Research on impulse response and variance decomposition analysis of co-integrated systems

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Abstract. The cointegration test explores whether a relationship of long-term equilibrium exists between the multi-dimensional series. It helps to exclude the possibility of spurious regression. As for the vector auto-regressive (VAR) model, it describes the interrelationship between endogenous variables. With impulse response and variance decomposition, the VAR model can further capture the dynamic response path of the dependent variable after being impacted by other variables, and the contribution rates of different variables to the impulse response of the dependent variable. In this paper, impulse response and variance decomposition analysis of cointegrated systems are adopted based on the VAR model to evaluate measurable data of RMB internationalization. The framework consists of four steps. First, the long-term equilibrium between variables after confirming the existence of cointegration relationship is explored. Second, the VAR model is adopted to consider the endogeneity between variables. Then, through the impulse response function, the dynamic response path of the system impacted by unit impulse is observed. Finally, combined with variance decomposition, further analysis is taken to realize the contribution rates of variables to the impulse. The results show that foreign influence has the greatest impact on RMB internationalization, followed by foreign exchange reserves. However, the corresponding paths of RMB internationalization still require to be adjusted.

1. Introduction
A complete study should not only explore the internal relations in the data, but also systematically analyze the research topics based on appropriate methods of data processing and analysis. In modeling analysis, non-stationary series will likely cause spurious regression, and the cointegration test can examine whether the regression equation is spurious according to the regression coefficients (Ma et al., 2020). If an eigenvalue test can be passed, it means that there is a long-term relationship of stable equilibrium between the tested variables (Tao and Bie, 2019). When studying the influencing factors of cross-border RMB settlement, Pang and Lu (2017) examined the existence of cointegration by the unit root test of residual series, followed by the maximum eigenvalue test. After obtaining the cointegration equation, they found that there is a long-term positive relationship between cross-border RMB settlement, foreign trade, exchange rate, and offshore RMB development. In addition, by adopting the cointegration test, He (2017) found the long-term equilibrium among capital flows, export trade, and foreign exchange reserves.
The vector auto-reflective (VAR) model refers to a method of multivariate analysis, and it is often applied in research related to data analysis (Wang et al., 2017; Wang et al., 2019; Liu and Lyu, 2021). The model is composed of variables in multivariate time series. Considering the endogeneity among variables, multiple equations are established at the same time, and the regression relationship is established between each endogenous variable and the lag function of all endogenous variables in the system to describe the interrelationship between variables in time series (Pang and Lu, 2017). Using the VAR model, Liu (2019) conducted an empirical study and found a dynamic linkage between RMB internationalization and foreign trade in China’s coastal areas in the short term. Xie and Liu (2019) also applied the VAR model to verify the conjecture of two-way effects between RMB exchange rate misalignment and foreign trade. The results show that export trade has a significant impact on exchange rate misalignment, while there are two-way effects between import trade and exchange rate misalignment.

The VAR model emphasizes the analysis of intertemporal relationships among endogenous variables, and along with impulse response analysis, it can present the dynamic change and duration of the impact on the dependent variable (Liu and Lyu, 2021). The impulse response function can capture the path of dynamic response when the dependent variable is impacted by other variables (Ouyang and Sun, 2019). By using impulse response, Ding and Ji (2014) conducted an empirical study on China’s foreign trade, real exchange rate, and economic growth. They found that, when given one-unit shock, both import and export trade had a significant stable positive effect on economic growth. In addition, when given one unit shock, the real exchange rate had a weak positive effect on economic growth in the early stage. Then, such effect becomes gradually strengthened and will eventually lead to the increase of investment and output to drive the national economy. According to the results of impulse response, Qian and Sha (2018) argued that the expansion of economic and trade scale will have a long-term positive effect on RMB internationalization. However, the impact of the capital market on RMB internationalization is negative. Therefore, they considered that the prosperity of the capital market brought by speculative hot money will not promote the sustainable development of RMB internationalization.

