



The Influence of RMB "Entering the Basket" on RMB Value and Exchange Rate Fluctuation

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Abstract. Based on the research background of RMB joining SDR currency basket, this paper adopts synthetic control method and GARCH model to study the impact of RMB joining SDR currency basket on RMB value and exchange rate fluctuation. The findings are as follows: Compared with not to join the SDR, the renminbi to join the SDR reduces the degree of depreciation, its role in the stability have a suit period, then the market mechanism will make the RMB exchange rate back to normal levels. In addition, to join the SDR to make the RMB against the dollar is affected by the external shocks are lower, but its exchange rate volatility of the renminbi memory enhancement effect is not obvious, indicating that the renminbi to join the SDR on the fluctuation of exchange rate is not the direct result of new RMB in the SDR allocation, but a representation of indirect effect.

Keywords: The SDR; The value of the RMB; RMB exchange rate fluctuations; RMB internationalization; Synthetic control method

1 Introduction

On October 1,2016, the RMB was officially added to the Special Drawing Rights (SDR) basket (hereinafter referred to as " entry into the basket "), and the RMB became the fifth "basket" currency. The RMB "entering the basket" can promote the use of RMB in international settlement, bring transaction facilitation, reduce transaction costs, and avoid the risk of exchange rate fluctuations. Therefore, joining the SDR will undoubtedly promote the internationalization of RMB and exert a certain impact on the RMB exchange rate.

In the study of the impact of RMB "entering the basket" on the value of RMB, Kaicong Xiao (2019)¹, Lisheng Xiao (2016)²believe that the inclusion of RMB in the SDR currency basket will become an important foreign exchange reserve for central banks of various countries and regions in the world, which is conducive to the improvement of the currency value of RMB.By contrast, Xiubo Wu (2016)³ is that the RMB to join the SDR, in the short term will not lead to overseas institutions of RMB assets more, it will increase the difficulty that domestic monetary policy, increase the devaluation of RMB exchange rate expectations.

In the study on the impact of RMB's "entry into the basket" on RMB exchange rate fluctuations, Zidan Li (2017)⁴ believed that the RMB "entry into the basket" would promote the further opening of RMB capital account and domestic financial market, thus making China's economy more sensitive to the turbulence of the external market, thus increasing the fluctuation of RMB exchange rate. Yongtao Zhou and Jiayang Xu (2017)⁵ suggest that the RMB after joining the SDR, need more market-oriented, flexible exchange rate formation mechanism, the exchange rate fluctuation elasticity will increase; On the other hand, Qing He et al. (2018)⁶ showed that reference to the exchange rate index of SDR basket is more conducive to guiding RMB exchange rate expectation and maintaining financial stability. Lingguo Meng and Xianjie Lu (2017)⁷ argued that RMB's SDR entry is beneficial to reduce the frequency and uncertainty of exchange rate fluctuations.

In terms of the selection of empirical methods, VAR model, simultaneous equation model and difference method, which are commonly used to evaluate the effect of policies in the past, are often criticized for their dependence on very strong model assumptions (Bingyan Liu & Cheng Lu, 2018)⁸, and the validity of estimation results and the difficulty of economic interpretation. The synthetic control method was first proposed by Abadie and Gardeazabal (2003)⁹ in the study of identifying the economic costs of terrorist activities in the Basque Region of Spain. Later, it was introduced into China. Zhi Su and Di Hu (2015)¹⁰ used it to test the effectiveness of inflation targeting. Naiquan Liu and You Wu (2017)¹¹ also studied the effect of expansion of the Yangtze River Delta on regional economic joint growth using the synthetic control method.

In the analysis and prediction of financial time series volatility, GARCH model has significant advantages over other models in volatility analysis. According to Zhibin Li (2009)¹², compared with ARCH model, GARCH model further models the variance of errors, which is suitable for the volatility analysis of economic variables. Shaoyan Sun and Wenxuan Sun (2019)¹³ showed that ARMA model could not be used alone to analyze the volatility of some financial markets, and GARCH model should be further introduced for research. Ronghai Yang and Fei Wu (2020)¹⁴ found that the GARCH model with wavelet denoising processing could accurately predict the asymmetric fluctuation of exchange rate.

