

Research on the Two-way Influence of RMB Internationalization Degree and RMB Exchange Rate Fluctuation

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ABSTRACT

Currency is a crucial part of the international payment system, and the international payment proportion of the national currency is an important embodiment of the international status. In this paper, the proportion of RMB international payment is selected to define the degree of RMB internationalization, and the TVP-SV-VAR model is constructed to study the two-way relationship between the degree of RMB internationalization and the RMB exchange rate. The empirical study shows that there is a significant two-way relationship between the degree of RMB internationalization and the RMB exchange rate. The rise of the exchange rate has a more significant positive impact on the degree of RMB internationalization in the short term, and the positive impact of the degree of RMB internationalization on the exchange rate increases with time. Therefore, China should coordinate its exchange rate policy with the process of RMB internationalization and deepen the market-oriented reform of RMB to form a currency anchor. Improving international payment infrastructure and improving the international legal system while exploring new payment technologies; Based on the "Belt and Road" priority to develop regional trade outward extension, enhance geopolitical influence; We will prudently supervise financial markets and promote market opening at a high level.

KEYWORDS

RMB internationalization degree; RMB exchange rate; Two-way impact

1. INTRODUCTION

The function path of RMB internationalization is settlement - investment - reserve - valuation. This paper focuses on the function of RMB international monetary payment and settlement. The construction of the RMB Cross-border Transaction Payment System (CIPS) began in 2012 and was officially launched in 2015. As of 2019, the business has covered 167 countries. The CIPS system has promoted the continuous growth of RMB cross-border payments, and the proportion of RMB international payments reached the highest point in 2022, that is, 3.2%, and the RMB payment and settlement function has developed steadily. This also reflects the steady progress of RMB internationalization.

In 2013, the "Belt and Road" policy greatly promoted the trade between the countries along the Belt and Road and provided more business opportunities for Chinese and foreign banks in the countries along the Belt and Road. Relying on the "Belt and Road", the currency transaction flow increased significantly. Meanwhile, the deepening of connectivity accelerated the internationalization process of RMB. In 2019, the Outline of the Guangdong-Hong Kong-Macao Greater Bay Area Plan was issued to further expand the scope of cross-border use of RMB and enhance the international status of RMB in both breadth and depth. In 2015, the International Monetary Fund announced that the

RMB would be included in the SDR currency basket, becoming the fifth currency to be included in the SDR after the US dollar, the British pound, the euro and the Japanese yen, and the international status of the RMB was enhanced. Since 2018, trade frictions between China and the United States have been escalating. In 2020, the COVID-19 epidemic has swept the world, seriously affecting global economic development. Geopolitical relations have become more and more complicated. In the process of international development, cross-border payment has many uncertainties. Changes in exchange rates will constantly affect the amount paid, the cost of hedging and insurance, and the tracking and monitoring of funds are limited, which is likely to lead to international terrorist financing and money laundering crimes.

In November 2023, the share of RMB in global payments rose to 4.61%, surpassing the Japanese yen to become the fourth largest payment currency in the world. In the ranking of global payment currencies based on volume statistics, the RMB maintained its position as the fifth most active currency in the world, accounting for 1.91%, and the overall RMB payment volume decreased by 12.79% compared with December 2022. Overall, all payment currencies declined by 1.54%. In January 2023, based on international payments outside the euro area as a statistical standard, the proportion of RMB international payments was 1.33%, ranking eighth. [31]It is believed that with the development of CIPS, the proportion of RMB international payment in China will continue to rise, and further expand the influence of RMB international payment. In addition, the development of digital technology promotes the diversification of cross-border payment options, and also helps to enhance the influence of RMB international payment. Digital currency makes all transaction activities, including cross-border transactions, transparent and traceable, opens up the "last kilometer" of transactions, and completely records the capital movements involved in transactions based on blockchain technology. Monitor money laundering and tax evasion from the root causes to reduce losses, use third-party payment platforms to supplement the reduced correspondent banking business in recent years, and digital currency exists in the form of digital, the cost of digital information acquisition and processing between financial institutions and regulatory authorities is greatly reduced, and the encryption algorithm technology adopted by digital currency can also support the loose coupling of accounts. In recent years, the central bank has accelerated the pilot CBDC, made use of digital currency to achieve faster, transparent and low-cost cross-border payments, further expanded the scope of use of RMB, and improved the efficiency of use. According to the Bank for International Settlements' 2022 annual report, 90 percent of central banks around the world are using central bank digital currencies for wholesale or retail transactions. [32]According to data from the three-year central bank survey released by the Bank for International Settlements, 88 percent of global transactions are conducted in dollars.[33] Most international foreign exchange transactions rely on the U.S. payment system. During the Bretton Woods system, gold was used as the monetary anchor and currencies of various countries were bound with fixed and adjustable exchange rates. The US dollar became the key international currency and capital flow was severely restricted. After the collapse of the Bretton Woods system, the US proposed "petrodollar" and continued to link the US dollar with oil resources by replacing gold with oil resources. In this way, the US dollar and oil trade are deeply tied, the petrodollar credit monetary system is established, and the settlement range of the US dollar is expanded. The United States and other Western countries have also imposed price restrictions on Russian oil, and once the price of Russian seaborne oil and oil products exceeds the ceiling level, relevant countries will also impose sanctions on Russia by prohibiting Russian seaborne oil and not providing transportation and related services. Although the dependence on a single global currency such as the US dollar has weakened after the collapse of the Bretton Woods system, the US dollar and the euro still play an important role in international trade, and the US dollar accounts for a high share of foreign exchange reserves, which is difficult to shake easily. Depending on its large proportion of foreign exchange market transactions and world hegemony, it dominates all aspects of foreign exchange market and international market transactions. In many changes in the international monetary system, the pound and gold have been gradually replaced, and the ability of foreign financial sanctions has been greatly improved.

In the future, the global economy will be mainly represented by the United States, Europe and Asia, and the internationalization of RMB will provide more fresh blood for an efficient and stable global reserve system. With the development of RMB internationalization, the appreciation of RMB as an international currency will exceed expectations and become an important choice among international reserve currencies.

2. LITERATURE REVIEW

Research on currency internationalization. Kenen (2009) defined the meaning of international currency, which refers to the currency used and held by residents and non-residents outside the issuing country and directly involved in international transactions. Cohen (2000) argued that international currency is a currency widely used outside the country of origin. Both trading and investment will promote the international currency circulation, change the spatial allocation of global currencies, and make the currencies circulating abroad become international currencies. The wide use of currencies will directly enhance the value of currencies and improve the global ranking of currencies. Tavlas (1992) considered the transaction cost of currency and concluded that the market preferred to choose the currency with low transaction cost, so the more choices of currency in the international market, the more the currency would become an international currency. Shen Bingxi et al. (2021) believe that the degree of internationalization of a currency should be judged from the realization of its main functions, namely, valuation means, payment means and reserve currency. The International Monetary Fund (IMF) defines the process of currency internationalization as when a country's currency acts as a medium of exchange, a unit of account, and a store of value in international transactions in which the issuing country does not participate. Tao Shigui et al. (2021) pointed out that the internationalization of RMB should be based on enhancing the currency status within the US dollar system and enhancing the international acceptance of RMB based on the function of RMB valuation and settlement.

Research on the influential factors of currency internationalization. Sato et al. (2018) analyzed the data of subsidiaries in China and other Asian countries and concluded that the abolition of onshore RMB market capital control could promote the internationalization of RMB. Tavlas (1991) believed that the necessary conditions for a currency to become an international currency are people's confidence in the currency, the breadth and depth of the financial market, the relaxation of the monetary authorities and the stability of the international political environment of the currency issuing country. Chinn & Frankle (2005) found out the influencing factors of international reserve currency through empirical analysis, namely the pattern of output and trade, the development level of national financial market, confidence in currency value and network externalities. Compared with foreign scholars, domestic scholars studied the influential factors of currency internationalization relatively late. Li Daokui and Liu Linlin (2008) deeply explored the internal factors affecting currency internationalization. The total amount of national economic development, inflation rate and real interest rate are all factors that significantly affect the level of currency internationalization. Peng Hongfeng and Tan Xiaoyu (2017) measured the influential factors of the internationalization of eight major currencies, and concluded from the fundamentals and structural factors that economic strength, trade scale, currency stability, political stability, capital account openness and other factors would significantly affect the degree of currency internationalization. Lin Lefen and Wang Shaonan (2016) used the GMM model to empirically analyze the influencing factors of RMB internationalization in the context of the Belt and Road Initiative, and concluded that economic scale contributes the most to the internationalization level of RMB, and factors such as exchange rate, economic freedom and trade scale will also significantly affect the internationalization level of a currency.

