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The Impacts of China's Shadow Banking Credit Creation on the Effectiveness of Monetary Policy

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Abstract

This paper researches the impact that shadow banking in China has upon credit creation and the potential effectiveness of monetary policy. Using a credit creation model, we derive the effect that shadow banking has upon the money multiplier and the money supply. The model shows that shadow banking can change the money multiplier, potentially increasing it during an expansion and decreasing it during a contraction. Introducing shadow banking in a CC-LM model results in a shift of the CC and LM curves resulting in a higher equilibrium output. A vector autoregressive model is used to empirically estimate the impact of shadow banking deposits' growth rate on the growth rates of the broad money supply, GDP, and the CPI. The results show that shadow banking's credit creation function in China has a pro-cyclical characteristic, potentially reducing the money supply's controllability and increasing the difficulty in effectively regulating monetary policy. This paper introduces shadow banking into the currency creation process of traditional commercial banks, accounting for the reserve requirement ratio, the excess reserve ratio, the shadow bank leakage rate, and the reserved deduction rate. Future research can determine whether coordinating monetary policy and leverage ratio regulation mitigates the impact of shadow banking. Another area of research is how the shadow banking of non-financial companies affect monetary policy.

Keywords: Shadow banking; Credit creation; Monetary policy; CC-LM model; VAR model

JEL Classifications: E5; G2

Introduction

In recent years, China's shadow banking system has expanded rapidly. According to Moody's monthly monitoring report, China's broad shadow banking assets reached renminbi (RMB) 59.6 trillion in the first half of 2019, accounting for 64% of the nominal gross domestic product (GDP) of China. According to data from the People's Bank of China, the RMB bank loans in China accounted for 68% of social financing scale in October 2019, compared with 92% in 2012. The proportion of Chinese banking loans in total social financing has declined, and shadow banking has developed rapidly. Growth in shadow banking increases its uncertain impact on monetary policy.

The International Monetary Fund (IMF) (2014) states that shadow banking can expand access to credit and support market liquidity, maturity transformation, and risk-sharing. However, there are some significant differences between China's shadow banking system and the developed countries' shadow banking systems. Shadow banking of developed countries is the non-bank financial institutions that rest outside the banking system. They focus on asset securitization and financial innovation. Shadow banking in China is mainly inside the banking system and is dominated by commercial banks, which has led to its description as "the shadow of the bank" (Sun, 2019). Shadow banking in China performs a similar function as commercial banks by issuing safe assets to finance loans. Elliott et al. (2015) also verify that shadow banking in China is considered "bank loans in disguise." They find that two-thirds of the flow of funds into shadow banking is from banks and that the other third are related to non-banks in China. Allen et al. (2019) find that entrusted loans are among China's largest shadow banking components. Entrusted loans occur when firms with access to inexpensive capital channel funds to firms with restricted capital access. Entrusted loans increase during periods of tight credit.

The differences in shadow banking in China and more developed countries inevitably lead to different impact mechanisms of shadow banking on monetary policy. In developing economies such as China, the bank lending channel is weakened when the response of aggregate bank loans is offset by the response of shadow banking credit (Liu et al., 2019). In developed economies such as America, shadow money, namely liquid deposits created by shadow banks, expands significantly when the Federal Reserve tightens monetary policy. In this paper, we analyze China's shadow banking's influence mechanism on the effectiveness of monetary policy theoretically and empirically to provide a scientific reference for the formulation and implementation of China's monetary policy.

This study analyzes the following three issues: (i) How does China's shadow bank system participate in the credit creation process, and correspondingly, how does it affect the money supply? (ii) How does the credit creation of China's shadow bank system affect economic growth? (iii) From an empirical perspective, how does the credit creation of China's shadow banks impact monetary policy effectiveness?