The impulse response analyzes the direction and intensity of the impact of shock on the dependent variable in the system, and variance decomposition will further divide the contribution rates of all variables to the impact on the dependent variable by analyzing the relative degree of each disturbance factor influencing the dependent variable (Zhou et al., 2018). When the dependent variable is disturbed by other variables, variance decomposition can attribute and decompose the fluctuations into different parts related to different variables, so as to show the impact of each variable on the dependent variable and better present the contribution rates of different variables (Liu, 2019; Ruan et al., 2017). Through the variance decomposition analysis, He (2017) investigated the impact of China’s capital flows and export trade on foreign exchange reserves, and found that the foreign direct investment has increasingly affected foreign exchange reserves with a contribution rate up to 42.5%. The export trade has a low impact on foreign exchange reserves, while it shows stability featured by slight but sustained growth.

On the basis of ensuring the overall accuracy and systematic integrity, this paper adopted a multi-angle analysis to study the measurable data and explore their equilibrium relationship, internal connection, dynamic response paths, and contribution rates. In terms of the cointegration relationship, it is found that there is a long-term equilibrium among import trade, export trade, foreign exchange reserves, offshore market development, cross-border trade settlement, and RMB internationalization. Then, this paper established the VAR model to explore the interrelationship between these factors. Moreover, through impulse response and variance decomposition, this paper further analyzed the dynamic impacts and contribution rates of these factors to RMB internationalization. The results show that RMB internationalization itself acts as the greatest influence factor, followed by foreign trade, and it declines in the contribution rates of foreign exchange reserves, offshore market development, and cross-border trade settlement in turn. The process of RMB internationalization cannot be accomplished overnight, but need to be propelled by multiple factors and ways.
2. Data description and analytical methods

2.1. Data description

Data used in the empirical study of this article include China’s import and export volumes, foreign exchange reserves, offshore market RMB deposit of Hong Kong, the proportion of cross-border trade settlement in RMB to foreign trade volume, and RMB internationalization index from the fourth quarter of 2009 to the fourth quarter of 2018, see Table 1 for related explanations. RMB internationalization index (RII) is explained variable. RMB is compared with other currencies in the world to describe the level of RMB internationalization from the perspective of the functions of money. Within the scope of 0 to 100, the higher the index, the higher the realization degree of the functions of RMB, thus we think the goal of RMB internationalization is achieved more adequately.

Table 1. Description of the variables.

| Types of variables | Names of variables | Purposes of variables selection | Symbols | Data sources |
|--------------------|--------------------|---------------------------------|---------|--------------|
| Explained variable | RMB internationalization index | To measure the realization degree of settlement, investment and reserve functions of RMB | RII | RMB Internationalization Report of International Monetary Institute of RUC |
|                    | Export volume      | To propose recommendations for the current foreign trade by depicting the relationships between import and export variables and other variables | EXP    | General Administration of Customs of China, Wind Database |
|                    | Import volume      |                                  | IMP    | Wind Database |
|                    | Foreign exchange reserves | To analyze China’s foreign exchange reserves and identify possible problems | REV    | State Administration of Foreign Exchange |
|                    | RMB deposit of Hong Kong, China | To measure the degree of offshore market development and the RMB liquidity in the international market | OFD    | Wind Database |
|                    | The proportion of cross-border settlement in RMB | To measure the development of RMB as settlement currency | CBS    | State Administration of Foreign Exchange, Wind Database |

There are five explanatory variables in the empirical study of this article, namely import and export trade, foreign exchange reserves, offshore market and cross-border trade settlement in RMB respectively. Studying export trade (EXP) and import trade (IMP) separately helps deepen the understanding of China’s foreign trade structure, thus enabling the pertinent analysis of the export-oriented economic strategy. Foreign exchange reserves are linked up with the international balance of payments and exchange rate of domestic currency, and foreign exchanges used in corporate import and export activities are related to it. China’s official foreign exchange reserves (REV) help people know and understand the trend and growth rate of its size. RMB deposit of Hong Kong, China, is an embodiment of the size of RMB capital in the offshore market, while the amount of overseas deposits reflects the demand of economic activities like trading, which is expressed by OFD. Cross-border trade settlement is one of the functions of a world currency. This article chooses the proportion of cross-border settlement in RMB to total foreign trade volume as the yardstick of the realization degree of the settlement function of RMB, which is expressed by CBS.

