

Research on China's funds outstanding for foreign exchange Fluctuation and Monetary Policy Adjustment

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ABSTRACT: *In the context of the Federal Reserve's interest rate hike process, This paper analyzes the impact mechanism of funds outstanding for foreign exchange account on domestic base currency investment. The structural VAR model empirically tests the relevant impact of funds outstanding for foreign exchange on domestic money supply and monetary policy. The empirical research results show that: First, the increase in funds outstanding for foreign exchange will help push up the domestic broad money supply M2 and domestic credit scale, but have less impact on M2 and domestic credit scale fluctuations; Second, the monetary policy operation means such as the central bank's rediscounting and refinancing business can play a more effective regulatory role for domestic M2, which indicates that China's monetary policy has a strong macro adjustment effect. Third, compared with the level of attention of the domestic broad money M2, China's central bank is more focused on regulating the impact of funds outstanding for foreign exchange on China base currency. There has not been a fundamental change in China prudent monetary policy.*

KEYWORDS: *funds outstanding for foreign exchange; monetary policy; structural VAR*

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I. INTRODUCTION

Since 2014, with the change of the “double surplus” pattern in China's international trade, China's funds outstanding for foreign exchange have reached a historical high and began to decline rapidly. It can be seen from Figure 1 that the scale of China's funds outstanding for foreign exchange has gradually declined after reaching a high level in May 2014, and there has been a “cliff” decline between May 2015 and July 2016. This has hindered China's traditional channel of relying on funds outstanding for foreign exchange to pay the base currency to the market.

Judging from the external environment that affects China's funds outstanding for foreign exchange, in recent years, with the gradual recovery of the US economy, the Fed begins to shrink its balance sheet. Three interest rate hikes have been completed in 2017, which indicates that the Fed's interest rate hike has accelerated. After the announcement of a 25 basis point rate hike in December 2017, the interest rate adjustment will be changed from 0-0.25% to 0.25%-0.5% (as shown in Table 1), which indicates that the interest rate adjustment range will have a larger operating range. Recently, the US Congress passed a large-scale tax reduction bill. Under the strategy of increasing interest rates and tax cuts in the United States, it has a “blood draw” effect on global capital markets and investment, this indirectly affects the changes in China's domestic base money supply.

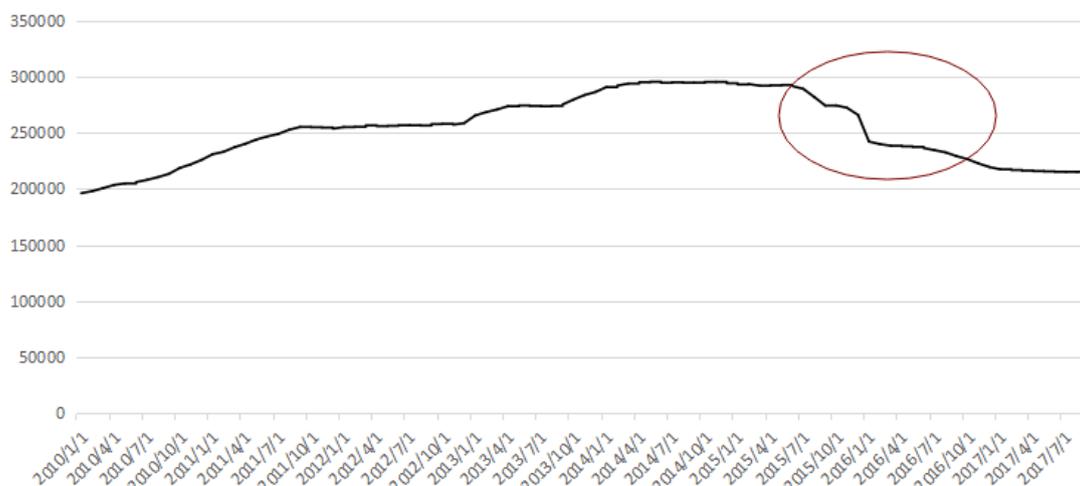


Figure 1. Funds outstanding for foreign exchange in China

Table 1: Adjustment of the Federal Reserve's interest rate policy in recent years