For the first issue, we have incorporated shadow banking into the currency creation process of traditional commercial banks, taking into account the role of the reserve requirement ratio, the excess reserve ratio, the shadow bank leakage rate, and the reserved deduction rate. By analyzing the credit creation process of shadow banking, we measure its impact on the money supply. We find that during an expansion, the shadow banking system has an expansionary impact on the money supply, while during a downturn, its impact is contractionary; thus, increasing the difficulty of the central bank's regulation of monetary policy

For the second issue, we introduce the credit market into the IS-LM model and obtain a CC-LM model that integrates the credit market, commodity market, and currency market. We use the CC-LM to analyze the impact mechanism of the credit creation function of China's shadow bank system on economic growth. We find that credit creation by the shadow banking system credit and shift the CC and LM curves resulting in an increased equilibrium point for economic output.

For the third issue, we use a vector autoregressive (VAR) model to study the impact of credit creation of China's shadow banks on monetary policy effectiveness. We selected indicators such as money supply, economic growth, and price levels, and used monthly data from January 2008 to December 2018 as the research sample, and analyzed it using Eviews 9.0 software.

Our main results are as follows. First, China's shadow banking impacts credit creation and money supply. The lower the reserve deduction rate of the shadow bank, and the higher the leakage rate, the stronger its

credit creation ability. Second, China's shadow banking credit creation can increase output levels and promote economic growth. Third, the empirical analysis shows that China's shadow banks' credit creation will impact monetary policy effectiveness.

The rest of the paper is structured as follows. Section 2 reviews the literature. Section 3 develops a theoretical model of China's shadow banking's impact on the effectiveness of monetary policy based on shadow bank credit creation. Section 4 utilizes a VAR model for an empirical test using data from 2008 to 2018, demonstrating the impact of China's shadow bank credit creation on macroeconomic variables. The paper concludes with a discussion of the results and suggestions for policy changes and future research.

Literature Review

This study relates to several strands of the expanding literature on shadow banking in China. First, it is closely related to research that explains the risk of shadow banking and its effect on financial stability. Previous studies indicate that shadow banking's growth is driven mainly by regulatory arbitrage, especially the arbitrage of capital requirements (Pozsar, et al., 2010; Plantin, 2014). In the context of regulatory arbitrage and neglected risks, shadow banks evade capital requirements and use "too big to fail" to influence financial stability via various channels. (Harris et al., 2014; Huang, 2018; Plantin, 2015). Empirical evidence of regulatory arbitrage is found in Acharya et al. (2013), Demyanyk and Loutskina (2016), and Buchak et al. (2018). Bengtsson (2013) also finds that shadow banking may affect financial stability. In the short-run, the shadow bank share rose when deposit interest rate ceilings were binding on traditional banks, the economic outlook improved, or risk premia declined and fell when event risks arose (Duca, 2016). Pozsar et al. (2010) and Jeffers and Baicu (2013) also indicate that the interconnections between regular banking and shadow banking activities negatively affect financial stability. Wu and Shen (2019) propose that a bank that engages in shadow banking tends to take considerable risks; however, good governance mechanisms can significantly reduce risk-taking.

Second, our study is related to existing studies about the impact of shadow banking on the monetary policy transmission mechanism. Bernanke (1983) and Bernanke and Gertler (1989) indicate that monetary policy credit transmission channels also apply to the shadow banking system. F. Verona (2011) uses the traditional Dynamic Stochastic General Equilibrium (DSGE) model to analyze the impact of shadow banking on monetary policy. The results show that loose monetary policy can promote shadow banking's rapid development, which will impact the achievement of monetary policy goals. Moe (2014) finds that the market sensitivity of securitized derivatives designed and issued by the shadow banking system during the credit creation process is relatively high. It makes the entire credit chain unstable and increases the central bank's restrictions on the shadow banking system's credit expansion. Based on a revised IS-LM model and a structural VAR (SVAR) model, Zhen and Hui (2014) find that shadow banking affects monetary policy transmission mechanisms such as credit and interest rates, making it more difficult for the central bank to regulate macroeconomics through monetary policy tools. Mazelis (2014) uses a DSGE model to show that the effect of monetary policy credit transmission will significantly weaken as the size of shadow banking increases. Based on the Dynamic New Keynesian - DSGE model, Xiang and Qianglong (2014) find that shadow banking complements the traditional financial system to a certain extent; however, its countercyclical effect impacts the effectiveness of monetary policy. Yang et al. (2019) develop a model of the Chinese economy using a DSGE framework that accommodates interaction between traditional banks and shadow banks. Financial frictions in the shadow banking sector create a "dual financial acceleration" mechanism that negatively affects monetary policy transmission and macroprudential policy's effectiveness.