Therefore, this paper intends to use synthetic control method to analyze the impact of RMB's "entry into the basket" on its currency value, and use GARCH model to analyze the impact of RMB's "entry into the basket" on its exchange rate volatility.

2 The Impact of "Entry into the Basket" on the Value of RMB

2.1 Study Design of Synthetic Control Method

Given $K+1$ currency at the exchange rate of that currency in $t \in [1, T]$ period, where e_{it}^N represents the exchange rate of the $i \in [1, K+1]$ currency that has not been added to SDR at time t , e_{it}^I denotes the exchange rate of the currency i when it joins SDR at time t . Suppose a currency joins the SDR at $t=T_0$, then in the period of $t \in [1, T_0]$, $e_{it}^N = e_{it}^I$ of the currency. After joining the SDR, $t \in [T_0 + 1, T]$, We use $\alpha_{it} =$

$e_{it}^I - e_{it}^N$ for the change in the exchange rate of the currency i brought by SDR accession. For the currencies that actually join the SDR, only the actual exchange rate e_{it}^I can be observed, e_{it}^I can not be observed when it has not joined SDR. We construct a "counterfactual" variable representation e_{it}^N .

$$e_{it}^N = \partial_t + \theta_t Z_i + \lambda_t \mu_i + \varepsilon_{it} \tag{1}$$

Equation (1) is the underlying currency exchange rate determination equation, where ∂_t is the $(F \times 1)$ dimensional unobserved monetary fixed effect, Z_i is the control variable not affected by SDR accession. This paper uses GDP per capita, trade to GDP ratio, inflation rate, domestic real interest rate, the exchange rate of the currency against the dollar and RMB effective exchange rate index exchange rate from 2010 to 2014 as a predictive control variable to fit the synthetic control object of RMB exchange rate. θ_t is a vector of $(1 \times r)$ dimensional positional parameters, λ_t is an unobserved $(F+1)$ dimensional common factor. The error term ε_{it} is a temporary unobserved shock in each currency with a mean of 0.

Suppose that the first ($i=1$) currency is in the SDR, the remaining K ($i=2, 3 \dots K+1$) have not been added to the SDR. In order to get the impact of joining SDR, we must estimate the currency that joins SDR if it does not join SDR at time $t \in [T_0 + 1, T]$ of e_{it}^N , the solution is to simulate the characteristics of the treatment group by weighting the control currency. So our goal here is to find a $(K \times 1)$ dimensional vector weight $W = (w_2, \dots, w_{K+1})$ such that $w_k \geq 0, k = 2, \dots, K + 1$ and $w_2 + w_3 + \dots + w_{K+1} = 1$. Each particular value of the vector W represents a potential combination of synthetic controls, that is, a particular weight on K currencies. The outcome variable value of each control group currency is weighted to obtain:

$$\sum_{k=2}^{K+1} w_k e_{kt} = \delta_t + \theta_t \sum_{k=2}^{K+1} w_k Z_k + \lambda_t \sum_{k=2}^{K+1} w_k \mu_k + \sum_{k=2}^{K+1} w_k \varepsilon_k \tag{2}$$

Suppose there is a weight vector $W^* = (w_2, \dots, w_{K+1})$ such that:

$$\sum_{k=2}^{K+1} w_k^* e_{k1} = e_{11}, \sum_{k=2}^{K+1} w_k^* e_{k2} = e_{12}, \dots, \sum_{k=2}^{K+1} w_k^* e_{kT_0} = e_{1T_0} \text{ and } \sum_{k=2}^{K+1} w_k^* Z_k = Z_1 \tag{3}$$

If $\sum_{t=1}^{T_0} \lambda_t' \lambda_t$ is a nonsingular matrix, then there is:

$$e_{it}^N - \sum_{k=2}^{K+1} w_k^* e_{kt} = \sum_{k=2}^{K+1} w_k^* \sum_{s=1}^{T_0} \lambda_t (\sum_{n=1}^{T_0} \lambda_n' \lambda_n)^{-1} \lambda_s' (\varepsilon_{ks} - \varepsilon_{1s}) - \sum_{k=2}^{K+1} w_k^* (\varepsilon_{ks} - \varepsilon_{1s}) \tag{4}$$