year	Federal funds rate adjustment	Adjusted US federal funds rate range
December 2015	Raise interest rates by 25 basis points	0.25%-0.5%
December 2016	Raise interest rates by 25 basis points	0.5%-0.75%
March 2017	Raise interest rates by 25 basis points	0.75%-1%
June 2017	Raise interest rates by 25 basis points	1%-1.25%
December 2017	Raise interest rates by 25 basis points	1.25%-1.5%
March 2018	Raise interest rates by 25 basis points	1.5%-1.75%
June 2018	Raise interest rates by 25 basis points	1.75%-2.00%
September 2018	Raise interest rates by 25 basis points	2.00%-2.25%

II. LITERATURE REVIEW

China's domestic research on the relationship between funds outstanding for foreign exchange and money supply is relatively early. The fluctuation of funds outstanding for foreign exchange has been considered as one of the important factors affecting the delivery of China's base currency. Huo and Lv(1995) analyzed the relationship between funds outstanding for foreign exchange and basic currency in China, and considered that the opening up, exchange rate system and foreign exchange management system are the main reasons that affect the changes in funds outstanding for foreign exchange, the impact of funds outstanding for foreign exchange on China's base currency was about 30% in 1995. Zhou and Liu(2009) analyzed the relevant data of China from 1996 to 2007, and believed that the release of China's base currency was mainly affected by funds outstanding for foreign exchange, which made China's monetary policy more passive. Niu and Tao(2011) believe that funds outstanding for foreign exchange will expand through the path of the base currency-currency supply-credit, and use the SVAR model to empirically analyze the impact of funds outstanding for foreign exchange on the base currency, broad money supply and financial institution loans. They pointed out that under the theoretical framework of "The Impossible Trinity", we must be alert to the impact of foreign exchange holdings on the independence of China's monetary policy.

But funds outstanding for foreign exchange is only a factor affecting China's money supply. Wu and Li(2012) analyzed the balance sheet of commercial banks, and concluded that in addition to funds outstanding for foreign exchange, commercial banks' credit business and other asset businesses will also create currency and affect the money supply, China's money supply has a relatively obvious period characteristics: Before 2005, various loan business of commercial banks was the main channel for China's money supply, The large inflow of foreign exchange from 2006 to 2008 made funds outstanding for foreign exchange the main channel for money supply, We need to pay more attention to the impact of other factors on the money supply.

In recent years, some new changes have taken place in the study of funds outstanding for foreign exchange and money supply. Wang, Wang, and Wu(2013) pointed out that the capital flow and exchange rate system is the key factor affecting China's monetary policy through the improved Mundell-Fleming model theory, and the influence of funds outstanding for foreign exchange on the money supply is weak. Zhang and Quan(2016) believe that due to the influence of funds outstanding for foreign exchange, the central target of China's base currency and the monetary policy are biased, and the central bank's adjustment of the base currency is more difficult. Wu and Zhuo(2017) believe that the domestic passive currency delivery method brought by funds outstanding for foreign exchange has been effectively hedged by the central bank by adjusting the reserve ratio of commercial banks, the impact of funds outstanding for foreign exchange on the M2 is limited.

In summary, the funds outstanding for foreign exchange do have a certain impact on China's money

supply, especially the impact of China's monetary policy independence. But there are also some drawbacks, On the one hand, there was relatively little empirical research between monetary policy operations such as central bank redemption and refinancing and funds outstanding for foreign exchange in previous studies, On the other hand, under the background of the Fed's interest rate increase, it is of great significance to study the relationship between the fluctuation of funds outstanding for foreign exchange and China's money supply and monetary policy. This paper tries to solve these problems.

III. THE INTRODUCTION OF MONEY SUPPLY CHANNELS IN CHINA

Generally speaking, the amount of money in circulation is equal to the product of the base currency and the currency multiplier. In China, the main body of money supply is the central bank and commercial banks, in which the central bank creates the base currency and the commercial bank plays the role of expanding the deposit currency.