Other studies find that monetary policy also affects shadow banking. Nelson et al. (2018) find a contractionary monetary policy reduces commercial bank assets' but increases shadow banks' assets. Several studies, including Mazelis (2016) and Chen et al. (2018a, 2018b), confirm this finding. Chen et al. (2018a, 2018b) find that contractionary monetary policy encourages banks to increase investments in entrusted assets to circumvent the loan-to-deposit ratio (LDR) and safe-loan regulations.

Finally, our study is also related to the literature on shadow banking's effect on the intermediate targets and the ultimate monetary policy goals. Using a Bayesian vector auto-regression (BVAR) model, Fei (2018) finds that shadow banking has a cyclical effect on the money supply. Lemma (2016) shows that the development of shadow banking is conducive to achieving equilibrium in the currency market and realizing monetary policy goals. Moreira and Savov (2017) find that shadow banks can transform risky assets into liquid securities under normal conditions to stimulate economic growth. However, when economic uncertainty surges, the

liquidity of securities tends to be inadequate, which will increase financial vulnerability. Yaming and Qiqi (2018) use a time-varying-parameter vector-autoregressive (TVP-VAR) model and find that China's shadow bank system has a pro-cyclicality, which has a positive effect on economic growth and price levels but reduces the measurability and controllability of the money supply, making it more difficult for the central bank to implement monetary policy.

These studies examine shadow banking from three perspectives: its risk for financial stability, its impact on the monetary policy transmission mechanism, its effect on the intermediate targets, and the ultimate goals of monetary policy. This paper's contribution to the literature is twofold. First, we consider the role of reserve requirement ratio, excess reserve ratio, shadow bank leakage rate, and reserve deduction rate; second, we consider the cyclical impact of shadow banking on monetary policy. This paper adds to the literature by incorporating shadow banking into the currency creation process of traditional commercial banks; using a CC-LM model that integrates the credit market, commodity market, and currency market to analyze the impact of China's shadow bank system on economic growth; and using a VAR model to study the impact of China's shadow banks on the efficacy of monetary policy.

Research and Methodology

Shadow banking impacts both the intermediate and the ultimate goals of monetary policy. The intermediary targets for monetary policy transmission are mainly money supply and interest rates. Since changes in the money supply will inevitably affect interest rates, we focus on the money supply among these two intermediary targets. Among the four ultimate monetary policy goals, full employment and price stability are the internal equilibrium goals; the balance of payments is the external equilibrium goal. Economic growth is the ultimate goal of implementing monetary policy. Among these four ultimate goals, we focus on the ultimate goal of economic growth. Through the impact of shadow banking on the money supply and economic growth, we analyze its influence mechanism on monetary policy effectiveness.

China's shadow banking system's operating model is rooted in the commercial banking system as it cannot directly accept deposits from the residential sector. The main form of operation is to transfer funds from the on-balance-sheet to the off-balance-sheet of commercial banks and to obtain interest margin benefits through lending at a higher interest rate. In China, the funds of shadow banks ultimately come from commercial banks, and the transfer and settlement of large amounts of funds are still mainly carried out through the banking system. We incorporate China's shadow banking system into the credit creation process of commercial banks and analyze its impact on the money supply.

We make the following assumptions. First, the financial system consists of the central bank, commercial banks, and shadow banks. The commercial bank system provides both traditional banking business and shadow banking business. Second, commercial banks need to maintain reserves per the central bank's provisions, assuming the reserve requirement ratio is r_d and the excess reserve ratio is r_e . Third, shadow banking products' profitability is higher, both for customers and commercial banks, resulting in a portion of commercial banking products shunted to the shadow banking sector. Assume that the proportion of the shunted deposits to the total commercial bank deposits is the shadow bank leakage rate (v). Fourth, similar to the commercial bank reserve, the shadow bank withholds a part of the received funds to guarantee repayment. Assume that the ratio of the shadow bank's withholding funds to its liabilities is the reserved deduction rate (a). Finally, customers do not withdraw cash, and all funds flow to commercial banks or shadow banks; that is, the cash leakage rate is zero. Finally, all the above parameters as r_d , r_e , v , a are in the range of (0, 1).