Abadie et al. (2010)¹⁵ proves that under general conditions, if the time period before SDR accession is longer than the implementation time of SDR accession, the right-hand side of (4) is going to go to 0. Therefore, during the period of SDR accession, can be used $\sum_{k=2}^{K+1} w_k^* e_{kt}$ as the unbiased estimate of e_{it}^N to approximately replace e_{it}^N , so the

estimated value of α_{it} can be expressed by equation (5):

$$\hat{\alpha}_{1t} = e_{1t}^I - \sum_{k=2}^{K+1} w_k^* e_{kt}, \quad t \in [T_0 + 1, \dots, T] \tag{5}$$

The key to solving $\hat{\alpha}_{it}$ is to determine the vector $W^* = (w_2, \dots, w_{K+1})$ that makes equation (3) valid. We determine the resultant control vector W^* by solving the approximate solution, that is, we choose to minimize the distance $(r + M) \times k$ between X_1 and X_0 to determine the weight vector W^* :

$$\|X_1 - X_0 W\|_v = \sqrt{(X_1 - X_0 W)' V (X_1 - X_0 W)} \quad (6)$$

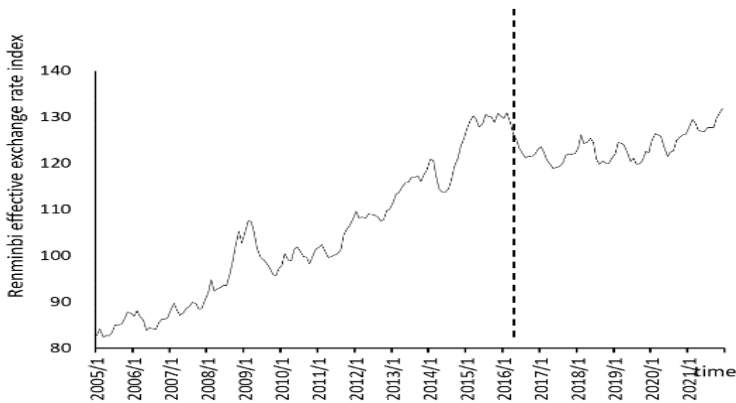
V is a $(r + M) \times (r + M)$ symmetric positive semidefinite matrix, its choice will affect the mean square error of the estimated value. The optimal choice of V is to assign a reasonable weight to the variables in X_0 and X_1 and medium variables to minimize the mean square error of the synthesized control value. This paper uses stata.15 software to complete this process.

2.2 Empirical Analysis of the Influence of RMB Entry Into Basket on RMB Value

Data Description and Descriptive Analysis.

This paper's target currency is RMB, the control group selects the currencies of 17 emerging economies and strong developing countries, none of which have joined the SDR. This paper uses the rise and fall of effective exchange rate index to represent the rise and fall of RMB. The basket currencies of RMB effective exchange rate index used in this paper contains 61 countries and regions. This paper uses the macro data of 18 countries in 2000-2019, including the effective exchange rate index, the currency against the dollar, currency corresponding trade as a share of GDP, per capita GDP, inflation rate and real interest rates, data are derived from the world bank.

Figure 1 shows the monthly sequence chart of the RMB effective exchange rate index, in which the vertical dashed line is the point when RMB joined the SDR basket. It can be seen from the left of the dashed line that the effective exchange rate index of RMB has been on the rise since 2005, and it did not begin to depreciate until 2015. After the global outbreak of COVID-19 in July 2020, the effective exchange rate index of RMB showed a new round of rapid rise. Simply by RMB effective exchange rate index, however, the sequence diagram we can't aware of the RMB into the basket on its exchange rate. To cover up the RMB exchange rate changes caused by the RMB into the basket, we will use the econometric methods to isolate the impact.



Source: Bank for International Settlements

Photo Credit: Original

Fig. 1. Time Series of RMB Effective Exchange Rate Index

Analysis of Empirical Results.