1) Commercial bank and deposit currency creation

Commercial banks occupy a dominant position in China's financial system, which can achieve the function of derivative currency, the function of the derivative currency of commercial banks is mainly reflected by its balance sheet. If Bank A receives the deposit, the remaining portion will be used to loan to Borrower B if part of the reserve is reserved. If Borrower B receives the funds, it will deposit the loan into Bank C again, and so on. Commercial banks play the role of derivative money in this process, and this function of derivative money is one of the important channels of money supply in China.

(2) funds outstanding for foreign exchange and base currency delivery

Funds outstanding for foreign exchange is derived from the surplus of current accounts and capital and financial accounts in China's balance of payments. Before 2014, the phenomenon of "double surplus" in China's international trade often appeared, due to China's foreign exchange settlement and sales system, this part of the trade surplus is converted into RMB and passively increases the supply of China's currency. Therefore, when China's funds outstanding for foreign exchange account increases, the currency in circulation in the market will increase, and vice versa. Under this circumstance, China's money supply has become relatively passive and vulnerable to the impact of international trade balance. To some extent, China's currency is more exogenous when it comes to the main factors of funds outstanding for foreign exchange.

(3) The central bank's monetary policy regulates the money supply

China's central bank's monetary policy adjustment measures mainly include deposit reserve ratio, rediscounting, refinancing and open market operations. Taking the deposit reserve ratio as an example, the central bank can reduce the deposit reserve ratio of commercial banks, so that commercial banks have more funds for credit. In general, China's central bank's interest rate instruments are relatively more used. In recent years, the central bank has released liquidity to the market through repeated policies to lower interest rates and reduce the deposit reserve ratio. The operating methods such as open market operations are relatively passive, and China's central banks use less.

IV. ECONOMETRIC MODEL METHOD AND DATA

(1) Econometric model method

Structural Vector Autoregressive Model (SVAR) is based on VAR model. VAR model can not reflect the current influence relationship between variables, which includes the current relationship among variables in the random error term. The SVAR model can not only reflect the lag time relationship between variables, but also reflect the current influence relationship between variables. The general expression of multivariable SVAR model is as follows:

$$D_0 y_t = \Gamma_t y_{t-1} + \Gamma_2 y_{t-2} + \dots + \Gamma_p y_{t-p} + \mu_t \quad (1)$$

$$\text{where, } D_0 = \begin{pmatrix} 1 & -d_{12} & \dots & -d_{1k} \\ -d_{21} & 1 & \dots & -d_{2k} \\ \vdots & \vdots & \ddots & \vdots \\ -d_{k1} & -d_{k2} & \dots & 1 \end{pmatrix}, \quad \Gamma_i = \begin{pmatrix} \gamma_{11}^{(i)} & \gamma_{12}^{(i)} & \dots & \gamma_{1k}^{(i)} \\ \gamma_{21}^{(i)} & \gamma_{22}^{(i)} & \dots & \gamma_{2k}^{(i)} \\ \vdots & \vdots & \ddots & \vdots \\ \gamma_{k1}^{(i)} & \gamma_{k2}^{(i)} & \dots & \gamma_{kk}^{(i)} \end{pmatrix}_{i=1,2,\dots,P}$$

$\mu_t = (\mu_{t1} \quad \mu_{t2} \quad \dots \quad \mu_{kt})^T$, D_0 main diagonal elements are 1, this reflects the simultaneous structural relationship between the variables. For the AB structure VAR, the constraint equation is:

$$A\varepsilon_t = B\mu_t \tag{2}$$

(2) The dataset

In order to study the impact of foreign exchange fluctuations on China's monetary policy, the article selects funds outstanding for foreign exchange (WHZ), broad money supply (M2), various loan scales in the financial institution's balance sheet(DK), credit rights to other depository companies in the balance sheet of the central bank (CK).The above data are monthly time series data from January 2007 to September 2017 in China.The broad money supply M2 is used to study the impact of funds outstanding for foreign exchange fluctuations on domestic money supply,Various loans(DK) are used to measure the impact of funds outstanding for foreign exchange on China's money supply through credit channels,CK is used to measure the impact of fluctuations in funds outstanding for foreign exchange on China's central bank refinancing, rediscounting monetary policy operations.This paper does not choose the central bank's open market business operation because China's central bank's open market business is rarely used. As can be seen from Figure 2, China's central bank's credit to the government remains at a relatively stable level,while the creditor's rights to other deposit-taking companies in the balance sheet have fluctuated greatly in recent years, indicating that China's central bank is more inclined to refinance and rediscount business than the open market operations.Under the financial system dominated by commercial banks, in terms of monetary policy operational indicators, the rediscounting and refinancing operations are more flexible and proactive than the open market operations.

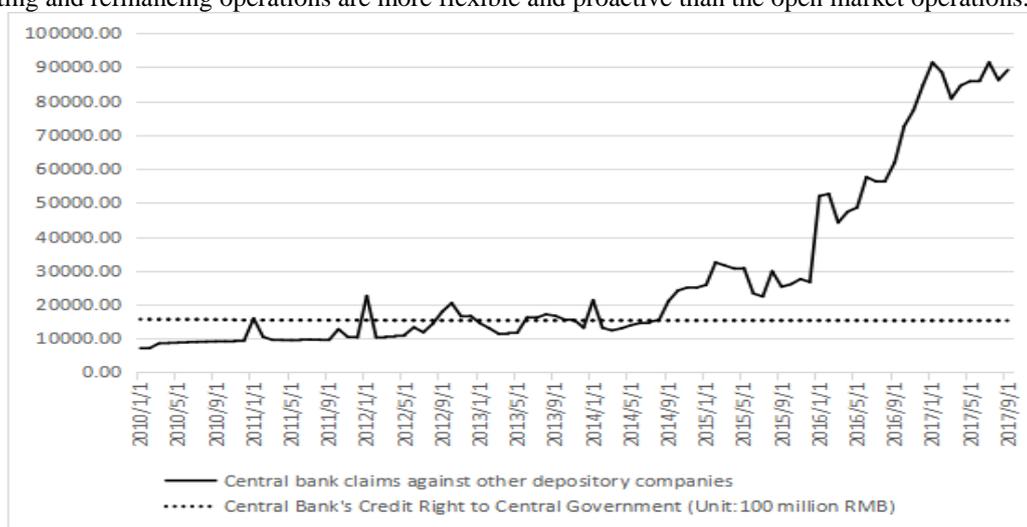


Figure 2. Central bank claims against other depository companies and central government

For the above four variables, the price factor disturbance is eliminated after the appropriate treatment, and the broad money supply data and the domestic credit scale data have obvious seasonal fluctuations. Therefore, the X12 method is used to eliminate the seasonal factor disturbance. After the above data processing, the logarithm of the original data is taken. The above data are from the website of the National Bureau of Statistics of China, and the econometric software is Eviews8.0.

V. EMPIRICAL ANALYSIS

1 Unit root test

As can be seen from Table 2, the original sequence is non-stationary. After the first-order difference, each variable rejects the assumption that there is a unit root at the 1% level, indicating that each sequence is stationary.¹

Table 2 Unit root test

Variables	t-Statistic	Prob.	Critical value		Conclusion
			1%	5%	
LWHZ	-0.7009	0.9704	-4.0319	-3.4456	Unstable
LM2	-0.2969	0.9900	-4.0344	-3.4468	Unstable
LDK	-1.1532	0.9149	-4.0319	-3.4456	Unstable
LCK	-2.0851	0.5488	-4.0319	-3.4456	Unstable
DLWHZ	-9.0902	0.0000	-4.0319	-3.4456	Stable
DLM2	-6.3282	0.0000	-4.0344	-3.4468	Stable

¹ The above test types include trend items and intercept items, and the lag order is determined by the SIC criteria.

DLDK	-8.5581	0.0000	-4.0319	-3.4456	Stable
DLCK	-11.1384	0.0000	-4.0325	-3.4459	Stable

2 Cointegration test of SVAR model

It can be seen from Table 3 that the four variables in the SVAR model reject the assumption that there is no cointegration relationship at the 1% level, which indicates that there is a long-term cointegration relationship between the above four variables.