Study on the influence of exchange rate on currency internationalization. Vaubel (1979) combined the standard of the currency exchange rate with the optimal currency area and emphasized the role of changes in the national real exchange rate in the economy. Paul Krugman (1999) proposed the "triad",

which pointed out that a country in an open economy could not simultaneously realize the independence of its domestic monetary policy, the stability of its exchange rate and the free flow of capital. Therefore, monetary policy independence and capital liquidity can be realized at the cost of exchange rate stability. Bai Qinxian and Zhang Zhiwen (2011) conducted an empirical analysis using GMM and concluded that excessive yen foreign exchange reserves are not conducive to the internationalization of yen, and exchange rate fluctuations can enhance the status of a currency as an international reserve currency. Huang et al. (2014) concluded through the study of reserve currencies that currency appreciation is conducive to enhancing the reserve status of currencies, while improving the flexibility of exchange rate will effectively promote the opening of capital account. Based on the demand-side preference analysis of currency, Cohen (2012) found that confidence in the future value and availability of currency generally exists in the initial stage of cross-border currency use, and such preference determines the success of currency internationalization. Jiang Xianling et al. (2012) empirically analyzed the impact of exchange rate expectations on overseas RMB demand based on the currency demand theory and the currency competition substitution theory, and the results showed that the change of exchange rate expectations would affect investors' asset allocation and thus have a significant impact on overseas RMB demand and international payment.

Research on the impact of currency internationalization on exchange rate. Maziad et al. (2011) believes that currency internationalization is an organic, evolutionary and market-driven process in nature. Currency internationalization has the opportunity to reduce exchange rate risks, reduce financing costs, increase the demand for financial assets denominated in this currency, and have appreciation potential. Islam et al. (2012) believes that changes in the price of RMB assets will have an impact on the exchange rate. After the scale of non-residents holding RMB and their denominated assets expands, the holders expect that the decline of RMB assets will lead to the great pressure of RMB depreciation. Frankel (2012) believes that currency internationalization mainly affects exchange rates through two aspects: on the one hand, the demand for currency and the change range of the demand for currency. The increase of the demand for currency will lead to the appreciation of the local currency.

A study on the selection of measurement indicators for currency internationalization. The selection of the index of the degree of currency internationalization is mainly divided into three ways based on international monetary functions. The first is to select proxy variables based on one function of currency internationalization; the second is to select proxy variables based on two or more functions; and the third is to construct a comprehensive index as proxy variables based on all functions. The functions of international currency mainly fall into three categories: store of value, unit of account and means of payment. The selection of proxy variables for currency internationalization is based on the international functions of different currencies and the number of different functions. It mainly includes currency shares of foreign exchange reserves, the proportion of free currency convertibility in international transaction payments, the proportion of currency in international investment, the proportion of trading volume of the national currency and other currencies in the total foreign exchange market, and the proportion of currency in international lending, etc. In addition to selecting a single proxy indicator to measure internationalization, multiple comprehensive variables are also selected as indicators to measure currency internationalization. Li Daokui and Liu Linlin (2008) and other scholars selected currency composition of international foreign exchange reserves, currency composition in international trade settlement and currency composition of international bonds as proxy variables. In addition, some scholars use principal component analysis to construct a variety of index indicators formed by comprehensive calculation of multiple data, including currency internationalization index, as proxy variables of currency internationalization.

To sum up, the world economy is increasingly connected, and with the deepening of financial integration, whether a national currency can achieve internationalization and what level of internationalization will affect its position in the international financial market. The research on the internationalization of RMB is also continuously enriched and improved. The stability of a country's

currency value and the size of its economic market will have an impact on people's currency choice in the international market. The proportion of RMB international payment is an important window to observe the degree of RMB internationalization. Through the literature review above, it is found that early scholars paid more attention to the international reserve function of currency, and paid more and more attention to the diversification and integration of indicators in recent years, and few of them chose the proportion of international payment of currency as the proxy variable. The innovations of this paper are as follows: First, based on the function of RMB transaction media, the latest data of RMB international payment is selected as the proxy index to measure the degree of RMB internationalization and the latest data is selected for analysis; Second, other influential factors including China's trade share are included in the empirical analysis of the two-way impact between the degree of RMB internationalization and the exchange rate, and the analysis content is more abundant.

3. ANALYSIS OF THE TREND OF RMB INTERNATIONALIZATION DEGREE AND RMB EXCHANGE RATE

This paper selects the monthly data from January 2012 to January 2024, and the change trend is shown in Figure 1. In general, the proportion of RMB international payments has shown an upward trend, rising steadily from 2012 to 2015, and reaching the peak of this growth stage in August 2015. Although the degree of internationalization of RMB is rising slowly but steadily, it can be seen from the line chart of the rate of change in Figure 2 that although the rate of change fluctuates every month, in general, the rate of change decreased year by year from 2012 to 2016, and in 2017-2018, the ratio fell again to below 2% and remained low. While 2017 was the beginning stage of Sino-US trade friction, the global industrial division of labor and the pattern of international trade changed, China's economy fluctuated, commodity prices were unstable, and the international status of the RMB was affected. However, China seized the opportunity of supply-side reform and timely adjusted monetary and fiscal policies. Therefore, despite the decline in the proportion of RMB international payments, the overall Chinese economy is still improving. After a brief recovery in 2019, the proportion of RMB international payments declined again in 2020, and the lowest value in recent years appeared in 2020, and the rate of change also decreased significantly. This is mainly due to the outbreak of COVID-19 in 2020, most enterprises have been forced to suspend production, while the domestic economy has been hit hard, the international market has been sluggish, and various international economic activities, including import and export trade, have been greatly impacted. In 2022, a turning point occurred, ushering in the highest value in the past decade, breaking the 3% mark for the first time, and surpassing the Japanese yen in the global payment currency ranking for the first time in the past decade, ranking fourth. In May 2022, the International Monetary Fund raised the weight of RMB in the Special Drawing Rights from 10.92% to 12.28%, and the international market's recognition of the free use of RMB increased, and the proportion of RMB in international payments reached a new high in 2024.

In contrast, it can be seen from Figure 3 that the RMB exchange rate against the US dollar remained relatively stable. During the epidemic period, China insisted on promoting the orderly two-way opening of the financial market, and the exchange rate still played the role of stabilizing the macro-economy and adjusting the automatic stabilizer of the balance of payments, and international investors had increased confidence in the use of RMB. After the exchange rate reform in 2015, the quotation of the central parity rate of the RMB against the US dollar was required to refer to the closing exchange rate of the previous day. A series of policies released the depreciation pressure of the RMB, further alleviated economic imbalances, greatly increased the marketization degree of the RMB, and improved market efficiency while optimizing the central parity mechanism. Existing studies have found that enhancing the exchange rate flexibility of RMB will effectively enhance the exchange rate and play the role of automatic stabilizer. During the exchange rate reform, RMB exchange rate flexibility and market mechanism will be enhanced, so the exchange rate reform policy

can rely on the market mechanism and reduce the process friction to enhance the exchange rate flexibility of RMB.