2.2. Analytical methods

This study investigates the relationships between these variables on the basis of the VAR model, for the VAR model can be used to analyze and predict the developments of multiple related economic variables. RMB internationalization index is the primary explained variable in this article, while import trade, export trade, cross-border trade settlement, the development of offshore market, and
foreign exchange reserves are explanatory variables, and there is endogeneity among the variables. Furthermore, the VAR model can better examine their endogenous relationships, straighten out the dynamic relationships between the explained variable and the five explanatory variables, and help us identify the combined effects of foreign trade. In light of explained variable and explanatory variables investigated in this study, the specific expression of VAR(p) model is as follows.

\[
\begin{bmatrix}
\ln RII_t \\
\ln EXP_t \\
\ln IMP_t \\
\ln REV_t \\
\ln OFD_t \\
\ln CBS_t
\end{bmatrix} = \begin{bmatrix}
\alpha_1 \\
\alpha_2 \\
\alpha_3 \\
\alpha_4 \\
\alpha_5 \\
\alpha_6
\end{bmatrix} + \sum_{i=1}^{p} \begin{bmatrix}
\beta_{11,i} & \ldots & \beta_{16,i} \\
\vdots & \ddots & \vdots \\
\beta_{61,i} & \ldots & \beta_{66,i}
\end{bmatrix} \begin{bmatrix}
\ln RII_{t-i} \\
\ln EXP_{t-i} \\
\ln IMP_{t-i} \\
\ln REV_{t-i} \\
\ln OFD_{t-i} \\
\ln CBS_{t-i}
\end{bmatrix} + \begin{bmatrix}
\varepsilon_{1t} \\
\varepsilon_{2t} \\
\varepsilon_{3t} \\
\varepsilon_{4t} \\
\varepsilon_{5t} \\
\varepsilon_{6t}
\end{bmatrix}
\] (1)

where in the VAR model, the variables are six-dimensional endogenous variables, \(\varepsilon_t\) denotes disturbance variables, the lag order of the model is \(p\) order. To smooth out the drastic fluctuations of data and eliminate the effects of data heteroscedasticity, all variables use natural logarithms, to make data have more practical significance.

Since all the variables used in this study are time series data, we use the ADF test to judge whether the variables are stationary to prevent “spurious regression” from happening in the model. Table 2 shows the results of the ADF test of the variables after logarithmic processing. In the test, within 95% confidence interval, \(\ln RII\), \(\ln OFD\), and \(\ln CBS\) are stationary. After first-order difference, all the variables passed the stationarity test and the next cointegration test can be conducted.

**Table 2. The augmented Dickey-Fuller (ADF) test.**

| Variables | ADF value | 1% critical value | 5% critical value | 10% critical value | Conclusion |
|-----------|-----------|-------------------|-------------------|-------------------|------------|
| \(\ln RII\) | -4.7032 | -3.6268 | -2.9458 | -2.6115 | Stationary |
| \(\ln EXP\) | -2.7558 | -3.6268 | -2.9458 | -2.6115 | Nonstationary |
| \(\ln IMP\) | -2.2369 | -3.6268 | -2.9484 | -2.6129 | Nonstationary |
| \(\ln REV\) | -2.5403 | -3.6268 | -2.9484 | -2.6129 | Nonstationary |
| \(\ln OFD\) | -5.0610 | -3.6268 | -2.9484 | -2.6129 | Stationary |
| \(\ln CBS\) | -13.5565 | -3.6268 | -2.9458 | -2.6115 | Stationary |
| \(D(\ln RII)\) | -3.4437 | -2.6327 | -1.9507 | -1.6111 | Stationary |
| \(D(\ln EXP)\) | -8.0729 | -2.6327 | -1.9507 | -1.6111 | Stationary |
| \(D(\ln IMP)\) | -8.9988 | -2.6327 | -1.9507 | -1.6111 | Stationary |
| \(D(\ln REV)\) | -2.7700 | -2.6327 | -1.9507 | -1.6111 | Stationary |
| \(D(\ln OFD)\) | -2.0560 | -2.6327 | -1.9507 | -1.6111 | Stationary |
| \(D(\ln CBS)\) | -5.8163 | -2.6327 | -1.9507 | -1.6111 | Stationary |

**Table 3. The maximum eigenvalue test.**

| Null hypotheses | Eigenvalue | Max. Eigen. statistics | 5% critical value | p-value |
|-----------------|------------|------------------------|-------------------|---------|
| 0 cointegration equation* | 0.9045 | 77.5008 | 40.9568 | 0.0000 |
| At least 1 cointegration equation* | 0.7409 | 44.5276 | 34.8059 | 0.0025 |
| At least 2 cointegration equations* | 0.6020 | 30.4044 | 28.5881 | 0.0290 |
| At least 3 cointegration equations* | 0.5150 | 23.8777 | 22.2996 | 0.0299 |
| At least 4 cointegration equations | 0.3714 | 15.3229 | 15.8921 | 0.0612 |
| At least 5 cointegration equations | 0.1441 | 5.1338 | 9.1645 | 0.2691 |

Note: * means significant at 5% level.