Table 3 Johansen cointegration test

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.
None	0.38816	135.7678	47.8561	0.0000
At most 1	0.2786	74.3575	29.7971	0.0000
At most 2	0.1811	33.5421	15.4948	0.0000
At most 3	0.0663	8.5707	3.8415	0.0034

3 SVAR Lag Order Selection Criteria

It can be seen from Table 4 that when the lag order is 1, the SC criterion and the HQ criterion both reach the minimum value. When the lag order is 2, the FPE criterion and the AIC criterion also reach the minimum value, which makes the selection of the lag order in dilemma. This paper uses the Likelihood Ratio (LR) method to determine the optimal lag order, the value of LR can be calculated as:

$$LR = -2(\text{Log}L_1 - \text{Log}L_2) = 2(1229.452 - 1252.582) = 46.26$$

Table 4 Lag Order Selection

Lag	LogL	LR	FPE	AIC	SC	HQ
0	1181.178	NA	3.54e-14	-19.61964	-19.52672	-19.58191
1	1229.452	92.52422	2.07e-14	-20.15753	-19.69295*	-19.96886*
2	1252.585	42.79681	1.84e-14*	-20.27642*	-19.44017	-19.93682
3	1263.487	19.44218	2.01e-14	-20.19146	-18.98355	-19.70092
4	1277.543	24.12777	2.08e-14	-20.15904	-18.57946	-19.51757
5	1291.937	23.75026	2.15e-14	-20.13228	-18.18103	-19.33987
6	1302.952	17.44051	2.36e-14	-20.04919	-17.72628	-19.10585
7	1314.844	18.03674	2.57e-14	-19.98073	-17.28616	-18.88645
8	1333.909	27.64425	2.49e-14	-20.03182	-16.96558	-18.78660

The null hypothesis of the test is that the lag order of the model is 1, and the value of the adjoint probability P used to test whether the null hypothesis holds is less than 0.05. Therefore rejecting the null hypothesis to establish the SVAR(2) model. It can be seen from Fig. 3 that the eight roots of the constructed SVAR(2) model all fall within the unit circle, indicating that the constructed model is stable.

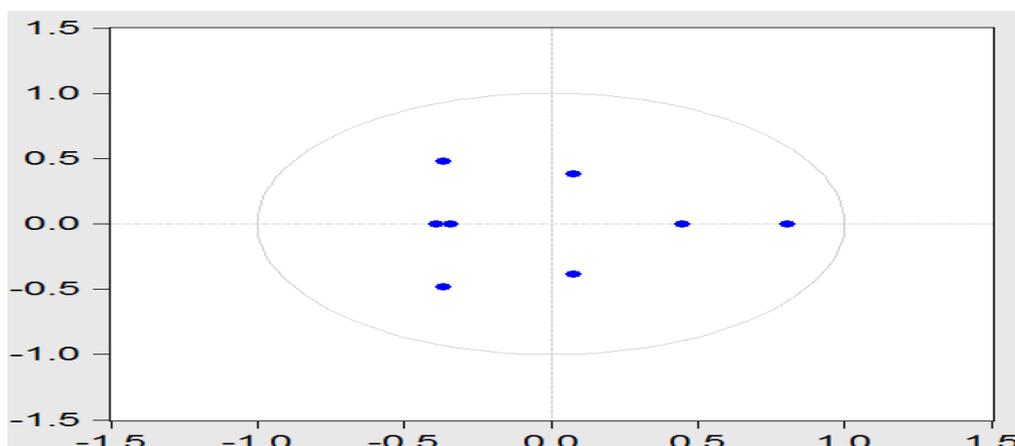


Figure 3. Inverse Roots of AR Characteristic Polynomial

4. Identification conditions of SVAR model

The relationship between the SVAR disturbance term and the structural shock term is as follows:

$$\begin{pmatrix} 1 & a_{12} & a_{13} & a_{14} \\ a_{21} & 1 & a_{23} & a_{24} \\ a_{31} & a_{32} & 1 & a_{34} \\ a_{41} & a_{42} & a_{43} & 1 \end{pmatrix} \begin{pmatrix} \mu_t^{WHZ} \\ \mu_t^{M2} \\ \mu_t^{DK} \\ \mu_t^{CK} \end{pmatrix} = \begin{pmatrix} b_{11} & 0 & 0 & 0 \\ 0 & b_{22} & 0 & 0 \\ 0 & 0 & b_{33} & 0 \\ 0 & 0 & 0 & b_{44} \end{pmatrix} \begin{pmatrix} \varepsilon_t^{WHZ} \\ \varepsilon_t^{M2} \\ \varepsilon_t^{DK} \\ \varepsilon_t^{CK} \end{pmatrix}$$

For the AB form of the SVAR model, the four variables selected in this paper need to apply at least 22 constraints to make the model meet the identifiable conditions. We apply the following constraints based on economic principles: First, M2, DK and CK have no impact on the current funds outstanding for foreign exchange holdings, that is, the values of α_{12} , α_{13} and α_{14} are all 0. Second, the scale of domestic credit does not affect the current M2, so the value of α_{23} is 0. Third, WHZ and CK have no impact on the current domestic credit scale (DK), so the values of α_{31} and α_{34} are 0. Finally, M2 and DK have no effect on the current CK, so the values of α_{42} and α_{43} are 0. After the constraint is imposed, the above formula can be changed to:

$$\begin{pmatrix} 1 & 0 & 0 & 0 \\ \alpha(1) & 1 & 0 & \alpha(4) \\ 0 & \alpha(3) & 1 & 0 \\ \alpha(2) & 0 & 0 & 1 \end{pmatrix} \begin{pmatrix} \mu_t^{WHZ} \\ \mu_t^{M2} \\ \mu_t^{DK} \\ \mu_t^{CK} \end{pmatrix} = \begin{pmatrix} \alpha(5) & 0 & 0 & 0 \\ 0 & \alpha(6) & 0 & 0 \\ 0 & 0 & \alpha(7) & 0 \\ 0 & 0 & 0 & \alpha(8) \end{pmatrix} \begin{pmatrix} \varepsilon_t^{WHZ} \\ \varepsilon_t^{M2} \\ \varepsilon_t^{DK} \\ \varepsilon_t^{CK} \end{pmatrix}$$

The estimated results are shown in table 5.

Table 5 Structural VAR Estimates

Matrix parameter	Coefficient	Std. Error	z-Statistic	Prob.
C(1)	-0.02315	0.0765	-0.3026	0.7622
C(2)	2.9981	1.1068	2.7088	0.0068
C(3)	-0.4661	0.0487	-9.5739	0.0000
C(4)	0.0088	0.0058	1.5137	0.1612
C(5)	0.0124	0.0008	15.8745	0.0000
C(6)	0.0103	0.0007	15.8745	0.0000
C(7)	0.0057	0.0004	15.8745	0.0000
C(8)	0.1535	0.0098	15.8745	0.0000

5. Impulse response using SVAR factors

It can be seen from Figure 4 that after a positive impact on funds outstanding for foreign exchange holdings, the response of broad money supply M2 is more obvious. The broad money supply M2 is positive in the first period, and gradually rises after a small decline, reaching in the third period. The peak, then this effect gradually decreases to zero after 18 (1.5 years). The impact of funds outstanding for foreign exchange on M2 is consistent with the actual economic theory: when China's funds outstanding for foreign exchange increases, it has a driving effect on China's money supply. In the medium term, this effect is basically stable.

From the relationship between funds outstanding for foreign exchange and domestic credit scale: After applying a positive impact to WHZ, DK was positive in the first period, then decreased to a negative value in the second period, and reached the maximum in the fifth period. Overall, the impact of foreign exchange holdings on domestic credit scale is positive, and this positive impact is consistent with real economic theory: when foreign exchange holdings increase, it will affect the supply of domestic base money, and further increase the scale of credit through the role of money multipliers.