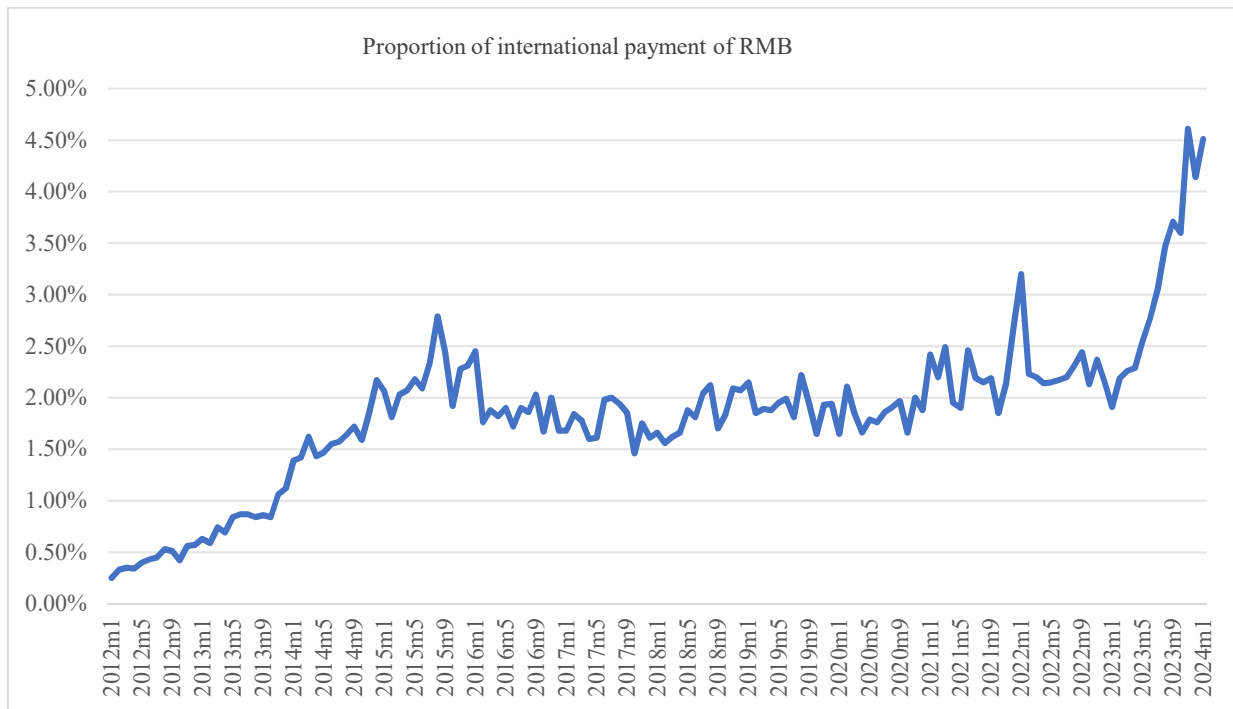


Figure 1. Proportion of international payment of RMB from January 2012 to January 2024

Data source: SWIFT RMB tracker

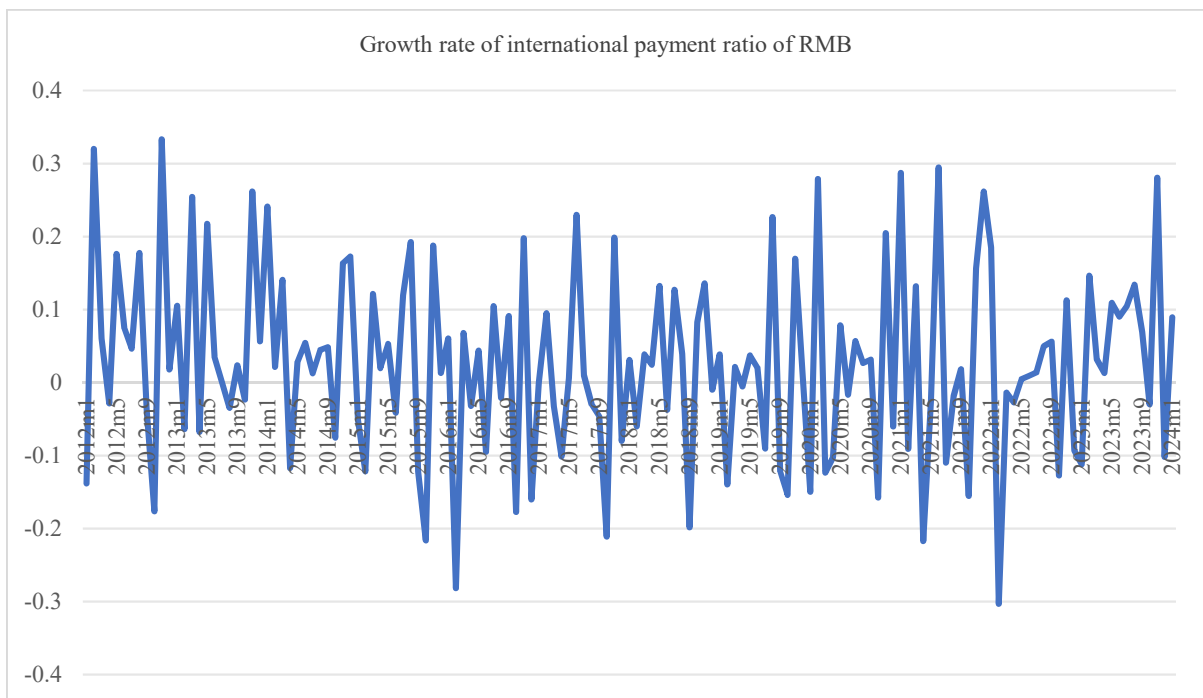


Figure 2. Growth rate of international payment ratio of RMB from 2012.01 to 2024.01

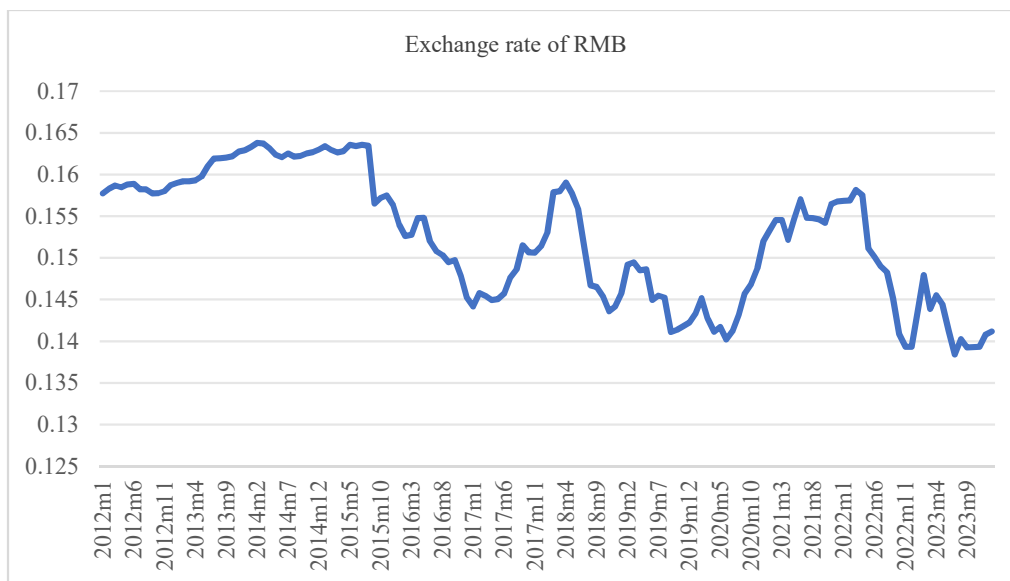


Figure 3. Exchange rate of RMB from 2012.01 to 2024.01

Data source: State Administration of Foreign Exchange

There are many countries involved in trade transactions in the international market, and currencies play a central role in the international market. According to the stability and liquidity of different currencies, the utilization rate of currencies also varies greatly. The larger the proportion of a country's currency in international payments, the higher its liquidity in international transactions, which also means the higher the status of the currency in the international market. The United States relies on the centralization of the dollar to make the dollar occupy the largest proportion in international payments and achieve the international hegemony of the dollar. At the same time, the proportion of its currency in international payments fluctuates in different stages with the changes of the international payment environment and the comprehensive national strength of various countries. In the international macroeconomic background of accelerated "de-dollarization", the US dollar index remains strong despite the continued interest rate hike by the Federal Reserve. Since 2022, the RMB exchange rate has fluctuated greatly. In October, the onshore and offshore exchange rate of RMB against the US dollar even fell below 7.3, indicating that there is depreciation pressure on the RMB exchange rate. For China, the world's second largest importer, the weak RMB exchange rate will lead to rising prices of imported commodities, rising costs and capital outflow, which will directly affect the stability of the domestic financial market and prices. Both imports and domestic production have been hit. However, the relatively weak exchange rate will promote exports and maintain the industrial chain and supply chain advantages of the international market.

