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Structural Monetary Policy, Bank Credit and Bank Liquidity—An Empirical Analysis Based on VAR Model

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After the outbreak of the international financial crisis, the People's Bank of China, based on traditional monetary policy tools, launched a series of structural monetary policy tools such as standing lending facility (SLF), medium-term lending facility (MLF), and pledged supplementary lending (PSL) and targeted at liquidity via the commercial banking system. In order to test the credit transmission effect of structured monetary policy, this paper empirically analyzes the relationship between structured monetary policy, bank liquidity and bank credit based on the VAR model. The research shows that the implementation of structured monetary policy reduces the liquidity of commercial banks in the short term and increases in loans to small or micro enterprises and agriculture-related loans, these policies have produced significant short-term effects on credit transmission in steady of long-term effects. Thus, a series of supporting measures are needed to fully exert the effects of structural monetary policy.

Keywords: structural monetary policy, bank liquidity, credit transmission, VAR model

Introduction

After the outbreak of the international financial crisis in 2008, subject to the "liquidity trap" and the zero lower limit of interest rates, the central banks of major economies in the world innovated various monetary policy tools to improve the transmission mechanism for monetary policy and guide the flow of monetary funds to the real economy sectors. For example, the Federal Reserve introduced the term securities lending facility (TSLF), commercial paper financing facility (CPFF), etc., the Bank of England launched the Financing-for-Loan Program (FLS), the European Central Bank launched the Targeted Long-Term Refinancing Operation (TLTRO), and the Bank of Japan launched the loan support program (Loan Support Program). These innovative monetary policy tools all have the characteristics of "structural type": the first one is to change from "flood of cash" to "precise delivery" to guide the monetary funds to flow to specific sectors of the real economy; the second one is to unblock the channels of monetary policy credit and provide targeted liquidity through the commercial banking system.

In the background of the "new normal", the external environment of China's current economy is complicated and changeable. Objectively, it requires "stable monetary policy to be flexible and appropriate".

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Monetary policy transmission must be directed to the real economy sectors in order to enhance the ability of financial services of serving the real economy sectors. Based on these elements, the People's Bank of China has introduced innovatively a series of structural monetary policy tools on the basis of traditional monetary policy tools such as targeted re-lending and targeted ratio reduction, short-term liquidity operations (SLO), standing lending facilities (SLF), medium-term Lending Facility (MLF), pledged supplementary lending (PSL), targeted medium-term lending facility (TMLF), etc.

What is the effect of aforementioned structural monetary policy implemented by the Central Bank of China?

Is the transmission mechanism smooth? To answer this question, the in-depth academical research is urgently needed. On account of its leading financial system for the Bank of China, bank credit is the main source of external funds for enterprises, while bank credit is also closely connected with bank liquidity. The central bank's structural monetary policy affects the bank's capital cost and risk-taking willingness by changing the bank's liquidity status, and then directs liquidity via credit channels. In a sense, the smoothness of bank credit channels determines the effect of structural monetary policy, in this situation, studying the relationship between structured monetary policy, bank liquidity and bank credit has important practical significance for deeply understanding the credit transmission channels of monetary policy and the effect of structural monetary policy.

Literature Review

This article reviews the literature from the connotation features of structural monetary policy and credit transmission.

Connotation Features of Structural Monetary Policy

Due to the heterogeneity of micro-subjects, aggregate monetary policy generally has a structural effect. Scholars such as Head and Kumar (2004), Ireland (2005), Wright and Williamson (2010) explored the structural distribution effect of monetary policy. Williamson (2008) believes that the degree of segmentation in different markets is different, thus the degree of closeness between market entities and the capital market, and the time and depth of the impact of overall liquidity are also different, which leads to the structural effects of redistributing wealth for monetary policy. Zhao (2012) found that monetary policy affects the economic aggregate in the short-term while affects the economic structure in the long-term. Yu (2006) explained the differences in the impact of the single currency policy on various regions from the regional differences in physical geography and human history as well as the effect of industrial structure. Ma (2011) defines the concept of structural monetary policy from a macro perspective, and summarizes the structural effects of structural monetary policy at three levels: that is, regional structure effect, industrial structure effect and consumption structure effect. However, structural monetary policies also have microstructural effects. The quantitative easing policies implemented by developed economies such as Europe and the United States have a direct impact on the balance sheets of commercial banks and other micro-financial institutions. Such monetary policies should also be included in the category of structural monetary policies (Peng and Fang, 2016). Li and Wu (2015) also believe that the unconventional monetary policies adopted by developed economies in response to the current round of financial crisis have obvious structural characteristics and conform to the definition of structural monetary policy. Feng and Sun (2016) hold similar views and believe that the unconventional

monetary policies adopted by developed countries in response to the financial crisis are structural monetary policies. On the contrary, some scholars believe that the unconventional monetary policy implemented by developed countries cannot be equated with structural monetary policy. Unconventional monetary policy aims to break through the "zero lower limit of interest rate" of conventional monetary policy, repair the transmission mechanism of monetary policy and restore the financial structure as well as the role of financial markets (Cecioni, Ferrero, & Secchi, 2011). The structural monetary policy implemented by China is a supplement to the conventional monetary policy. It aims to guide the targeted investment of funds to facilitate economic transformation and structural adjustment. It is very different from the unconventional monetary policy implemented by developed countries.