This study uses Johansen’s approach to test the VAR model built to judge whether there are long-term stable relationships between the variables. The variables \(\ln RII\), \(\ln EXP\), \(\ln IMP\), \(\ln REV\), \(\ln OFD\), and \(\ln CBS\) of the VAR model built in this study are all first-order integrated series, which are all suitable for cointegration test. The test results are shown in Table 3. In the maximum eigenvalue test
Table 3, the null hypothesis of zero cointegration equation is rejected, therefore, there are cointegration relationships between the variables. One of the cointegration relationships is:

\[
D(\ln RRI_t) = 20.1138 \times D(\ln EXP_t) - 2.3633 \times D(\ln IMP_t) - 1.7587 \times D(\ln REV_t) + 3.7023 \times D(\ln OFD_t) + 1.0726 \times D(\ln CBS_t) - 2.8785 \tag{2}
\]

### Table 4. Criteria for lag order selection.

| Lag | LogL  | LR    | FPE   | AIC   | SC    | HQ    |
|-----|-------|-------|-------|-------|-------|-------|
| 0   | 204.5840 | —     | 1.64E-13 | -12.4115 | -12.1367* | -12.3204 |
| 1   | 249.9643 | 70.9068* | 9.53E-14 | -12.9978 | -11.0740 | -11.3601 |
| 2   | 281.8315 | 37.8423 | 1.59E-13 | -12.7395 | -9.1667 | -11.5552 |
| 3   | 337.3809 | 45.1339 | 9.34e-15* | -18.4855* | -8.7396 | -16.2081* |
| 4   | 338.7679 | 47.4193 | 1.02E-13 | -13.9613 | -11.6149 | -12.2305 |

Note: * denotes lag order selected by the criterion.

According to the results shown in Table 4, lag order 3 is chosen by the three of six selection criteria. Additionally, the overall results show that the lag order 3 of VAR, namely VAR(3), is enough. Finally, the stability test of the VAR model can be judged by whether the reciprocal values of all the eigenvalues in the model are less than 1. If the reciprocal values are less than 1, then the model is stable. The test results show that all the unit roots in the model are less than 1, which means VAR(3) model is stable, the result of fitting is good, the analysis below is valid.

### 3. Empirical analysis

#### 3.1. Granger causality test

Table 5 shows that \(\ln EXP\), \(\ln MP\), \(\ln REV\) and \(\ln OFD\) all show Granger causality with \(\ln RRI\). First, special geographical location and financial system make Hong Kong the principal market for the international circulation of renminbi, and related policies facilitate the development of the offshore market of Hong Kong. RMB expands its circulation size through the medium of the offshore market, the offshore market offers investors at home and abroad more diverse ways and channels of investment and financing and accelerates the progress of RMB internationalization. Second, both \(\ln EXP\) and \(\ln MP\) are the Granger cause of \(\ln RRI\), among which \(\ln EXP\) and \(\ln RRI\) have causal effects upon each other. The improvement of the settlement function of RMB benefits from the growth of foreign trade, further internationalization of RMB enhances transaction safety for foreign trade companies and the diversity of settlement currency options. Last, \(\ln OFD\) is also the Granger cause of \(\ln RRI\), the size of foreign exchange reserves can influence the demand and supply of domestic currency as a world currency and is one of the important methods for a country to maintain macroeconomic stability.