4. MECHANISM ANALYSIS OF THE TWO-WAY INFLUENCE OF RMB EXCHANGE RATE AND RMB INTERNATIONALIZATION DEGREE

(1) The impact of the degree of RMB internationalization on the RMB exchange rate

In recent years, with the improvement of the internationalization of RMB, the demand for international payment currency has increased, and more opportunities have been provided to foreign investors. Capital inflow will lead to currency appreciation, reducing the international competitiveness of exporters, and the increase in demand for local currency will also lead to exchange rate fluctuations and affect the stability of exchange rate. Figure 5 shows that the proportion of international payments of RMB increases, and the conversion rate of RMB to US dollar has an upward trend. As early as 2007, Zhang Hongmei and other scholars proposed that a small and gradual

adjustment of the exchange rate could promote the appreciation of RMB and enhance the influence of RMB. In 2005, the single peg to the US dollar was abandoned through the RMB exchange rate reform, and in 2015, the RMB exchange rate reform again created a new situation in the deeply market-oriented foreign exchange market. Figure 5 also shows that the trend of RMB is more stable and orderly.

The proportion of international payment of RMB can reflect the degree of internationalization of currency to some extent. International investors' demand for the allocation of RMB assets is an important driving force for RMB to play a greater role in the international arena. If the expected return of RMB increases or the risk decreases, non-residents will prefer to hold more RMB assets, and the demand for RMB will increase and the RMB will appreciate. Moreover, in recent years, China has optimized international market transactions from the aspects of infrastructure construction and macroeconomic policies, which has greatly increased investors' willingness to hold RMB in the foreign exchange market, and the RMB exchange rate tends to rise.

In terms of value storage, the increase in the proportion of RMB international payments means that the proportion of RMB denominated assets in international assets will rise, the increase of RMB in international markets, the expansion of non-residents' choices, and the increase in demand for RMB will lead to the appreciation of RMB. If the possibility of income risks is reduced, more international assets will tend to choose RMB for asset valuation, and the demand for RMB will also increase. On the premise that other conditions remain unchanged, RMB will appreciate. However, if there are already many non-residents holding RMB, When choosing RMB denominated assets, non-residents will adjust the amount of RMB assets held according to the income risk, and the international demand for RMB will change accordingly, which will eventually lead to the change of RMB exchange rate again.

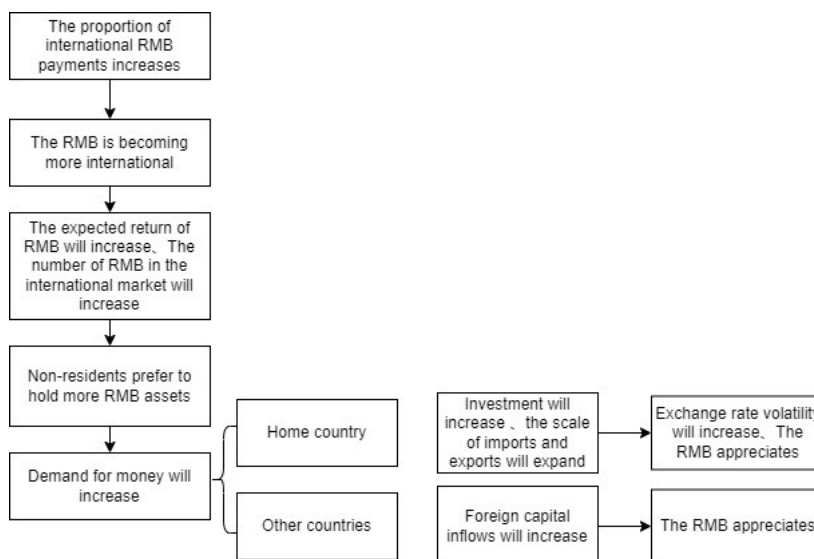


Figure 4. The relationship between the degree of RMB internationalization and the structure of RMB exchange rate

(2) The impact of RMB exchange rate on the degree of RMB internationalization

Exchange rates are an important price signal for the global economy and markets. The more stable the currency exchange rate of a country, the more stable the currency value. Stable currency value will bring more international recognition, the higher the use rate in international payments, and the greater the proportion in international payments. As can be seen from Figure 5, the smaller the change of exchange rate, the proportion of international payment of RMB shows an upward trend. Investors

in the international market adjust their holdings according to the exchange rate of RMB, thus affecting the degree of RMB internationalization. If the local currency appreciates or the expected rate of return increases, it will attract a large number of international investors, who will adjust their assets, increase the demand for RMB, increase their holdings of RMB assets, a large number of speculative capital inflows, and increase the proportion of RMB payments in the international market, promoting the deepening of the internationalization of RMB. The RMB exchange rate has a positive influence on the degree of RMB internationalization in stages, and the influence is different with the deepening of the degree of RMB internationalization.

At present, China's economy is gradually opening up in a more stable and safe way. The exchange rate is not only an important starting point for the central bank to implement monetary policies, but also an important factor affecting the international market's demand for RMB. The flexibility of RMB exchange rate directly affects the openness of capital account and the proportion of RMB international payments. Enhancing the flexibility of the RMB exchange rate will effectively promote the exchange rate to play a greater role. In addition, the enhancement of monetary liquidity is also conducive to the development of overseas currency markets. The internationalization of RMB not only requires the enhancement of RMB convertibility, but also requires the marketization of RMB exchange rate, which is conducive to maintaining a balanced market level.

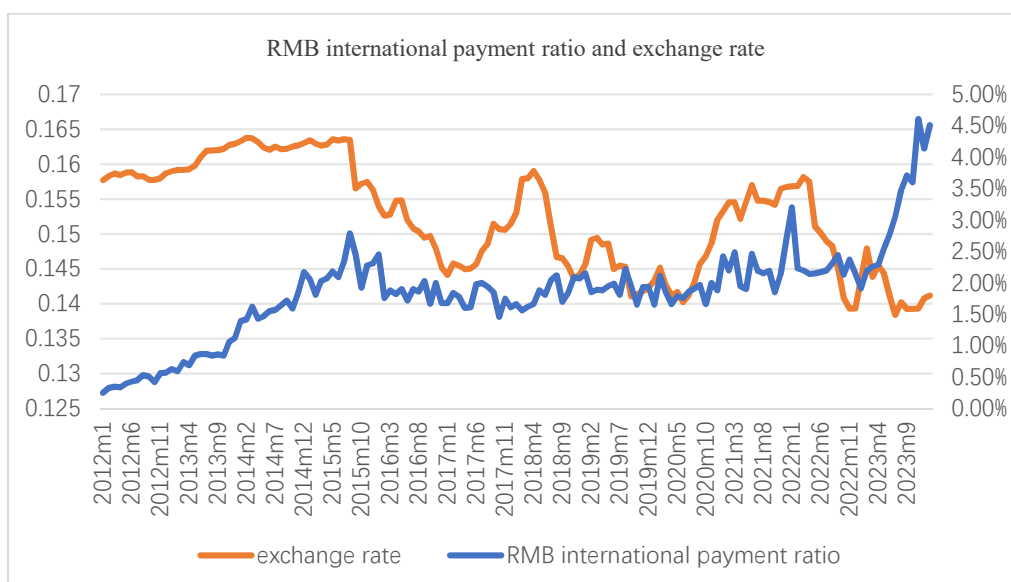


Figure 5. RMB international payment ratio and exchange rate from 2012.01 to 2024.01

Data source: SWIFT RMB tracker, State Administration of Foreign Exchange

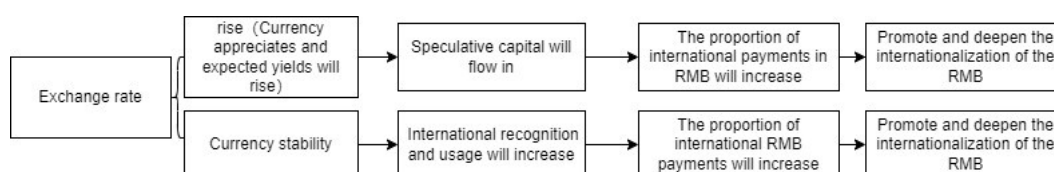


Figure 6. Structural relationship between RMB exchange rate and RMB internationalization degree

5. EMPIRICAL ANALYSIS

Monthly time series data from January 2012 to January 2024 were used. The proportion of RMB international payment is selected to reflect the degree of RMB internationalization. In addition to the

exchange rate index, this paper also selects China's trade proportion, GDP and CPI indicators to include in the empirical analysis, so as to better control the impact of changes in other aspects on the degree of RMB internationalization. Specific indicator definitions and data sources are as follows:

RMB International payment ratio (RMBP): The international payment proportion of RMB is selected as a measure of the degree of internationalization of RMB mainly because the function of RMB as a medium of exchange is widely used at present, and the functions of RMB as a means of valuation and settlement and payment are also developing rapidly. With the gradual expansion of cross-border settlement scale, the status of RMB in international trade and investment and international reserves is enhanced, so the selection of RMB international payment proportion is more basic. It can also avoid some duplicate studies. Data is from SWIFT RMB tracker.