From the perspective of foreign exchange holdings and central bank rediscounting and refinancing monetary policy: WHZ has a negative impact on CK. This shows that when China's funds outstanding for foreign exchange increases, it will have a large positive pressure on China's domestic money supply, which may cause excessive money supply in the market in the short term. The central bank will reduce the currency supply through rediscounting and refinancing to achieve the goal of stabilizing domestic money supply. It can be seen from Figure 2 that in recent years, with the decline in the size of China funds outstanding for foreign exchange ,

the creditor's rights of other deposit-taking companies in China central bank balance sheet are rising rapidly, indicating that China central bank is currently seeking more initiative ways to maintain a stable supply of money.

The impact of the central bank's rediscounting and refinancing operations on M2. When the central bank increased the claims of other deposit-taking companies, it indicated that the central bank actively reduced the rediscount rate and the re-loan interest rate and placed the base currency on the market. When the central bank puts the base currency into the market through the rediscounting and refinancing operations, the effect of the money multiplier has a positive impact on the M2 supply.

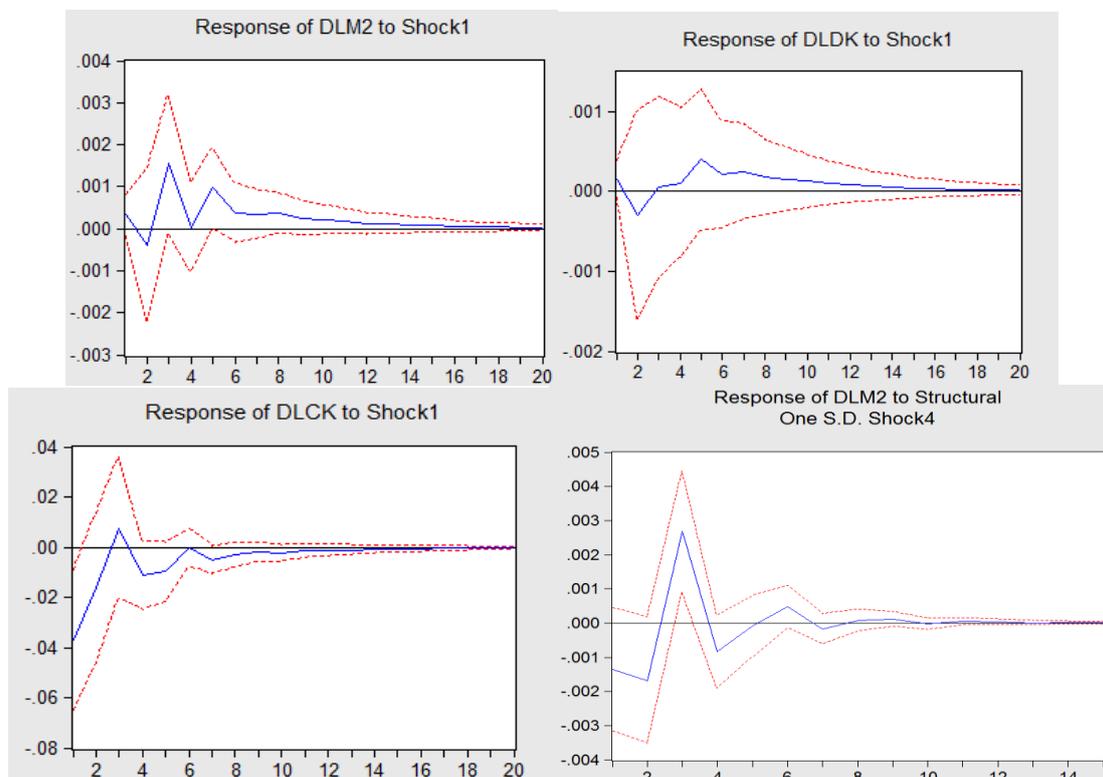


Figure 4. Impulse response

6. Variance decomposition

For M2, it can be seen from Table 6 that among all the factors, M2 has a greater impact on itself, about 86%, which indicates that the supply of M2 in China is mainly affected by expected factors and inertia. In addition, the contribution rate of China's central bank's rediscount and re-lending monetary policy to M2 is about 10.26%, which indicates that in recent years, China's central bank can achieve stronger regulation of M2 supply through monetary policy tools. By comparing the contribution rate of central bank rediscounting, refinancing and funds outstanding for foreign exchange to M2, we can find that the central bank's rediscounting and refinancing operations have a greater impact on M2, which shows that with the continuous improvement of the central bank's currency control system and means, the degree of influence of foreign exchange holdings on China's money supply may show a downward trend.