### Table 5. The Granger causality test.

| Null Hypothesis | F-value | p-value |
|-----------------|---------|---------|
| \(\ln EXP\) not the Granger cause of \(\ln RRI\) | 3.1197 | 0.0588 |
| \(\ln MP\) not the Granger cause of \(\ln RRI\) | 2.6480 | 0.0873 |
| \(\ln REV\) not the Granger cause of \(\ln RRI\) | 4.8374 | 0.0151 |
| \(\ln OFD\) not the Granger cause of \(\ln RRI\) | 5.6363 | 0.0084 |
| \(\ln CBS\) not the Granger cause of \(\ln RRI\) | 2.2600 | 0.1218 |
| \(\ln RRI\) not the Granger cause of \(\ln EXP\) | 6.6679 | 0.0040 |

The evidence supporting that \(\ln CBS\) is the Granger cause of \(\ln RRI\) is somewhat weak. The higher the proportion of currency of a country in international trade settlement, the more powerful the economic discourse power and leadership that the economy of this country owns. At the early stage of RMB internationalization, cross-border trade achieved huge growth and was at the stage of rapid growth owing to the expansion of the pilot programs and the development of the Belt and Road
initiative. Nonetheless, its role as a driver for RMB internationalization was not satisfactory, as cross-border trade has not experienced a qualitative leap and its advantage in quantitative growth remains superficial. Cross-border trade settlement has internal and external problems in the development process: the external problem is that the global dominance of US dollar is unshakable; internal troubles include disequilibrium of balance of payments, volatility of RMB, undesirable development of foreign trade, and underdeveloped reflux mechanism of RMB. Under multifold pressure, cross-border trade settlement has not exerted its due driving effect.

3.2. VAR model-based impulse responses
Figure 1 shows the impulse responses of RMB internationalization to different factors. Panel A is the impulse response of RII to export trade. When export volume increases, its effect changes from negative to positive, reaches a peak in the third phase and then hovers around 0. In Panel B, the impulse response trend of RII to import trade is different from export trade, the effects change from positive to negative, hit rock bottom in the fifth phase, and the subsequent trend is roughly the same with that of export trade. We think that an increase in foreign trade volume is accompanied by the expansion of trade size of a country, to the benefit of the internationalization of the currency of this country. The trade structure of China is highly unbalanced that exports are largely low value-added primary commodities, and for these less heterogeneous exports, exporters tend to choose a currency with low transaction costs for settlement to increase profits; for import trade, we do not have bargaining power and the initiative to choose trading currency over energy products that China needs more as the heart of industry. To sum up, there are still many shackles to stimulate foreign trade to play a positive role in the current context at a deeper level.

Figure 1. The impulse response of RMB internationalization to each factor.

Panel C shows the impulse response of RII to foreign exchange reserves. A positive impact of foreign exchange reserves hardly had any influence at the initial stage, produced negative response in the third phase, and then response slowed down gradually and turned into weak positive effects. In light of the demand for currency as the world currency, considerable foreign exchange reserves brings a stable exchange rate, the market signal released is positive and optimistic, the will to hold RMB upsurges, and the demand for it increases. Yet, from the supply side, RMB and other foreign exchange reserve currencies can substitute one another to some extent, enormous foreign exchange reserves means foreign currency is used more frequently as settlement currency in foreign trade, which weakens the settlement function of RMB.

Panel D shows the impulse response of RII to offshore RMB deposit of Hong Kong. Offshore RMB deposit of Hong Kong generated negative effect in the second phase after it rose, negative effects subsided until the fourth phase, and generated weak positive response in the seventh phase in
the end. Normally, the more the offshore RMB deposit, the stronger the demand for international investment and financing, then the broader and the deeper the circulation of RMB in the international market. However, for the offshore market of Hong Kong, the inflow of hot money brings about the dual price of RMB in two regions, and the resultant interest margin and CNH-CNY spread exactly bring about an opportunity to short-term capital flows with the purpose of arbitrage. Restrained by capital account and financial system, overseas demand for RMB for various purposes may have a negative influence on RMB internationalization. Yet, it is certain that mature offshore RMB market of Hong Kong will consolidate walls against overseas financial risks for China once it completed.

Panel E shows the impulse response of RII to the proportion of cross-border trade settlement in RMB. An increase in the proportion of cross-border trade settlement to total import and export volume can generate positive effects, which proves that the realization of trade settlement function has a positive influence on the internationalization process. However, the positive effects declined quickly in the second phase and even turned to negative effects, and effect value fluctuated around 0 after the fifth phase. China’s cross-border trade needs changes to make up for the negative effects brought by the disadvantages of foreign trade and to play its role as a real driver. Currently, in China, cross-border trade settlement has not played its role to force a financial reform on RMB yet, and its role in the course of RMB internationalization process is only from functions, without working with other economic factors to generate greater positive effects. Finally, Panel F shows the impulse response of RII to its own influence. The rise of RII has strong positive effects on itself, the positive effects tapered off in the fourth phase and fell into the bottom of negative effects over time, then the negative effects disappear.