Credit Transmission of Structural Monetary Policy

Early research results on the transmission mechanism of monetary policy mainly include: interest rate transmission channels (Hicks, 1937), credit transmission channels (Roosa, 1951), wealth transmission channels (Ando & Modigliani, 1963), currency transmission channels (Friedman, 1956), and Central bank information communication channel (Svensson, 2003). Among them, the credit transmission channel focuses on the effect of credit scale on output. According to the different research scope, the broad credit channel refers to the balance sheet channel, and the narrow credit channel refers to the bank loan channel. The research of this article focuses on the bank loan channel.

The latest research on bank credit channels is based on the unconventional monetary policies implemented by developed economies during the financial crisis. Ippolito et al. (2018) believe that in the financial crisis, the price mechanism that affects corporate financing costs and credit demand through interest rate adjustment has failed, and bank credit transmission channels are not smooth. Balafas et al. (2018) pointed out that the large-scale liquidity expansion of the central bank during the crisis did not increase the credit supply of commercial banks, and credit transmission was blocked. In contrast, some scholars believe that the credit transmission of unconventional monetary policy is effective. Salachas et al. (2017) studied that the Bank of Japan's unconventional monetary policy significantly improved the liquidity shortage of financial institutions and stimulated the credit volume of commercial banks. Bassett et al. (2014) established a credit shock constraint model to empirically analyze the impact of the Fed's expansionary monetary policy on credit demand and output levels, and verified the effectiveness of credit transmission channels. Amzallag and Calza (2018) researched that the European Central Bank's negative interest rate policy credit transmission channel is effective, and commercial banks with a high percentage of overnight deposits will increase the pricing of fixed-rate loans. The research of Ciccarelli et al. (2015) shows that the credit channel effect of unconventional monetary policy in the crisis is affected by the size of the enterprise, and the credit channel effect of different banks is also different.

Chinese scholars have carried out a series of researches on the influence of banks' micro characteristics on the effect of monetary policy credit channels. Most studies believe that commercial bank liquidity is a key factor in the process of monetary policy credit transmission. Xu and Chen (2011) analyzed empirically the impact of commercial bank balance sheet characteristics on monetary policy credit channels, and believed that small and medium banks' credit behavior is more susceptible to liquidity characteristics. Duan and Ding (2015) used a panel measurement model to analyze the relationship between the micro characteristics of China's 134 banks and the credit response to monetary policy, and found that the role of bank liquidity is obvious. Li (2015)

examined the effectiveness of China's monetary policy credit channels since the financial crisis and believes that bank liquidity has a significant impact on credit supply. Song et al. (2020) used the GMM generalized moment estimation method to analyze empirically the impact of different microstructure characteristics such as asset liquidity of 62 different types of commercial banks on the transmission of monetary policy credit.

In summary, some scholars explain the connotation of the characteristics of structural monetary policy from the macroscopic perspective of the structural effects of aggregate monetary policy, and others regard directly the unconventional monetary policies implemented by developed economies during the crisis as structural monetary policies. However, the structural monetary policy implemented by the People's Bank of China has its own characteristics: First, it is different from the "overflow" of the aggregate monetary policy. The essence of the structured monetary policy lies in the "precise delivery" of liquidity, which guides the flow of money to a specific; The second is that it is different from developed economies which were restricted by the "zero interest rate lower limit" during the financial crisis which led to the failure of conventional monetary policies and forced the introduction of unconventional monetary policies. The introduction of structural monetary policies was a complement to conventional monetary policy in steady of substitutes. Under the bank-led financial system, the key to China's structural monetary policy is to unblock bank credit transmission channels. Many scholars have analyzed the factors that influence the effect of credit channels from the microstructure characteristics of banks and found that bank liquidity characteristics are one of the key factors.