Exchange rate (ER) : The more stable the exchange rate of a country, the more stable the currency value, the higher the international recognition, and the stronger the willingness of people to hold. The exchange rate index is RMB to USD conversion rate, and the data is from the State Administration of Foreign Exchange.

China's TRADE ratio(TRADE) : The index of trade share refers to the practice of Yu Xiang (2016), and selects the proportion of China's total foreign import and export trade in the 30 countries of China, the United States, Japan and the European Union to measure the status of RMB in international trade, so as to better control its impact on the proportion of RMB international payments. The data is from the WTO database.

GDP: Chinn (2012) points out that the proportion of a country's currency in international currencies is affected by the scale of a country's economy. The larger the scale of a country's economy, the more confidence people have in the currency, thus affecting the willingness to hold currency and ultimately affecting the proportion of international payments of currency. Therefore, quarterly GDP data is selected as the indicator of economic scale. Eviews uses quadratic interpolation to convert quarterly data into monthly data, which comes from the National Bureau of Statistics.

CPI: In addition to the exchange rate affecting the currency value, the stability of the price level will also have an impact on the currency value. A high inflation rate is not conducive to international trade, thus affecting the international payment ability of a currency. CPI is selected to reflect the stability of the domestic price level, and the data comes from the National Bureau of Statistics.

(1) E-G two-step co-integration analysis

1) Stationarity test

Table 1. Results of ADF unit root test for each influencing factor

Variable	ADF value	1% critical value	5% critical value	10% critical value	P-value	Conclusion
lnRMBP	-3.019195	-4.023506	-3.441552	-3.145341	0.1307	unsteady
dlnRMBP	-16.33055	-3.476472	-2.881685	-2.577591	0.0000	steady
lnER	-2.676741	-4.023506	-3.441552	-3.145341	0.2479	unsteady
dlnER	-9.284137	-3.476472	-2.881685	-2.577591	0.0000	steady
lnTRADE	-1.865839	-4.029041	-3.444222	-3.146908	0.6665	unsteady
dlnTRADE	-5.896136	-3.480425	-2.883408	-2.578510	0.0000	steady
lnGDP	-2.324795	-4.027959	-3.443704	-3.146604	0.4174	unsteady
dlnGDP	-4.936137	-3.479656	-2.883073	-2.578331	0.0001	steady
lnCPI	-3.027098	-4.023042	-3.441330	-3.145211	0.1285	unsteady
dlnCPI	-6.156480	-3.480425	-2.883408	-2.578510	0.0000	steady

ADF test was performed on the time series data before cointegration analysis, and the results were shown in Table 1. After first-order difference processing, all variables have no unit root at the significance level of 1%, and all indicators need to be stabilized by first-order difference. Therefore, the model variables are adjusted to a first order single integer sequence.

2) Cointegration analysis

The E-G two-step method was used to check whether the variables were stable in the long run.

$$\ln\text{RMBP} = 29.089 + 0.686\ln\text{ER} + 0.059\ln\text{TRADE} + 1.2061331\ln\text{GDP} - 9.769\ln\text{CPI}$$

(1.97) (0.79) (0.17) (7.18) (-3.13)

The regression results show that the regression parameters of variables $\ln\text{GDP}$ and $\ln\text{CPI}$ are significant, and the other variables are also consistent with economic significance. The unit root test is conducted for residual e , and the results are shown in Table 2.

Table 2. Results of unit root test for residual e

Variable	ADF value	1% critical value	5% critical value	10% critical value	P-value	Conclusion
Residual error	-3.307134	-2.581120	-1.943058	-1.615241	0.0011	steady

As can be seen from Table 2, when the significance level is 1%, the residual rejects the null hypothesis, the residual is a stationary series, and there is a long-term co-integration relationship between the two variables.

The regression results show that when the exchange rate index increases by 1%, the international payment ratio of RMB increases by 0.686%, that is, the appreciation of RMB is more conducive to improving the international payment ratio of RMB and promoting the internationalization of RMB. China's trade share is positively correlated with the degree of internationalization of RMB. The higher the trade share, the more important the status of China in the international trade market and the higher the internationalization level of RMB. For every 1% increase in GDP, the proportion of RMB international payments increases by 1.2061331%. The degree of RMB internationalization is inversely proportional to CPI, and high domestic inflation will lead to currency depreciation and ultimately affect the degree of RMB internationalization.

3) Robustness test of VAR model

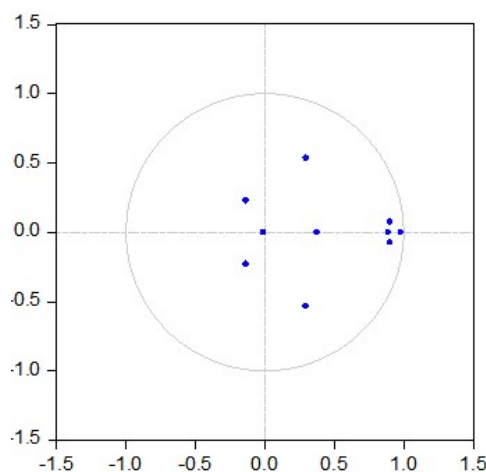


Figure 7. AR root diagram

As shown in Figure 7 below, the feature roots of all models are located in the unit circle, and the VAR model in this paper is robust, so it is meaningful to carry out impulse response analysis on the model in this paper, which can better reflect the dynamic change relationship between the degree of RMB internationalization and influential factors.

(2) Dynamic time-varying impulse response analysis based on TVP-SV-VAR model

Based on the actual situation of dynamic changes in the macroeconomic environment of economy and finance, the TVP-SV-VAR model is selected. Compared with the VAR model, there are more time-varying parameters and random fluctuations, which can solve the heteroscedasticity problem with time-varying.

In this paper, Oxmetrics6 was selected to establish the TVP-SV-VAR model, the lag time was set as 3, and the effective sample was obtained by simulating 10,000 times using MCMC method. The results are shown in Table 3. The Geweke convergence values in the parameter estimation results of the model are all less than 1.96, and the null hypothesis of 5% confidence level tending to a posterior distribution cannot be rejected, indicating that the pre-burning period can make the Markov chain concentrated, and the invalid factors of the models are all less than 100, so the model is generally valid.