3.3. VAR model-based variance decomposition
Through VAR model-based variance decomposition, Figure 2 and Figure 3 explain the contribution rate of different factors to RMB internationalization from different perspectives. As shown in Figure 2 and Figure 3, RMB internationalization itself had the highest contribution rate to RMB internationalization, but its contribution rate decreased from 72.3% to 39.5% over time. In light of the impulse response shown in Figure 1, positive response made more contribution at the early stage, while negative response has less influence at the late stage. Looking back at the two financial crises in 1997 and 2008, China was less impacted by them than other countries owing to its capital control, and it was the Chinese economy which remained vigorous in the time of the crises that gave Chinese citizens and international investor confidence. In 2009, by virtue of the growth of the Chinese economy, RMB internationalization showed robust momentum and its contribution rate was the largest.

Moreover, with regards to export trade, Figure 2 and Figure 3 show that the influence of export trade fell after it rose and stabilized at around 18.5% in the end. The positive effects of the expansion of trade size and cross-border settlement brought by the growth of export trade reached a peak in the second phase. Since China’s export trade structure is imbalanced and advantages of commodities are inadequate, the positive effects of export trade are largely attribute to superficial benefits of trade volume, and the quality of trade at a deeper level is poorly developed.

In comparison, the contribution rate of import trade is stable between 4.5% and 5.8%, which indicates that the influence of import trade on RMB internationalization is stable yet limited. China’s imports are mainly divided into two categories: one is crude oil, iron and copper ore, grain, and other products that satisfy industrial production and basic living needs of citizens; the other is integrated circuit, precise instrument, medical facilities and other weak products that China is unable to manufacture and produce on its own. China has a huge demand for the former and is heavily reliant on them, trade relations are stable yet with a slight advantage in pricing; while the latter reveal the weakness of China in science and technology. On the whole, the positive effects of foreign trade need to coordinate with the domestic industrial level and the development of the real economy.
In addition, Figure 2 and Figure 3 show that the contribution rate of foreign exchange reserves was on the rise steadily and ended in 18.7%. The macro meaning of foreign exchange reserves to a country is that it stabilizes the exchange rate, the Chinese government can maintain the stability of RMB exchange rate by trading foreign exchanges. While the stability of the exchange rate makes foreign trade settlement more safe and convenient, and eventually influences the fluctuations of the international balance of payments. Besides, the contribution rate of the offshore market of Hong Kong to RMB internationalization rose from 2.7% to 11.2%, and then slowed down to 9.1%. The main reason is that there are flaws in the reflux mechanism of RMB, and the CNH-CNY spread and speculation in offshore and onshore markets weaken the due exchange rate pricing power of the onshore market and hence put the offshore market in a dilemma.

Finally, the contribution rate of cross-border trade settlement rose after it fell, and stabilized at around 8.5% in the tenth phase. Cross-border trade settlement links foreign trade with foreign exchange reserves and offshore market into a unique RMB internationalization operating system of China. The coordination between cross-border trade and offshore market earlier contributed to the success of RMB being included in SDR. However, the disadvantages of foreign trade weaken the valuation basis of RMB, together with the insufficiency of related service facilities, making it hard for trade settlement as the superstructure of the two to increase its contribution rate. The results of the variance analysis show that except RII itself, export trade and foreign exchange reserves are the largest contributors, followed by the offshore market of Hong Kong and cross-border trade settlement, and import trade makes the smallest yet the most stable contribution.
4. Conclusions

According to empirical research results in this paper, the direct influence of foreign trade on RMB internationalization is nearly 20%, while the indirect effects of it through other factors are fluctuant and negative in the short run yet are positive in the long term. Hence, foreign trade is an important factor influencing future further advancement of RMB internationalization. The trade size, structure, and settlement model all have driving effects to varying degrees. Yet, China does not have obvious advantages compared with other countries in terms of foreign trade structure, production model, and technology, which may hinder further development of RMB internationalization. This study considers that the foreign trade industry needs to actively resolve trade frictions when adjusting the trade structure and promoting industrial optimization and upgrade.