Theoretical Analysis

Traditional monetary policy tools are generally divided into quantitative and price-based tools. Similarly, the structural monetary policy tools implemented by the People's Bank of China can also be divided into quantitative and price-oriented tools based on operational objectives. Quantitative structural monetary policy tools focus on directional liquidity supplements, such as targeted RRR cuts, short-term liquidity operations (SLO), temporary liquidity facilities (TLF), pledged supplementary lending (PSL), etc.; price-based structural monetary policies tools focus on adjusting short-term interest rates, guiding long-term interest rates and building interest rate corridor mechanisms such as structural rediscount rates, refinancing rates, standing lending facilities (SLF), medium-term lending facilities (MLF), etc.

The Impact of Structural Monetary Policy on Bank Liquidity

Under the financial system led by Bank of China, commercial banks are a key link in the central bank's liquidity management. The central bank provides liquidity to commercial banks by injecting base currency, and commercial banks provide liquidity to the society through credit channels. The liquidity situation directly affects the scale of credit and affects the financing needs of the real economy sectors.

Structural monetary policy has been playing an increasingly important role from the perspective of liquidity supply channels. As shown in Figure 1, compared the SLF balance, MLF balance, and PSL balance with the open market operations during the same period. From June 2013 to January 2014, SLF, together with open market operations, became the main monetary tool for central bank liquidity investment. Since September 2014, the balance of MLF has exceeded the amount of money in the open market for most of the time and has become an important channel for banks to replenish liquidity. From May 2015 to March 2019, the PSL balance increased steadily, and after December 2017, it exceeded the amount of open market currency. It can be seen

that the structural monetary policy represented by SLF, MLF, and PSL has gradually become an important channel for currency delivery.

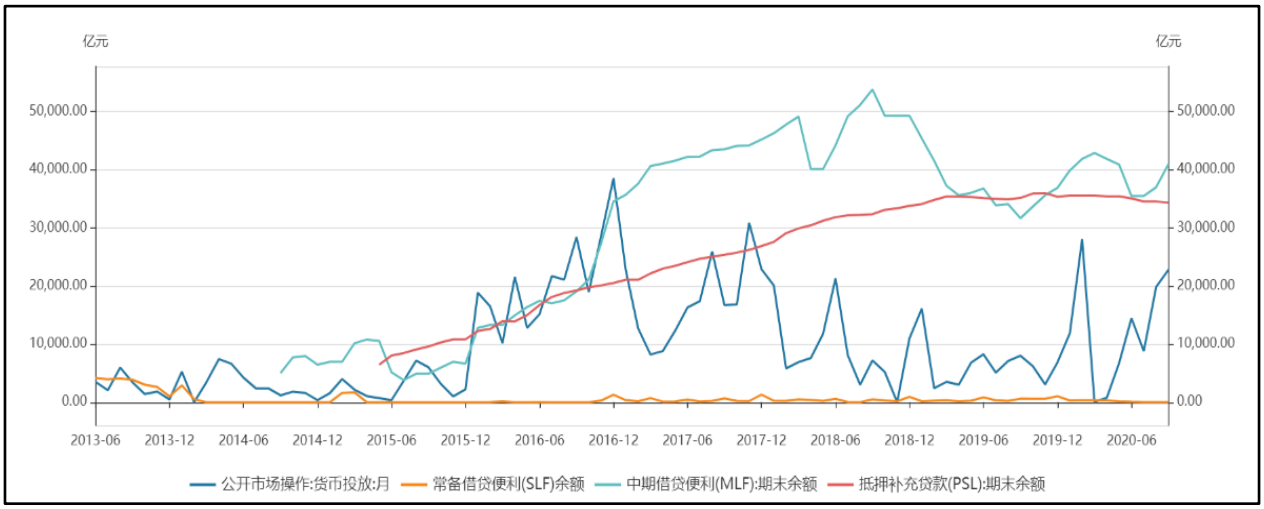

Figure 1. Structural monetary policy and open market operation money supply comparison.

As shown in Figure 2, the liquidity level of Chinese commercial banks has shown an increasing trend in recent years. In the second quarter of 2013, the liquidity ratio of Chinese commercial banks was 43.68, which exceeded 50% in the fourth quarter of 2017, and increased to 58.19% in the second quarter of 2020. Commercial banks adjust their liquidity by measuring their own risks and returns. The emergence of excess liquidity may be based on the following reasons: First, the central bank has increased financial support for the development of the real economy sectors and innovated a series of monetary policy tools in recent years, it is especially the implementation of structural monetary policy that has improved the convenience of commercial banks to obtain liquidity; secondly, after the financial crisis, commercial banks' willingness to take risks has declined under the guidance of macro-prudential policies, and banks' operating behavior has become more cautious. Commercial banks generally have the phenomenon of "loan-gracious", so they retain more liquid assets. However, considering that the structural monetary policy has reduced the capital cost of commercial banks, it has increased the willingness of commercial banks to lend to specific areas to a certain extent, and increased credit supply in the short term, which will cause the liquidity of commercial banks to decline in the short term.