As for the central bank's rediscounting and refinancing monetary policy operation methods, it can be seen from Table 6 that among all the factors, in addition to its own influence, WHZ contributes a large amount to CK, which is about 6.08%, while the impact of M2 on central bank rediscounting and refinancing is small, about 4.3%. On the whole, the main focus of China's central bank's monetary policy objectives is to deal with the impact of funds outstanding for foreign exchange fluctuations on domestic base money supply, which also shows that China's central bank is actively adapting to the challenge of the decline in funds outstanding for foreign exchange for China's traditional currency distribution channels.

Table 6 Variance decomposition of SVAR model

Period	Variance decomposition of M2			Variance decomposition of CK		
	Shock1	Shock2	Shock4	Shock1	Shock2	Shock4
1	0.0982	98.2140	1.6877	5.5029	0.0000	94.4971
2	0.2365	96.5694	4.1900	5.5087	0.0483	94.4387

3	2.1796	87.6743	9.7432	5.4700	3.4643	90.7657
4	2.1538	87.2542	10.1913	5.7274	4.1521	89.7608
5	2.8915	86.5498	10.1079	5.9578	4.1073	89.5555
6	2.9915	86.3035	10.2547	5.9375	4.2802	89.3831
7	3.0827	86.2030	10.2646	6.0278	4.3035	89.2718
8	3.1892	86.0993	10.2574	6.0434	4.3036	89.2487
9	3.2342	86.0519	10.2597	6.0514	4.3089	89.2354
10	3.2653	86.0237	10.2568	6.0680	4.3090	89.2180
11	3.2910	85.9988	10.2556	6.0740	4.3098	89.2112
12	3.3040	85.9868	10.2546	6.0779	4.3099	89.2072
13	3.3135	85.9782	10.2536	6.0815	4.3097	89.2036
14	3.3200	85.9722	10.2532	6.0833	4.3099	89.2018
15	3.3237	85.9687	10.2528	6.0845	4.3099	89.2006

VI. CONCLUSION

This paper studies the relationship between funds outstanding for foreign exchange and monetary policy in China and draws the following conclusions: On the one hand, funds outstanding for foreign exchange have a certain impact on the domestic broad money M2, when China's funds outstanding for foreign exchange increases, it will affect China's base currency, thereby increasing the domestic M2 supply. It can be seen from the variance decomposition that the influence of funds outstanding for foreign exchange on domestic M2 is limited, and the central bank's monetary policy operation means have a strong influence on domestic M2, which indicates that China's central bank's monetary policy has a greater impact on M2 regulation. On the other hand, the purpose of China's central bank's use of monetary policy is not only to regulate the level of domestic M2, but also the influence of foreign exchange on the base currency is one of its regulation, and the central bank is more focused on the regulation of foreign exchange.

Combined with the changes in China's central bank's monetary policy since 2014, it can be seen that after the central bank cut interest rates for the first time in November 2014, the central bank cut interest rates five times in a row throughout the year to release liquidity to the market. In 2014, China funds outstanding for foreign exchange account fell for the first time. According to data released by the central bank, from November 2014 to January 2016, China funds outstanding for foreign exchange holdings fell rapidly from 295,274 trillion yuan to 242,092 trillion yuan, the decline is about 20%. At this time, the central bank released liquidity to the market through the policy of lowering interest rates to compensate for the lack of market liquidity caused by the decline in funds outstanding for foreign exchange. Therefore, for the changes in the central bank's interest rate policy since 2014, it should not be simply understood as an expanded monetary policy. There is no fundamental change in China's continued implementation of a sound monetary policy.

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