Table 3. Parameter estimation results

Parameter	Mean	Stdev	95%L	95%U	Geweke	Inef.
sb1	0.0227	0.0025	0.0183	0.0283	0.924	8.35
sb2	0.0228	0.0026	0.0184	0.0285	0.080	7.89
sa1	0.0523	0.0123	0.0344	0.0891	0.031	32.89
sa2	0.0603	0.0157	0.0365	0.0980	0.041	20.91
sh1	0.1535	0.0606	0.0692	0.3021	0.008	71.57
sh2	0.3174	0.0565	0.2266	0.4493	0.966	38.80

1) Time-varying characteristics of random volatility of variables

It can be seen from Figure 8 that the degree of RMB internationalization, exchange rate, trade share, GDP and CPI have been fluctuating constantly. The degree of RMB internationalization is constantly changing and there is a small peak in the random volatility around 2016, 2018 and 2022, but the volatility is constantly changing but generally stable. The outbreak of the novel coronavirus around 2020 caused a huge impact on the economy, and China actively adopted various measures to deal with it. In 2022, there was a small peak of volatility again, and the volatility changed more with the change of the epidemic. The exchange rate fluctuated continuously before 2015, and the fluctuation trend became larger since 2013, but it declined and gradually stabilized after 2015. Similar to the random fluctuation rate of the degree of RMB internationalization, the trade index of China fluctuates every year. In 2012, the impact of the international financial crisis deepened, the European sovereign debt crisis continued to ferocity, the world economic recovery was slow, China faced a prominent overcapacity problem, and the internal and external environment for the development of foreign trade was complicated. During this period, China actively promoted the export of high-tech products and labor-intensive products, and timely introduced policies for steady growth and structural adjustment of foreign trade to achieve steady development of foreign trade, so there were several small peaks in fluctuations. Figure 8 shows that the large fluctuations of GDP random volatility are mainly concentrated after 2020. During the impact of the novel coronavirus epidemic, China strictly controlled and timely contained the large-scale spread of the epidemic, and domestic production was carried out orderly under control, so the random volatility was the largest in 2020-2024. The random

volatility of CPI peaked in 2012-2013, and the volatility kept changing before 2015. However, China's domestic demand was insufficient, deflation was more serious, and the deflation phenomenon was more obvious because of the continuous decline of industrial product prices. Therefore, the year-on-year rise of China's CPI in 2014 hit a new low since 2010.

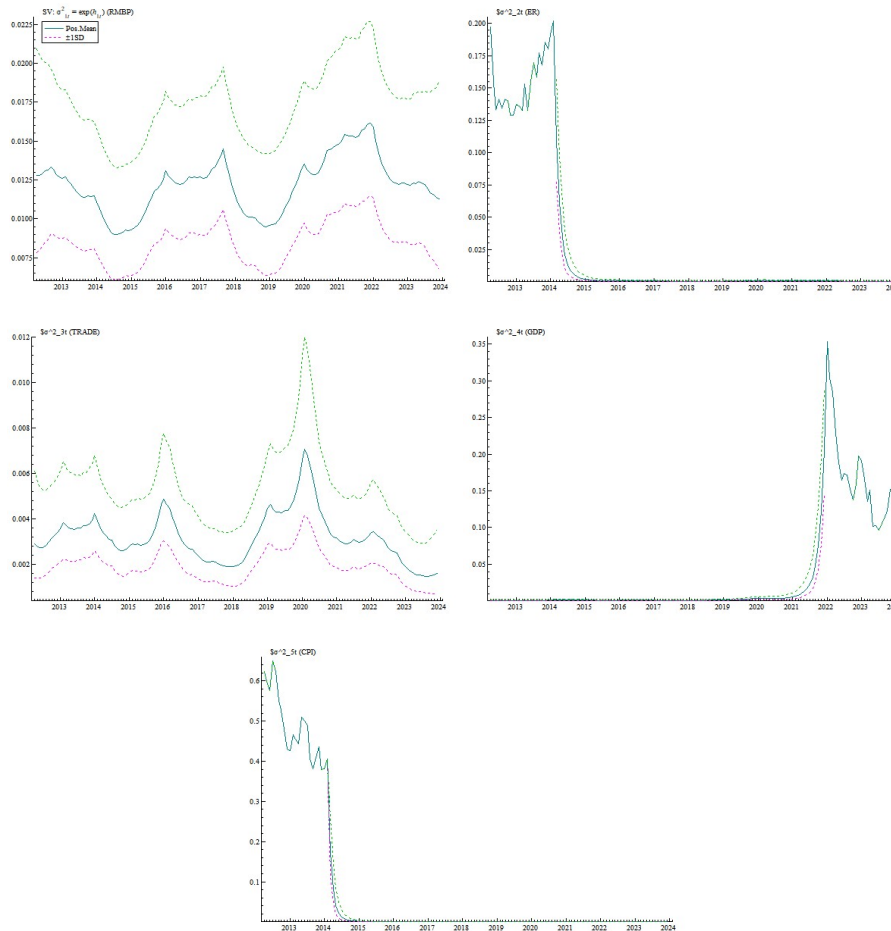


Figure 8. Time-varying characteristics of random volatility of structural shocks with different variables

2) Time-varying characteristics of impulse response of shocks with different lead times

The three lead periods are set to be phase 1, phase 4 and phase 8, which are used to reflect the dynamic change process of impulse response. It can be seen from FIG. 9 that the variation trend of impulse response of variables with different lead times is similar to some extent, and it can be observed that the impulse response of all variables changes with time.

When the exchange rate has a positive impact, the impact of the first phase has a positive impact on the internationalization degree of RMB, and the impact of time has little change, the response of the fourth and eighth phases is basically negative but the value is very small, and the eighth phase has a large fluctuation in 2015, 2018 and 2020, mainly because the impact of the epidemic has expanded the international market transactions. Coupled with the continuous optimization of exchange rate indicators in the exchange rate reform in 2015, the appreciation of RMB has a significant positive impact on the degree of internationalization of RMB in general, that is, the proportion of international payments increases and the status of RMB in the international market increases.

From the perspective of the impact of the degree of internationalization of RMB on the exchange rate, when the degree of internationalization of RMB has a positive impact, the eighth period in advance has a significant positive impact, and the first and fourth periods in advance have a negative impact. In the long run, there is also a positive response after 2020. Although the negative impact in the short and medium term is more significant, it gradually increases and shows a positive trend. Generally speaking, it is basically a positive response. Therefore, the deepening of RMB internationalization has a positive and stable impact on the exchange rate in the short term, and the impact is more significant in the short and medium term. In terms of economic significance, the increase in the proportion of RMB international payment means the increase in the degree of internationalization of RMB, the increase in the use of international market transactions and investment, the increase in the frequency of use, the increase in the international demand for RMB, and the appreciation of RMB.

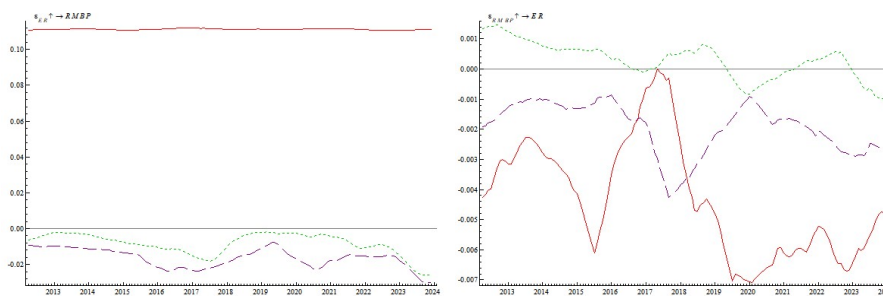


Figure 9. Impulse response function under different lead times

3) Time-varying characteristics of impulse response at different time points

In terms of time point selection, three time points were selected after comprehensive consideration. In 2015, the "811" exchange rate reform proposed a new central parity formation mechanism, introduced the "stable 24-hour basket currency" factor, and the uncertainty of RMB exchange rate changes increased, China's trade exports also rose sharply, and the role of RMB in the international market changed. In March 2018, the Sino-US trade friction escalated again, and the scale gradually expanded, which affected the proportion of RMB international payment and the exchange rate. The COVID-19 pandemic swept the world in January 2020, causing a huge impact on the global economy and also affecting international financial markets. Therefore, this paper chooses August 2015, March 2018 and January 2020 for comparison.