The target currency in the synthetic control method is RMB, and the control group currency is the currencies of the aforementioned 17 countries that have not joined the SDR currency basket. Liansheng Zheng (2016)¹⁶ believed that RMB's desire to join the SDR currency basket was an important reason for the exchange rate reform on August 11. Therefore, we set 2015 as the implementation date of the policy of RMB joining the SDR currency basket to correct the advance impact of market expectations on the RMB exchange rate. The impact of RMB's SDR accession on its currency value is reflected by the exchange rate difference between RMB and its synthetic control currency after 2015. The selection criterion of the weight of each currency in the synthetic control group is to minimize the mean square error of the exchange rate between the two in the period before the implementation of the policy. Table 1 shows the weight of each currency in the synthetic control group.

Table 1. Weight of Currencies in Each Control Group

countries	The weight				
	(1)	(2)	(3)	(4)	(5)
Russian Federation	0.098		0.14	0.034	0.218
Hungary	0	0	0	0	0
South Africa	0	0	0	0	0
Colombia	0	0	0	0	0
Mexico	0.045	0.162		0.096	0.446
The republic of Korea	0	0	0.042	0	0.223
Papua New Guinea	0	0.064	0	0	0.112
Brazil	0.062	0.056	0.07		0
Solomon Islands	0.795	0.718	0.747	0.724	

Czech Republic	0	0	0	0	0
Morocco	0	0	0	0	0
Fiji	0	0	0	0.147	0
Chile	0	0	0	0	0
Poland	0	0	0	0	0
The Philippines	0	0	0	0	0
Samoa	0	0	0	0	0
Malaysia	0	0	0	0	0

Table Source: Original

The exchange rate trend of RMB and its corresponding synthetic control currency from 2010 to 2019 is shown in Figure 2. On the whole, in the years to the left of the dashed line, the exchange rates of RMB and its composite control country are very close, which indicates that the fitting effect of the composite control group's currency to the effective exchange rate index of RMB is good, but on the right of the dashed line, the two gradually deviate. Specifically, RMB joined the SDR basket in 2015. Before joining the SDR, the effective exchange rate index of RMB and its composite control object was basically the same. However, since around 2015, the effective exchange rate index of the composite control object of RMB has been significantly higher than the effective exchange rate index of RMB. The difference between the two is exactly the policy effect of RMB joining the SDR basket. This result shows that the inclusion of RMB in the SDR currency basket has increased the effective exchange rate index of RMB, that is, it has restrained the degree of RMB depreciation. In addition, can be seen from figure 2, in the RMB to the SDR basket, the RMB real effective exchange rate curve and the fitting line is always synthetic control of the money by changes in the opposite direction, the results show that the renminbi to join the SDR basket can effectively from reverse adjustment of RMB exchange rate changes, changes in the value of the RMB in a reasonable range.

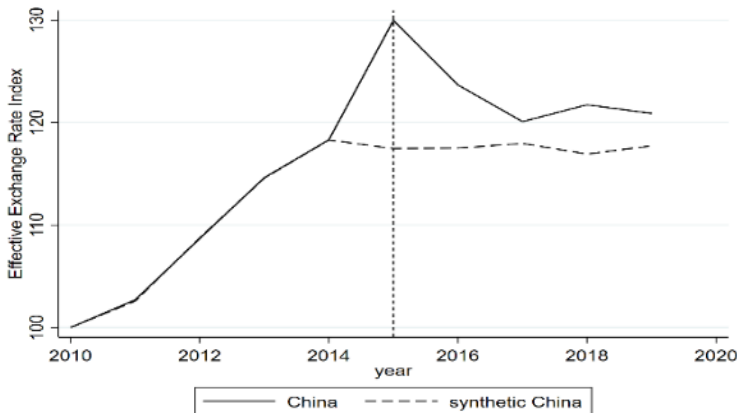


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Fig. 2. Exchange Rate Trend Chart of RMB and Its Composite Control Currency

Robustness Test.

We by investigating whether to join the SDR basket's impact on the value of the RMB will be affected by weight of synthetic objects, the empirical results is because the lack of a certain currency in the control group. Therefore, in a series of robustness test, we delete respectively in table 1 in the first column (1) analysis of the basic currency, with a positive contribution to synthetic RMB of table 1 (2), (3), (4), (5) column shows the remove of the Russian federation, Mexico, Brazil, and the Solomon islands currency after the weight of each control. The robustness results show that the empirical results do not vary with the countries in the control group, indicating that the empirical results are robust.