Based on the above analysis, we propose hypothesis 1: The implementation of structural monetary policy will reduce the liquidity of commercial banks in the short term and provide liquidity supplements for commercial banks in the long term.

The Impact of Structural Monetary Policy on Bank Credit

The theory of traditional monetary policy believes that the credit channel is the main transmission channel of monetary policy. As far as China is concerned, the credit behavior of commercial banks is consistent with the direction of monetary policy. Expansionary monetary policy will increase bank credit, and conversely, tightening monetary policy will tighten bank loans. However, along with changes in the economic environment and the transformation of commercial banks' operating methods, the transmission channels of traditional monetary policy have been blocked, and the promotion of bank credit expansion by loose monetary policies has

declined and weakened the regulatory role of monetary policy in the real economy sectors. Therefore, the monetary authorities have introduced structural monetary policy tools, the most fundamental purpose of which is to unblock the transmission channels of monetary policy and encourage commercial banks to provide financial support to the real economy, thereby promoting structural adjustment and economic development.

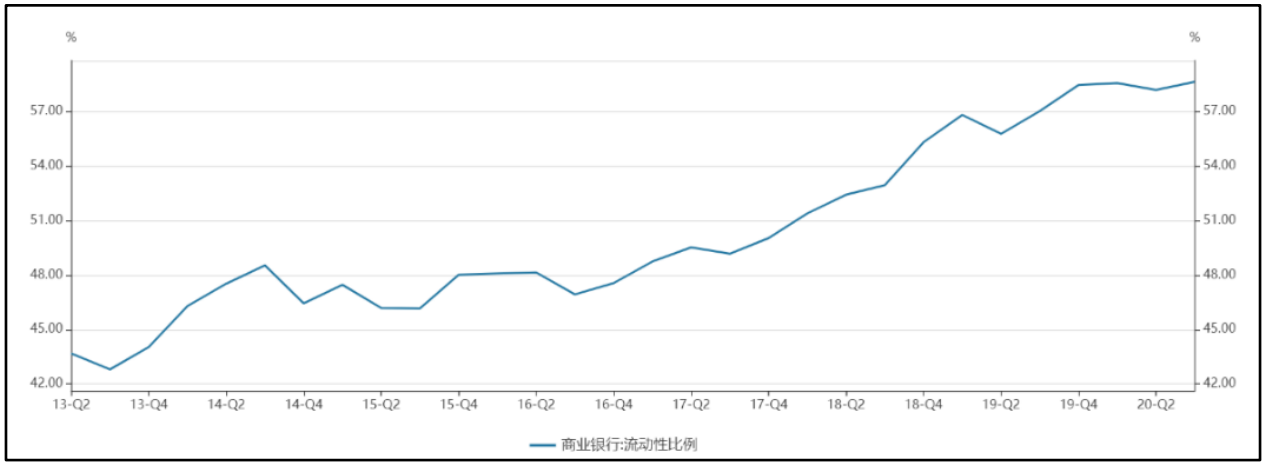

Figure 2. Liquidity ratio of commercial banks (quarterly).

In recent years, China's commercial banks have always had the phenomenon of "loan-saving". In order to prevent liquidity risks and reduce non-performing loans, commercial banks prefer to lend companies and individuals good assets after measuring their own returns and risks. There are problems with financing difficulties and expensive financing for SMEs. The structural monetary policy provides banks with low-cost financial support, encourages banks to lend rural areas and small and medium enterprises, and promotes the rational allocation of credit resources.

From the data point of view, the structural monetary policy does play a certain role in reducing financing costs. In the current process of transition from a quantitative monetary policy to a price-based monetary policy, it is necessary to give full play to the guiding role of policy interest rates, establish an "interest rate corridor" mechanism, give play to the upper limit of the SLF "interest rate corridor", stabilize short-term interest rate expectations, and reduce liquidity Risk premium, thus reduce the corporate financing costs. As shown in Figure 3, the weighted interest rate of the 7-day inter-bank lending is roughly below the SLF interest rate in the same period, showing that the SLF interest rate basically has the upper limit function of the "interest rate corridor". In Figure 4, most of the time the 1-year MLF interest rate was lower than the weighted interest rate of inter-bank lending in the same period, which significantly reduced the cost of commercial banks to obtain medium and long-term liquidity, therefore reduced the cost of credit.

Through the implementation of these structural monetary policies, the monetary authorities have reduced the financing cost of the bank's capital supply side, therefore reduced the cost of corporate loans to a certain extent and increased the willingness of corporate loans. At the same time, with the diversification of liquidity supply channels and the reduction of capital costs, commercial banks have also increased their willingness to take risks and provide more credit support to enterprises. Therefore, we propose Hypothesis 2: The implementation of structural monetary policy reduces the liquidity of commercial banks in the short term, and at the same time promotes the increase of commercial bank loans.

