown in Fig.3.
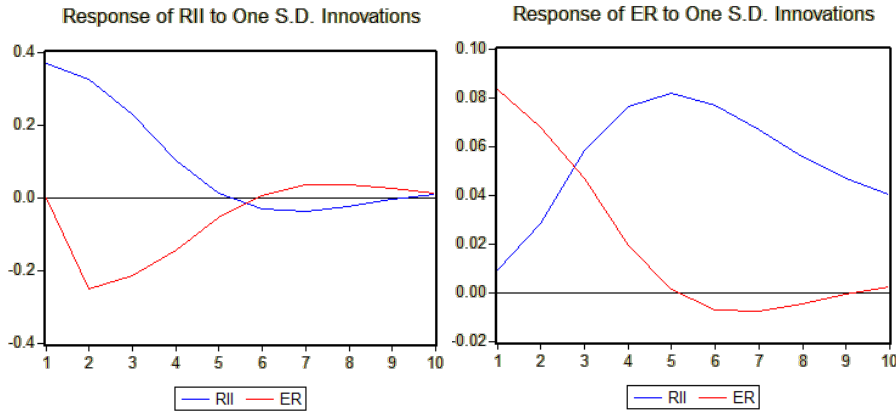
Figure. 3 Response of RII and ER to a standard deviation information

It can be seen from the first graph in Fig.3 that RII has no response to its own standard deviation perturbation in the first phase, and at the second phase the response is around -0.2, after which the whole system shows a rising law of change, and gradually return to an unresponsive state. The impact of ER on RII reaches about 0.4 in the first phase, showing a positive effect, but the overall trend shows a downward trend, and remains unresponsive from the sixth period. The economic implications of this conclusion are as follows: RII is jointly promoted by itself and ER, but ER has a greater impact on it. That is, RII relies more on the influence of ER, and its influence on itself is relatively weak.

As can be seen from the second figure in Fig.3, ER has a positive effect on the impact of RII, and a higher level of response is made in the fifth period, showing a performance of 0.08, followed by a slight decline, to the tenth phase, the response coefficient is basically stable at around 0.04. The response of ER to itself is as follows: in the first phase, the reaction is larger, showing 0.08. The third phase is down to 0.05 and lower than the response to RII, and then continues to show a downward trend. After the fifth phase, the level of impact is roughly flattened to an unaffected state.

The economic implications of this conclusion are as follows: ER is also influenced by itself and RII. In the short term, it is mainly driven by itself. But this kind of promotion gradually weakens with time, and the degree of RMB internationalization is the driving role is constantly increasing; in the long run, the degree of internationalization of RMB will exceed its own influence and become the leading force driving ER changes.

6. Variance decomposition analysis

In order to further understand the interaction between RII and ER, the variance of VAR_RII_ER model is decomposed, the contribution of each structural impact to RII and ER changes is analyzed, and the importance of mutual influence is further evaluated. The output results are respectively shown on Tab.3 and Tab.4.

Table 3 RII prediction variance decomposition

Period	Standard deviation	RII	ER
1	0.4354	100.00	0.00
2	0.6509	79.38	20.62
3	0.7487	72.91	27.09
4	0.7770	70.00	30.00
5	0.7798	69.52	30.48
6	0.7808	69.59	30.41
7	0.7832	69.51	30.49
8	0.7849	69.34	30.66
9	0.7855	69.24	30.76
10	0.7857	69.23	30.71

Table 4 ER prediction variance decomposition

Period	Standard deviation	RII	ER
1	0.0984	1.27	98.73
2	0.1308	7.19	92.81
3	0.1575	23.84	76.16
4	0.1828	41.90	58.10
5	0.2066	54.52	45.48
6	0.2257	61.74	38.26
7	0.2391	65.77	34.23
8	0.2480	68.14	31.86
9	0.2541	69.64	30.36
10	0.2586	70.66	29.34

We can analyze the data in Tab.2 to know that RII is mainly affected by itself. At the beginning of the first period, the influence level is 100%, and then it continues to decline, but it remains at 69% in the 10th period. The impact of ER on its forecast variance has been increasing from the second period, but only reached 30.71% in the tenth period, indicating that there are about 30% of the RII change is explained by the exchange rate in the long run, that is the role of ER in promoting the internationalization of RMB is relatively small.