3 Analysis of the Impact of RMB "Entering the Basket" on RMB Exchange Rate Fluctuation

3.1 Sample Data and Model Selection

This paper selects the daily data of 12 RMB effective exchange rate index from January 2010 to 2021, which is obtained from the Bank for International Settlements. In order to carry out empirical analysis, the effective exchange rate index of RMB will be processed, the specific transformation formula is: $r_t = \log(e_t) - \log(e_{t-1})$. Where e_t is the daily data of the RMB effective exchange rate index from January 2010 to December 12, 2021.

We further analyze the impact of RMB's entry into the SDR basket on its exchange rate fluctuations. This study chooses GARCH (1,1) model to study the fluctuation of RMB exchange rate.

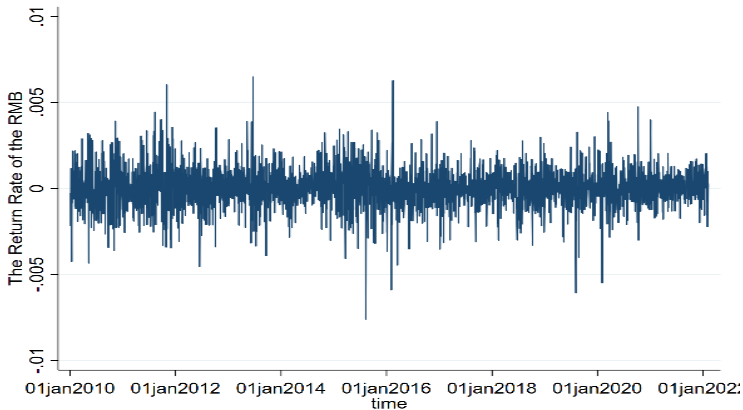
The basic expression of GARCH (1,1) model is as follows:

$$\left. \begin{aligned} y_t &= \beta x_t + \xi_t \\ \hat{h}_t &= \text{var}(\xi_t | \Omega_{t-1}) = a_0 + a_1 \xi_{t-1}^2 + \lambda_1 \hat{h}_{t-1} \end{aligned} \right\} \quad (7)$$

The above conditional variance h_t includes mean a_0 , ARCH term ξ_{t-1}^2 and the first-order lag term h_{t-1} of GARCH term h_t . ξ_{t-1}^2 measures the fluctuation information obtained from the previous period, h_{t-1} is the predicted value of the variance of the previous period. In addition, to ensure a nonnegative sum of the variances, $a_0 > 0, a_1 \geq 0, \lambda_1 \geq 0, a_1 + \lambda_1 < 1$ is required. In this study, GARCH (1,1) models will be constructed for the RMB effective exchange rate index before and after RMB's inclusion in the SDR currency basket, and the impact of RMB's inclusion in the basket on exchange rate fluctuations will be analyzed accordingly.

3.2 Data Characteristics

The unit root test of return rate series r_t shows that r_t is stationary series. FIG. 4 shows the return sequence diagram of RMB effective exchange rate index. It can be preliminarily seen from Figure 4 that the volatility of RMB exchange rate after joining the SDR currency basket is less than that before joining the SDR currency basket. It can be preliminarily determined that RMB's inclusion in the SDR currency basket has a certain impact on RMB exchange rate volatility.



Source: Bank for International Settlements

Photo Credit: Original

Fig. 3. Time Series Plot of the Return of the RMB Effective Exchange Rate Index

3.3 Regression Results

Table 2 shows the regression results of GARCH (1,1) variance equation model, where α_1 is the ARCH term coefficient, which reflects the impact of external shocks on exchange rate fluctuations; λ_1 is the coefficient of GARCH term, which represents the influence degree of previous variance on current variance. The sum of ARCH coefficients and GARCH coefficients is less than 1, and the model satisfies the parameter constraints. The ARCH term coefficients are greater than 0, reflecting that external shocks will aggravate exchange rate fluctuations. And the ARCH term coefficient before joining the SDR currency basket is greater than that after joining the SDR currency basket, indicating that the impact of external shocks after joining the SDR currency basket is lower. The coefficient of GARCH term before and after joining the SDR currency basket were 0.4654935 and 0.3407644 respectively, both of which were less than 1, indicating that exchange rate fluctuations had certain memory, and the memory of exchange rate volatility weakened after RMB's entry into the basket, that is, the persistence of exchange rate fluctuations decreased after RMB's entry into the SDR currency basket.