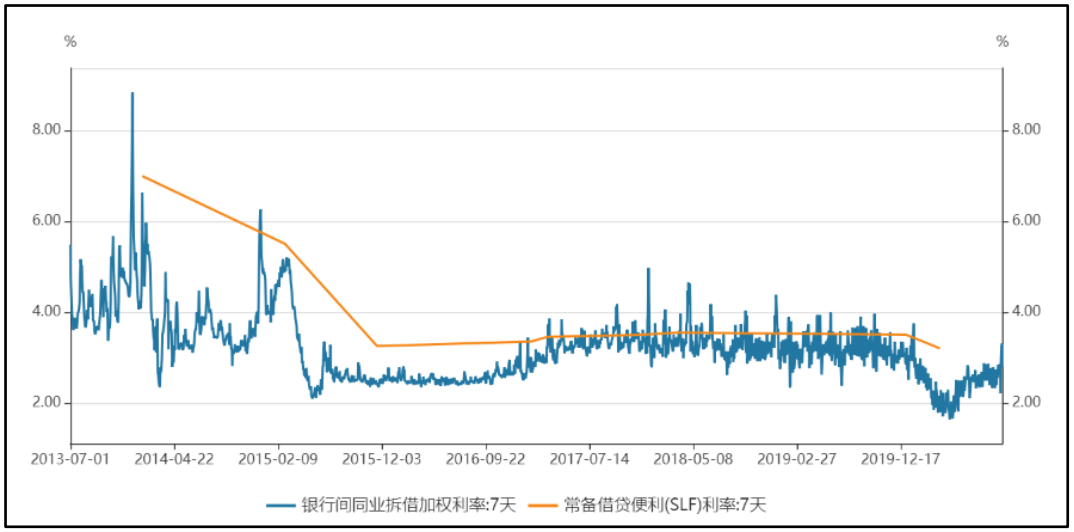

Figure 3. Comparison of interbank lending weighted rate and SLF rate.

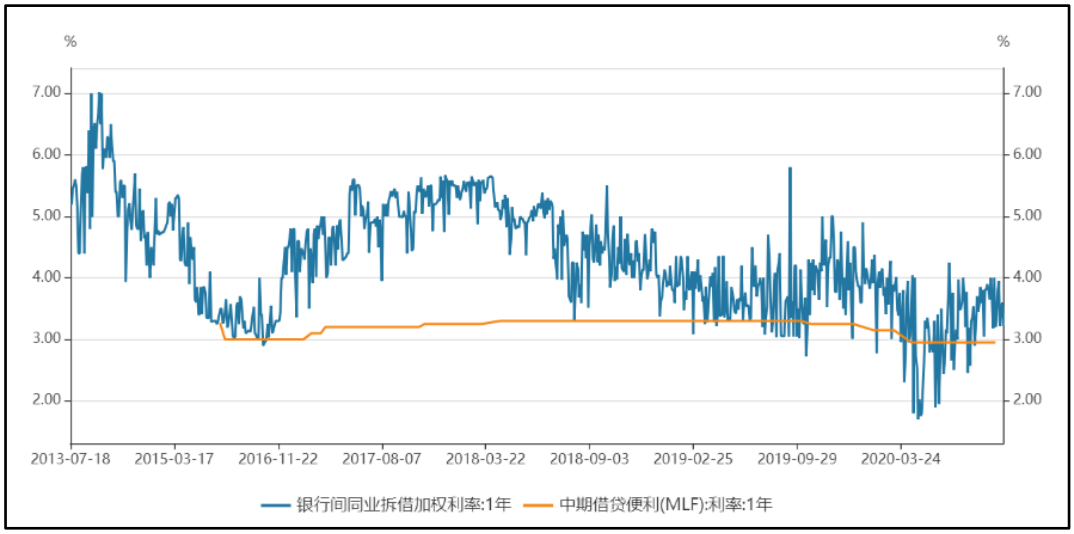

Figure 4. Comparison of interbank lending weighted rate and MLF rate.

Model Design and Variable Selection

Model Design

This paper uses vector autoregressive model (VAR) to analyze empirically the dynamic relationship between structural monetary policy, bank liquidity and bank credit, and explore the credit transmission effect of structural monetary policy. The VAR model takes each endogenous variable in the economic system as a function of the lag value of all endogenous variables in the system, and has a wide range of applications in dealing with the analysis and forecasting of multiple related economic indicators.