As can be seen from Figure 10, August 2015 had a positive impact on the exchange rate. The index of the degree of internationalization of RMB responded quickly in the first phase and reached a positive response peak. However, this positive response declined rapidly in the second phase, but then gradually increased and finally stabilized, mainly because of the exchange rate reform and adjustment in August 2015. The quotation mechanism of the central parity of the RMB exchange rate against the US dollar has promoted the further marketization of the RMB exchange rate mechanism, made the central parity mechanism more transparent, and the exchange rate can more truly reflect the supply and demand of the foreign exchange market. The proportion of RMB international payment has risen and reached the highest level in a decade. A positive shock to the exchange rate in March 2018 will bring about a positive response to the proportion of RMB international payments, which also rose rapidly to the peak value in the first period and then gradually rose to the second peak value and then gradually stabilized. The escalation of Sino-US trade friction has increased the depreciation pressure of RMB exchange rate, and China's trade surplus is mainly due to the rise of commodity prices but the slowdown of export growth. The proportion of international payments made in RMB is still rising. With the outbreak of COVID-19 at the end of 2019, the impact of the epidemic expanded rapidly in January 2020. Given a positive impact on the exchange rate, the proportion of RMB

international payments reached a peak and declined rapidly in the first period, but the overall response was positive. Under the impact of the epidemic, the global industrial chain was blocked and enterprises' production was affected, but China managed and controlled the economy in time to return to the right track. The response to shocks has also been slow to level off.

In August 2015, the degree of internationalization of RMB had a positive impact, and the exchange rate had a weak negative response in the first phase and gradually remained stable. As the proportion of international payment of RMB increased, the degree of internationalization of RMB gradually deepened. After the exchange rate reform, the two-way fluctuation range of RMB increased, the speculative pressure of RMB decreased, and the global spillover effect of RMB increased. Moreover, since the 811 exchange rate reform, the exchange rate mechanism has been improved, the exchange rate is no longer unilateral appreciation, the openness of the foreign exchange market and the innovation of foreign exchange products have been enhanced, and the RMB has slightly depreciated and the exchange rate fluctuations have increased, but generally it has remained stable. In March 2018 and January 2020, the international currency ratio of RMB is impacted, and the impulse response degree of exchange rate is relatively similar. When the international payment ratio of RMB is impacted positively, the exchange rate responds in the current period and is negative, and gradually decreases after reaching the maximum in the first period. In 2018, due to the impact of the Sino-US trade war, the influence of the RMB exchange rate was continuously suppressed. In March, the United States imposed a large scale of high tariffs on Chinese imports and exports, and the accelerated process of internationalization increased the volatility of the RMB and increased the depreciation pressure. In January 2020, China's effective response to the COVID-19 epidemic and rapid economic recovery provided a solid economic foundation for the internationalization of RMB and established a good international image. More and more people choose to hold RMB as a hedge, and the RMB has a long-term trend of appreciation after a brief devaluation.

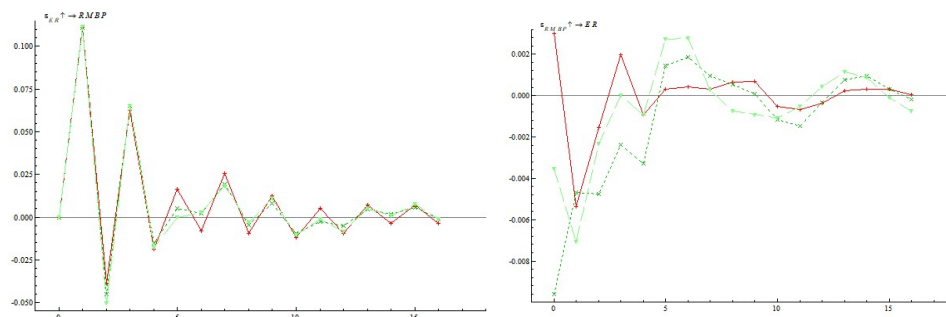


Figure 10. Impulse response functions at different time points

6. CONCLUSION AND POLICY RECOMMENDATIONS

This paper studies the two-way influence of RMB internationalization degree and RMB exchange rate fluctuation in China from both theoretical and empirical aspects, and draws the conclusion that there is a two-way influence between the two. First of all, RMB appreciation has a significant positive impact on the degree of RMB internationalization, that is, it helps to promote the deepening of RMB internationalization. Secondly, the increase in the proportion of RMB international payment means that the degree of internationalization of RMB is enhanced, and the international demand for RMB is enhanced, which has a positive and stable impact on the RMB exchange rate in the long run. In addition, after adding the indicators of GDP, CPI and China's trade proportion, the direction of two-way influence is still in line with practical significance, and the two-way influence of RMB exchange rate and the degree of internationalization is still significant.

Changing exchange rate trends and market expectations will have an impact on the degree of RMB internationalization. If RMB appreciates or is expected to appreciate against the US dollar, it will help increase the international payment ratio of RMB. Meanwhile, changes in the international payment ratio of RMB also require the coordination of exchange rate policies. The RMB exchange rate market should remain relatively stable, and a sharp depreciation is not conducive to the internationalization of RMB. At present, currencies such as US dollar, Euro and British pound have the requirement of national currency, and the road of RMB internationalization will inevitably encounter obstacles from the United States and Western countries. Faced with the hegemony of Western countries' currencies, China should use exchange rate combined with digital RMB and other new payment technologies to enhance China's national discourse power and actively promote more international cooperation and transactions. With the help of the Belt and Road Initiative, we will build an open cooperation platform and seek new opportunities for the development of the international market. It is a historical development trend for RMB to become an international currency. The exchange rate advantages should be brought into play based on the different market characteristics of domestic and overseas markets, the interaction between RMB exchange rate and the degree of internationalization should be included in the consideration of policy formulation, and appropriate policies should be formulated based on the relationship between the two to promote the marketization of RMB exchange rate and the internationalization of RMB.

In the future, the proportion of RMB in global payments still has great room for development, the dominant position of US dollar is still difficult to change, the long-term development prospect of domestic economy is promising, and the RMB is becoming more and more important in international payments, investment and reserves. It is necessary to steadily promote the internationalization of RMB to match China's international economic status, and optimize relevant policies to make the RMB exchange rate and internationalization mutually promote each other. Achieve common development. This can be expanded from the following aspects:

(1) Improving international payment infrastructure and technical operations

In terms of infrastructure, improving the technology and operation of the infrastructure on which international Payments depend, the Financial Stability Board (FSB) has published the G20 Roadmap for Enhancing Cross-border Payments, which sets out the G20's next steps to enhance cross-border payments. In the international payment market, the implementation of remittance and settlement of PvP are more widely adopted, and the use of PvP effectively reduces the settlement risk of foreign exchange in international transactions and the uncertainty of international payments dependent on foreign exchange. At present, most foreign exchange transactions are completed over the counter, and the risks are extremely high. China should gradually explore reciprocal liquidity arrangements between the People's Bank of China and other central banks, promote bilateral flows between large payment operators and the central bank, increase the participation of banks and non-banking financial institutions in cross-border payment infrastructure, extend the working hours of the payment system, improve the access system of the payment system, and promote the interconnection of cross-border payment infrastructure. Efficient international payments with long transaction chains and complex compliance processes.

(2) Pay close attention to international trade and use the Belt and Road to develop regional trade

In terms of international trade, we should obtain alternative external demand, reduce exports to developed countries, increase trade with developing countries and emerging markets, for example, we can increase trade with other BRICS countries and other RCEP members, and give priority to the use of RMB, increase the proportion of international payments in RMB, and accelerate the internationalization of RMB. Strengthen the regional payment and settlement mechanism, take the countries along the "Belt and Road" as the priority area to extend outward, promote digital trade based on digital technologies including digital currency, give play to the currency anchor function of RMB,

use local currency more than the US dollar in regional trade, and promote the cross-border payment and development of digital RMB.

(3) Prudently regulate financial markets and promote a high level of opening up of financial markets, including the foreign exchange market

In terms of the financial market, we should prudently supervise the financial market and currency, especially strengthen the regulation and supervision of the foreign exchange market to prevent the impact caused by the excessive issuance of currency by Western countries. At the same time, market adjustment and macro-intervention should be combined to establish the foreign exchange stabilization fund to avoid the rapid and excessive fluctuations of the exchange rate in the short term, which will bring a big impact on the market. Actively prevent the "herd effect" in the foreign exchange market, guide market expectations, and enhance market confidence in the RMB. In addition, promote the public and private sectors to develop common cross-border objectives and principles, promote the high level of opening up of financial markets, tap the potential of cross-border transactions of RMB, break the barriers to the flow of information at home and abroad, selectively open the foreign exchange market to foreign institutions, improve the market-oriented mechanism of RMB exchange rate, and foreign institutions can effectively reduce the risk of RMB positions. We will take the bond market as the focus of opening-up, increase the frequency of overseas use of RMB, and expand the scope and scale of RMB transactions in the foreign exchange market.