In addition, after joining the SDR, RMB exchange rate fluctuations are less affected by external shocks, and its exchange rate fluctuations continue to decline. It also shows that the impact of RMB's SDR entry on exchange rate fluctuations is not directly caused by the new RMB allocation in the SDR currency basket, but a representative indirect

effect. This is mainly reflected in the following: First, the status of RMB has been recognized internationally and become more authoritative. Second, the deep value lies in helping the renminbi to realize true internationalization. Third, to force reform of the domestic financial system. Therefore, although the SDR accession has no significant direct effect on the fluctuation of RMB exchange rate, it plays a huge role in improving the status of RMB in the international monetary system.

Table 2. Regression Results of GARCH (1, 1) Variance Equations

	a_0	a_1	λ_1
Before joining the SDR basket	0.0000683**	0.0998283***	0.4654935**
After joining the SDR basket	0.000011	0.0902558***	0.3407644*

Note: *** indicates significant at the 1% level of significance.

Table Source: Original

4 Conclusions

The RMB to join the SDR basket suppresses the RMB's depreciation degree. In addition, the stability maintenance effect of RMB entry into the basket on its exchange rate first increases and then gradually decreases, which indicates that there is an adaptation period for the effect of RMB entry into the basket on its exchange rate.

Joining the SDR currency basket makes the RMB exchange rate less affected by external shocks, which is caused by reducing the risk of exchange rate fluctuations through promoting RMB internationalization and reducing the transmission of international risks to China through promoting exchange rate liberalization. In addition, joining the SDR basket weakens the memory of RMB exchange rate volatility.

The impact of RMB's inclusion in SDR currency basket on exchange rate fluctuations is not directly caused by the new allocation of RMB in SDR, but a representative indirect effect. This is mainly reflected in the international recognition of the status of the RMB, which is more authoritative, helping the RMB to realize real internationalization and forcing the reform of the domestic financial system.

5 Policy Recommendations

Expand the overseas asset allocation of RMB. On the one hand, it encourages qualified foreign entities to issue RMB bonds in China, and actively guides domestic enterprises to make foreign direct investment in the form of RMB, opening up the channel of RMB "going global". On the other hand, domestic financial institutions should also be encouraged to "go global", enhance their ability to allocate capital of global resources, improve their ability to monitor and control cross-border risks, and realize the optimal allocation of RMB overseas while enhancing their competitiveness.

Reduce the constraint and influence of exchange rate fluctuations on interest rates. One is to improve our financial market, develop effective risk hedging tools and reduce the risk that our interest rate is affected by the exchange rate fluctuations. Second, accelerate the process of RMB internationalization, further increase the use of RMB in international settlement and capital transactions, and get rid of the situation of international disturbance in the domestic currency market.

Optimize international reserve structure and reserve management in China. China should realize diversified foreign exchange reserves and replace foreign exchange reserves with gold reserves, foreign exchange reserves, ordinary drawing rights and Special Drawing Rights, and reduce the interference of exchange rate fluctuations on foreign exchange reserves through diversified currency reserve strategy. Further, with the help of RMB's "entry into the basket" to enhance the status of RMB in the international monetary system, the settlement of RMB in international trade and investment is promoted.

Acknowledgements

This paper was supported by the National Social Science Fund project " Research on the mechanism and implementation path of enterprise digitalization empowerment on the high-quality development of OFDI in China " (Number:22BJL103) and Postgraduate Scientific Research Innovation Project of Chongqing Municipal Education Commission" Research on the mechanism and implementation path of enterprise digitalization empowerment on the high-quality development of OFDI in China "(Number CYS22566).

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