Furthermore, China’s cross-border trade settlement has some difficulties in the development process. The USD and EUR have the biggest discourse power in the current world economy, and the yen and pound are powerful rivals against the RMB. In addition, due to combined action of the foreign trade and offshore market, cross-border trade settlement in RMB still faces challenges in the process of development. While the offshore market faces two major problems: how to avoid financial risks behind international investment, and how to work with onshore RMB market to maintain RMB pricing power together. In brief, the cross-border trade and offshore market need to break free from the shackles of the overall economy and institutional environment to seek new growth. The significance of foreign exchange reserves to the development of RMB internationalization is self-evident, but the pros and cons of China’s high foreign exchange reserves and what management model can facilitate the future development of RMB internationalization need to be further explored.

The economic strategy of a country is not changeless, and it works only when it accords with the current national conditions and international situation. Foreign trade strategy of China always takes export as the emphasis of economic construction, but today the development of the Chinese economy no longer simply pursues employment and economic goals, so rapid growth is no longer the aim of Chinese economic development. Foreign trade should not take size as the only yardstick, but should turn eyes to structural optimization and risk reduction on this basis. For a development entity based on foreign trade, the utility of its cross-border trade settlement relies on the development of foreign trade, and its offshore market and foreign exchange reserves are also closely bound up with cross-border trade. RMB internationalization should keep pace with the times after learning from other currencies, then create its own up-to-date model according to circumstances, and exploit its guiding role and the stabilizing function of foreign exchange reserves on the basis of adjusting foreign trade strategy. Moreover, it should be able to reform and innovate the model of original offshore market paired with cross-border trade settlement and take the initiative to increase the export of capital to go with the sustainable development of transnational corporations.

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References

[1] Ma D, Luo Y and Zhang Y 2020 The impact of RMB internationalization on China’s financial risks Finance Forum 25(3) pp 7-17.
[2] Tao S and Bie Y 2019 Research on the interactive relationship between commodity pricing power and currency internationalization — An empirical analysis based on American data Shanghai Journal of Economics 5 pp 103-117.
[3] Pang Y and Lu A 2017 An analysis on the development of RMB settlement in cross-border trade and its influencing factors International Business Research 38(5) pp 62-74.
[4] He W 2017 Research on the impact of capital flow and export trade on China’s foreign exchange reserves: Empirical study based on VAR model Price: Theory & Practice 1 pp 114-117.
[5] Wang Y, Tsai J and Chen T 2017 Renminbi internationalization: Progress and comparison
Journal of Discrete Mathematical Sciences and Cryptography 20(6-7) pp 1309-1313.

[6] Wang Y, Tsai J and Chen X 2019 The impact of RMB internationalization and international situations on China’s foreign exchange market: Dynamic linkages between USD/CNY and SDR/CNY Emerging Markets Finance and Trade DOI: 10.1080/1540496X.2019.1624521

[7] Liu Y and Lyu Y 2021 VAR model empirical analysis based on nonstationary time serie Journal of Qufu Normal University (Natural Science) 47(1) pp 41-46.

[8] Liu L 2019 Impacts of RMB internationalization on China's foreign trade: A comparative case study of the coastal areas of eastern China and the border areas of western China Journal of Yunnan Normal University (Humanities and Social Sciences Edition) 51(1) pp 66-75.

[9] Xie F and Liu T 2019 Study on the two-way effect of RMB exchange rate misalignment and import and export trade Reform 3 pp 128-138.

[10] Ouyang H and Sun Z 2019 Real exchange rate, technological innovation and upgrading of foreign trade Journal of Industrial Technological Economics 38(6) pp 55-62.

[11] Ding Z and Ji C 2014 Empirical study of China’s import, export, real exchange rate and economic growth based on VAR model Journal of International Trade 12 pp 91-101.

[12] Qian Y and Sha W 2018 Internationalization of RMB: Degree measurement and determinants analysis: A perspective of offshore stocks of RMB Accounting and Economics Research 32(5) pp 99-112.

[13] Zhou Z, Zhou Z and Pan Y 2018 RMB exchange rate trend and RMB internationalization — An empirical study based on VAR and SVAR models Shanghai Finance 10 pp 65-70.

[14] Ruan X, Zhang Y and Feng J 2017 Will RMB devaluation shake Hong Kong's status as an offshore RMB financial center? — Empirical analysis based on VAR model Modernization of Management 37(3) pp 1-4.