(4) Enhance geopolitical influence, rely on political strength

To increase China's geopolitical influence, whether in the exchange rate market or the international payment market, political power is an important support for maintaining a good reputation on an international scale. In the context of global integration, trade between countries is frequent and gradually deepening, the global trade network is constantly expanding, and the differences in the distribution of power resources between major countries will form a position. Use the regional system of RMB to expand the international influence of RMB, take the initiative to respond to new changes in the international situation, make full use of geostrategic resources to create a good geopolitical environment for the construction of the Silk Road, actively carry out bilateral cooperation, establish regional multilateral cooperation mechanisms, use regionalization to pave the way for the internationalization of RMB, deepen regional cooperation, and enhance the international voice.

(5) Explore new payment technologies and regulatory systems, improve the international legal system

Promote the digitalization of payments, further increase the research on CBDC, promote the construction of new multilateral platforms, strengthen the robustness of global payments, and reduce the complexity of traditional international payments by using peer-to-peer transmission mode. In addition, new technologies such as blockchain have features such as distributed ledgers, consensus mechanisms, and multi-layer encryption, which can improve security and efficiency while reducing payment costs. Coordinate and update the regulatory means and institutional framework, conduct unified supervision and data sharing on the multi-currency payment infrastructure existing in international payments, formulate international consistent response measures against international money laundering and terrorism, supplement and improve the corresponding international legal system, strengthen the role of justice in international payments, and ensure the security of transaction data and payment channels.

(6) Deepen market-oriented reform of the RMB exchange rate and make the exchange rate more flexible

The formation mechanism and trend of exchange rate are closely related to the degree of RMB internationalization, and the competition for the pricing power of exchange rate directly affects the process of exchange rate and RMB internationalization. Therefore, the government should timely intervene in the formation mechanism of RMB exchange rate in the onshore market, promote the marketization of RMB exchange rate, and adjust the RMB exchange rate with reference to a basket

of currencies to enhance the flexibility of RMB exchange rate and achieve the basic stability of the exchange rate. Deepen the market-oriented reform of RMB, cultivate the demand for RMB through international trade and investment, prudently carry out monetary cooperation with other countries, improve the currency anchor position of RMB, accelerate the internationalization of RMB, establish a linkage mechanism between the degree of internationalization of RMB and exchange rate changes, and promote closer integration and positive interaction between the two.

REFERENCES

- [1] Bai Qinxian and Zhang Zhiwen, 2011: "Scale of Foreign Exchange Reserves and Internationalization of Local Currency: An Empirical Study of the Japanese Yen", *Economic Research*, Issue 10.
- [2] Guo Fengjuan and Ding Jianping, 2023: "Research on the Interaction between RMB Internationalization, Exchange Rate, and Cross border Capital Flow", *Contemporary Economic Science*, Issue 2.
- [3] He Guanghui and Yang Hecan, 2022: "Research on the Elasticity of RMB Exchange Rate and Its Market Mechanism in China", Volume 12 of "Quantitative Economy, Technology and Economics Research".
- [4] Jiang Xianling, Liu Wei, Ye Bingnan, 2012: "The Impact of Exchange Rate Expectations on Overseas RMB Demand", *International Finance Research*, Issue 10.
- [5] Liu Yaying, 2019: "Deepening Global Financial Integration and Increasing the Proportion of RMB International Payment", *Financial Expo*, Issue 8.
- [6] Lin Lefen, Wang Shaonan, 2016: Empirical Analysis on the Influencing Factors of RMB Internationalization in the the Belt and Road Process, *International Finance Research*, Issue 2.
- [7] Li Daokui and Liu Linlin, 2008: "Internationalization of RMB: Quantitative Research and Policy Analysis", *Financial Research*, Issue 11.
- [8] Peng Hongfeng and Tan Xiaoyu, 2017: "Research on RMB Internationalization: Degree Measurement and Analysis of Influencing Factors", *Economic Research*, Issue 2.
- [9] Shen Bingxi and Shen Jianlan, 2021: "Research on Several Issues of RMB Internationalization", *Financial Forum*, Issue 12.
- [10] Shen Wei, 2020: "Renminbi Exchange Rate Reform and Renminbi Internationalization: The Third Path Beyond Market and Regulation", *Regional and Global Development*, Issue 3.
- [11] Tao Shigui, Hu Jingyi, Zhou Guannan, 2021: "Strategic choices for steadily and cautiously promoting the internationalization of the RMB", *Economic Vertical and Horizontal*, Issue 7.
- [12] Wang Huiwen, Ge Yuejing, Ma Teng, 2018: "Geopolitical Potential and China - A Preliminary Exploration of Central Asian Geopolitical Relations", *Economic Geography*, Issue 9.
- [13] Zhao Songhui and Feng Bao, 2022: "Challenges and Countermeasures of Implementing Central Bank Digital Currency in the Digital Economy Era", *Heilongjiang Finance*, Issue 12.
- [14] Zhang Hongmei, Jiang Lili, Li Chunxiao, 2007: "Interactive Analysis of RMB Appreciation and RMB Internationalization", *Journal of Northeast Normal University (Philosophy and Social Sciences Edition)*, Issue 1.
- [15] Zhou Xianping and Li Biao, 2013: "The Linkage Relationship between Domestic and Foreign RMB Spot Exchange Rates: Empirical Analysis Based on VAR-MVGARCH", *International Finance Research*, Issue 5.
- [16] Benjamin J.Cohen, 2012, "The Yuan Tomorrow? Evaluating China's Currency Internationalisation Strategy", *New Political Economy*, 3, 361-371.
- [17] Chinn, M., and J.Frankel, 2005, "Will the Euro Eventually Surpass the Dollar as Leading International Reserve Currency", *NBER Working Paper*, 11510.
- [18] Cohen,B.J., 2000, "Life at the Top: International Currencies in the 21st Century", *Cuadernos de economía*, 37(110), 9-34.
- [19] Dennis, G. E. J., and Vaubel, R, 1979, "Strategies for Currency Unification: The Economics of Currency Competition and the Case for a European Parallel Currency", *The Economic Journal*, 355, 697-699.
- [20] Frankel,J, 2012, "Internationalization of the RMB and Historical Precedents", *Journal of Economic Integration*, 27(3), 329-365.
- [21] Huang Y, Wang D, and Fan G, 2014, "Paths to a Reserve Currency: Internationalization of the Renminbi and Its Implications", *Ssrn Electronic Journal*.
- [22] Iglesias M O, 2011, "The Internationalisation of the Renminbi: Prospects and Risks (ARI)", *iglesias*.
- [23] Islam,M.S.,and Bashar,O.K.M.R, 2012, "International of Renminbi:What does the Evidence Suggest?", *World Review of Business Research*, 5, 65-85.

- [24] Jeffrey Frankel, 2012, “Internationalization of the RMB and Historical Precedents”, *Journal of Economic Integration*, 3, 329-365.
- [25] Jong-Wha Lee, 2014, “Will the Renminbi Emerge as an International Reserve Currency?”, *The World Economy*, 37(1), 42-62.
- [26] Kenen, P, 2011, “Currency Internationalization: An Overview”, *BIS papers*, 61(1), 1-10.
- [27] Maziad S., Farahmand P., Wang S., Segal S., and Ahmed F, 2011, “Internationalization of Emerging Market Currencies: A Balance between Risks and Rewards”, *IMF Staff Discussion Note*, 11.
- [28] Sato, K., and Shimizu, J, 2018, “International use of the renminbi for invoice currency and exchange risk management: Evidence from the Japanese firm-level Data”, *The North American Journal of Economics and Finance*, 46, 286-301.
- [29] Tavlas,S.G., Yuzuru,O, 1992, “The Internationalization of Currencies: An Appraisal of the Japanese Yen”, *IMF Occasional Paper*.
- [30] Tavlas G S, 1997, “The international use of the US dollar: an optimum currency area perspective”, *The World Economy*, 6, 709-747.
- [31] Data source: SWIFT RMB tracker
- [32] Data source: BIS Annual Economic Report 2022
- [33] Data source: BIS Annual Economic Report