The mathematical expression of the VAR(p) model is:

$$y_t = A_1 y_{t-1} + \ldots + A_p y_{t-p} + B x_t + \varepsilon_t$$

Among them: y_t is the k-dimensional endogenous variable vector, x_t is the d-dimensional exogenous variable vector, p is the lag order, $A_1,\ldots, A_p$ and B are the coefficient matrices to be estimated, ε_t

which are the disturbance vectors. VAR models usually use the impulse response function to analyze the dynamic impact of the model on the system when subjected to a certain shock. The impulse response function describes the impact of innovation on the disturbance item on the current and future values of endogenous variables. It can more intuitively describe the dynamic interaction between variables and their effects. Variance decomposition is to further evaluate the importance of different structural shocks by analyzing the contribution of each structural shock to the change of endogenous variables (usually measured by variance). Therefore, the variance decomposition gives information about the relative importance of each random disturbance that affects the variables in the VAR model.

Index Selection

This paper selects SLF and MLF as the proxy variables of structured currency tools, that is, the sum of the standing loan facility balance and the medium-term facility loan facility balance is used as an indicator of the implementation of the structured monetary policy, which is recorded as lm, of which SLF was created in 2013, MLF was established in 2014. This article selects the quarterly average of the balance data of the two as the research object. Before September 2014, the structural monetary policy tools only included the standing loan facility loan balance. The formula is as follows:

lm = log (quarterly average balance of standing borrowing facility + quarterly average balance of mid-term borrowing facility)

Bank credit indicators refer to the amount of money that financial institutions lend small and micro enterprises and “three agriculture enterprises” under the guidance of the People’s Bank of China’s structural monetary policy, they are usually in the form of pledges. Only after a certain proportion of agricultural enterprises and small and micro enterprises can obtain preferential interest rates or more liquidity. We add the balance of small and micro enterprise loans, rural loan balances, and quarterly balances of rural household loans of major financial institutions as a measure of structural credit loan. The formula is as follows:

loan = log (small and micro enterprise loan balance + rural loan balance + rural household loan balance)

The bank liquidity index is expressed by the commercial bank liquidity ratio, and the formula is as follows:

liq = liquid assets/liquid liabilities.

This paper selects the GDP growth rate and the logarithmic value of the base currency balance as control variables, which are represented by con1 and con 2, respectively.

Therefore, in this VAR model:

$$y_t = (\mathrm{lm},\mathrm{liq},\mathrm{loan})^t, x_t = (\mathrm{con1},\mathrm{con2})^t.$$

Data Source

Taking account of the availability of data, this paper collects quarterly data from June 2013 to September 2020, all from the wind database. Before taking the logarithm of the relevant variables, the data was adjusted seasonally by using the TRAMO/SEATS method to eliminate Seasonal trends.

Empirical Analysis Results

The construction and identification of the VAR model are divided into the stationarity test of the variables, the determination of the lag order of the VAR model and the stability test.

Stationarity Test

As shown in Table 1, the unit root test of the lm, liq, and loan levels shows that the three variables are all first-order single integers. After taking the first-order difference, they are all stationary sequences. Therefore, the first-order difference of each variable is taken into the VAR model.

Table 1

Unit Root Test Results

Variable	Test Form(C, T, L)	ADF Value	1%	5%	10%	Is it stable?
lm	C, t, 0	-0.926103	-3.689194	-2.971853	-2.625121	No
d(lm)	0, 0, 0	-4.968718	-2.653401	-1.953858	-1.609571	Yes
liq	C, 0, 0	-0.144508	-3.689194	-2.971853	-2.625121	No
d(liq)	C, 0, 0	-4.269254	-2.653401	-1.953858	-1.609571	Yes
Loan	C, t, 0	-2.422477	-4.356068	-3.595026	-3.233456	No
d(loan)	C, 0, 0	-3.216368	-3.699871	-2.976263	-2.627420	Yes

Notes: The test forms C, T and L respectively represent the constant term, time trend and lag order of the ADF test equation, and 0 means no constant term or trend term.

VAR Model Lag Order and Stability Test

Table 2

Selection of Optimal Lag Order

Lag	LogL	LR	FPE	AIC	SC	HQ
0	61.90663	NA	1.80e-06	-4.712530	-4.566265*	-4.671963
1	72.70741	18.14531*	1.57e-06*	-4.856593*	-4.271532	-4.694322*
2	77.65536	7.125057	2.26e-06	-4.532429	-3.508573	-4.248455
3	83.36372	6.850032	3.24e-06	-4.269098	-2.806447	-3.863421

As shown in Table 2, the zero-order lag term has 1 asterisk, the first-order lag term has 4 asterisks, and the second and third-order lag terms have no asterisks. Based on the above criteria, we determine the optimal VAR model in this paper. The lag order is 1.