From the data in Tab.4, it can be concluded that ER is affected by RII and its own fluctuations at the beginning, but it is at a high level by its own influence,

which is 98.73%. The influence of RII on it from the first period is strong. But the upward trend reached 54.52% in the fifth period, exceeding the impact of the ER on itself. It can be seen that the degree of internationalization of RMB has a stronger stimulus effect on ER.

7. Conclusions and policy suggestions

By establishing the VAR model and using the impulse response function analysis and variance decomposition method to analyze the RII and ER quarter data, it is found that there is a long-term equilibrium relationship between the two, and they promote each other. With the passage of time, the interaction effect is more obvious. Especially RII has a greater effect on ER. It can be seen that the adjustment of the exchange rate policy is very effective in promoting the process of RMB internationalization. The exchange rate fluctuation brought about by the internationalization of the RMB also brings risks that should not be ignored.

Therefore, it is necessary for the government to adjust or mitigate the risk impact through reasonable monetary policy, Foreign exchange policy and Exchange rate policy to maintain the stability of the currency of RMB. In order to promote the internationalization of the RMB and maintain the stability of the RMB, the following policy recommendations are proposed:

7.1. Develop the real economy and promote China's economic transformation

Strong economic strength and maintaining macroeconomic stability are the fundamental guarantees for the internationalization of the currency. The reason why the US dollar, the euro and the Japanese yen can play the role of the world currency for a long time is that their country's strong economic strength can provide sufficient capital supply. Therefore, China needs long-term sustainable economic development, which depends on the transformation and upgrading of China's economic industry. Nowadays, China is the world's largest manufacturing country, and its total import and export commodities and services are among the highest in the world. However, the problems of poor economic operation, low product technology and limited industry competitiveness are still very serious. That calls for the government deepening supply-side structural reforms, actively attracting foreign investment, carrying out international capacity cooperation, and promoting the transformation of labor-intensive industries into capital-intensive and technology-intensive industries. By promoting the construction of the "Belt and Road", domestic enterprises will be guided to go abroad, participate in global competition, use RMB to conduct bulk commodity pricing, and fully play the role of the RMB in international economic exchanges.

7.2. Promote the reform of the RMB exchange rate formation mechanism

Through the analysis of the data on model VAR, we can find that the development of RMB internationalization is closely related to the exchange rate. In the past few years, due to the continuous turmoil in the global financial market, in order to reduce the impact of the currency crisis brought by foreign capital on China, the government adopted more rigorous means to control the exchange rate to ensure the stability of RMB, but this over-regulation limits the development of RMB. In order to accelerate the process of RMB internationalization. Firstly, the government should gradually and moderately expand the fluctuation of the RMB exchange rate and increase the marketization degree of the exchange rate generation mechanism to adapt to the development needs of the market supply and demand relationship, so that the RMB exchange rate can keep closer to the real exchange rate of the market. Secondly, actively developing new foreign exchange products, opening up the accessibility of the foreign exchange market, strengthening innovation and regulation of relevant foreign exchange trading policies and rules, and establishing a stable, open and prosperous foreign exchange market is very necessary.

7.3. Establish a regional international financial center for RMB

Undoubtedly, the smooth progress of the internationalization of the RMB has a significant effect on the changes in the RMB exchange rate and it even affects the development of the entire financial market. From the history of the internationalization of currencies such as the US dollar, the euro, and the British pound, we can see that one of the conditions that the currency is accepted by the majority of the world is whether the currency issuer has a mature financial market. Compared with the western developed countries such as the United States and the United Kingdom, the development of China's financial market is much late. Although China's financial market has developed rapidly in recent years and the system has been continuously improved, the gap is still very obvious, and the market is not standardized and open. It still hinders the RMB from aligning with the world currency. Therefore, the government should learn from the experience of the internationalization of the developed countries' monetary internationalization, strengthen the construction of financial markets, expand the degree of market openness, and promote the flow of international capital. In addition, China's existing RMB offshore trading market only includes Hong Kong, Shanghai, Singapore and London. The limited number of offshore trading markets is not conducive to expanding the global circulation of RMB. The government can establish a group of regional financial center cities with high degree of openness and regional political and economic stability, achieve the goal of regionalization of RMB, and radiate to the global economic circle through the development of regional cities, continuously enhance the influence of RMB region and expand its trading. Role step by step. And finally China achieve the ultimate goal of RMB internationalization

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