In the VAR model stability test, if the VAR model has a root greater than 1, it means that it is an unstable system and a stable VAR model cannot be established; if there is no root greater than 1, it means that this is a stable system and can be established Stable VAR model. It can be seen from Figure 5 that there is no root greater than 1 in the VAR model, and it is a stationary system. Therefore, the correlation sequence can be used to establish a stable VAR model, and perform impulse response analysis and variance decomposition.

Impulse Response Analysis

The generalized impulse response analysis is used in this paper. Koop, Pesaran and Potter (1996) proposed a generalized impulse response (Generalized Impulse Response) to avoid the dependence of orthogonalization on the ordering of variables.

Figure 6 shows the impact of structural monetary policy on bank liquidity. The first period was -0.06, the second period reached the maximum value of -0.185, and the influence basically disappeared after the third period. This shows that the structural monetary policy represented by SLF and MLF has possessed a short-term negative impact on the liquidity of commercial banks. This is consistent with the analysis of Wang, Lu, and Cao (2016). The implementation of structural monetary policy has reduced the liquidity ratio of the bank. The main reasons are as follows: First, the implementation of structural monetary policies such as SLO, SLF, and

MLF facilitates the liquidity management of commercial banks and stabilizes the bank's liquidity expectations. Under the conditions of controllable security and liquidity, appropriate reducing the proportion of liquid assets can improve profitability; second, the implementation of structural monetary policy has reduced the liability side costs of commercial banks, stimulated banks to increase credit, and maintained a relatively low liquidity ratio.

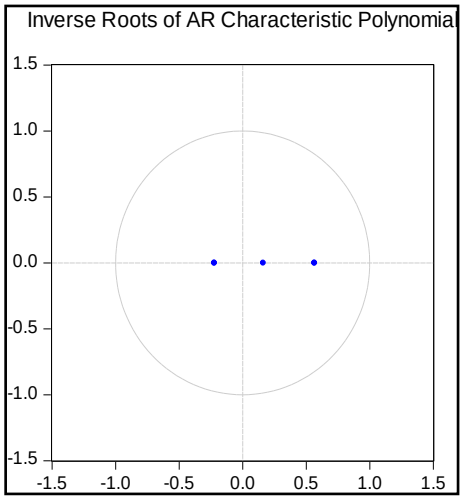

Figure. 5 Stability test of VAR model.

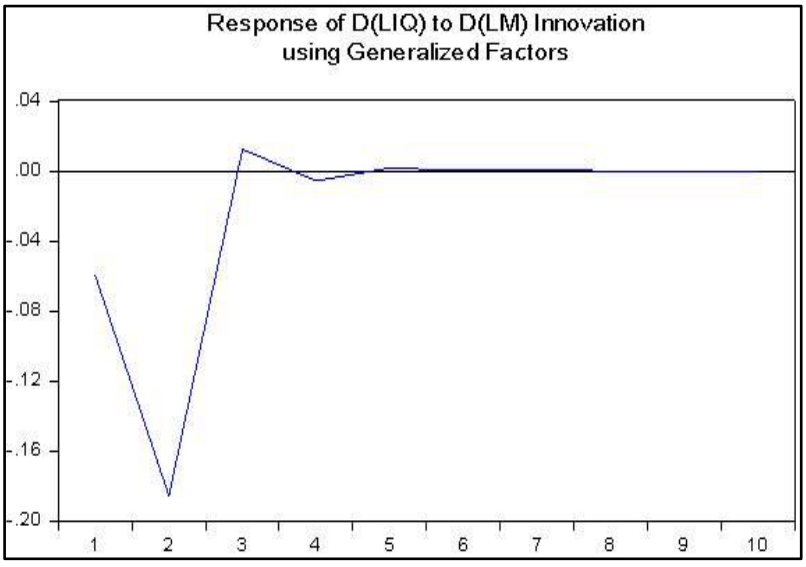

Figure 6. Impulse response analysis of structural monetary policy to bank liquidity.

As shown in Figure 7, after a one-unit positive impact on the structural monetary policy, bank credit declined briefly in the first period, and then quickly rebounded in the second period, and remained high in the second and third periods, and after the third period maintained a positive response and gradually weakened its influence. This verifies the positive impact of structural monetary policy on bank credit. The implementation of structural monetary policy has lag behind in the first period, and its influence reaches its peak in the second and third periods. The new interest shock of one standard deviation unit of bank liquidity caused a reverse change in bank credit, which reached the maximum response in the second period, and then its influence gradually

declined. Structured currency has a long-term stimulus effect on the expansion of bank credit. Structural monetary policies such as SLF and MLF have increased the amount of credit in the areas of small and micro businesses and rural areas. Meanwhile, structural monetary policy has a negative impact on bank liquidity in the short term. The decline in bank liquidity is accompanied by an increase in credit, which also shows that structured monetary policy has enhanced the effect of credit transmission channels.

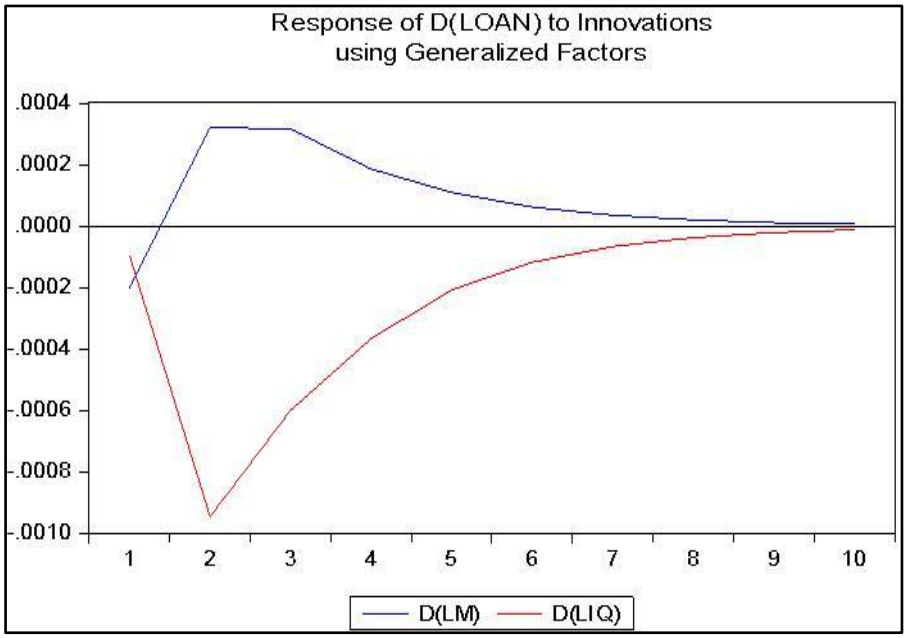

Figure 7. Analysis of structural monetary policy and bank liquidity's impulse response to bank credit.

Analysis of Variance Decomposition

Variance decomposition can be used to analyze the contribution of structural shocks that affect endogenous variables. From the results of the variance decomposition of bank credit, the influence of bank liquidity has gradually increased on it, with the largest contribution reaching about 7.3%. The contribution of structural monetary policy to the variance of bank credit has also increased gradually, but the maximum contribution is only about 1.53%.

Table 3

Bank Credit Variance Decomposition Results

Period	S.E.	D(LM)	D(LIQ)	D(LOAN)
1	0.292669	0.344572	0.098609	99.55682
2	0.298660	0.859835	5.290872	93.84929
3	0.299341	1.319497	6.637192	92.04331
4	0.299520	1.459745	7.104368	91.43589
5	0.299584	1.507408	7.247416	91.24518
6	0.299604	1.522373	7.293483	91.18414
7	0.299610	1.527179	7.308070	91.16475
8	0.299613	1.528707	7.312727	91.15857
9	0.299613	1.529194	7.314209	91.15660
10	0.299613	1.529350	7.314682	91.15597

Cholesky Ordering: D(LM) D(LIQ) D(LOAN)

Conclusions and Recommendations

This paper firstly examines the effect of structural monetary policy based on the bank's credit transmission channel, and then selects structural monetary policy, commercial bank liquidity, bank credit and other related variables to construct a VAR model, and finally empirically analyzes the credit channel transmission effect of structured monetary policy. Research has shown that structural monetary policy has a short-term negative impact on bank liquidity, the factors such as reducing bank liquidity management costs and stimulating credit provision; bank liquidity has a long-term negative impact on bank credit, and the decline in bank liquidity has brought about the expansion of bank credit; the credit transmission channel of structural monetary policy has a certain effect, but there is still a certain gap from the expected effect.

In regarding of this, the proposes of this article firstly further unblock the credit transmission channels, and then improve the structural monetary policy—commercial banks—the transmission mechanism design of the real economy sectors, and next reduce the idle transfer of monetary funds in the banking system and stimulate bank credit; second, the researches improve incentives design of a compatible mechanism, try to encourages commercial banks to issue loans in accordance with the intent of policies to support structural adjustment and development in specific fields; the third is to strengthen the supervision and restraint of financial institutions, and strengthen the flow of funds from the structural monetary policy. Strengthen monitoring of the flow and allocation of funds under structural monetary policy and to prevent policy intentions from being distorted. Once the economic environment changes, structural monetary policy tools should be withdrawn in time.

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