Assume that a customer deposits a deposit B into the first commercial bank and then transfer part of the deposit Bv to the first shadow bank. The deposit of the first commercial bank was reduced to $B(1-v)$. The bank paid the statutory reserve $B(1-v)r_d$ to the central bank and withdrew the excess reserve $B(1-v)r_e$, and then lent the remaining funds $B(1-v)(1-r_d-r_e)$. After the first shadow bank left withholding funds Bva , the remaining funds $Bv(1-a)$ were issued as shadow bank loans.

After a round of credit creation, the total loan value for the commercial banks and shadow banking is $B[(1-v)(1-r_d-r_e)+v(1-a)]$. Then these funds will flow to the second commercial bank in the form of a derivative deposit. This process will be repeated following the previous round of deposit diversion and the re-creation process of loans and deposits by the shadow and commercial bank. Because there is no cash leakage, the

credit creation process will continue, and eventually, we can get the shadow bank's credit creation process, as shown in Table 1.

Table 1: Credit creation process of shadow banking

Stage	Commercial bank deposits (1)	Shadow bank deposits (2)	Statutory reserve (3)=(1-2)r _d	Excess reserve (4)=(1-2)r _e	Commercial bank loans (5)=(1-2-3-4)	Shadow bank loans (6)=2 × (1-a)	Total loans (5)+6
1	B	Bv	B(1-v)r _d	B(1-v)r _e	B(1-v)(1-r _d -r _e)	Bv(1-a)	B[(1-v)(1-r _d -r _e)+v(1-a)]
2	Bq	Bqv	Bq(1-v)r _d	Bq(1-v)r _e	Bq(1-v)(1-r _d -r _e)	Bqv(1-a)	Bq ²
...	...	...	...	...	...	...	...
N	Bq ⁿ⁻¹	Bq ⁿ⁻¹ v	B q ⁿ⁻¹ (1-v)r _d	B q ⁿ⁻¹ (1-v)r _e	Bq ⁿ⁻¹ (1-v)(1-r _d -r _e)	Bq ⁿ⁻¹ v(1-a)	-
Total	B/(1-q)	Bv/(1-q)	B(1-v)r _d /(1-q)	B(1-v)r _e /(1-q)	B(1-v)(1-r _d -r _e)/(1-q)	Bv(1-a)/(1-q)	Bq/(1-q)

Let $q = v(1 - a) + (1 - v)(1 - r_d - r_e)$. After the first round of credit creation, the total new loans for shadow banks and commercial banks is Bq . From $q = v(1 - a) + (1 - v)(1 - r_d - r_e)$, we can get $q = 1 - [(1 - v)(r_d + r_e) + va]$. From $[(1 - v)(r_d + r_e) + va] < 1$, we can get $0 < q < 1$.

Therefore, if the original deposit is B , after n -time deposit derivation from the entire banking system, the final money supply is as follow :

$$M = \frac{B}{1-q} = \frac{B}{r_d + v(a - r_d) + r_e(1-v)} = \frac{B}{(r_d + r_e) + v(a - r_d - r_e)} \quad (1)$$

The influence of shadow banking on the money supply mainly comes from two sources. First, the size of deposits of shadow banks shunted from the commercial banks. The more shunted deposits, the smaller the credit creation ability of commercial banks. Second, after the shadow bank shunts commercial bank deposits, the shadow bank will create credit by itself. The combined effect of these two aspects determines the effect of shadow banking on the money supply. In equation (1), the following relationship exists:

$$\frac{dM}{dr_d} = \frac{(v-1)B}{[r_d + v(a - r_d) + r_e(1-v)]^2} < 0$$

$$\frac{dM}{dr_e} = \frac{(v-1)B}{[r_d + v(a - r_d) + r_e(1-v)]^2} < 0$$

The equation shows an inverse relationship between the money supply, the reserve requirement ratio, and the excess reserve ratio. The higher the reserve requirement ratio and the excess reserve ratio, the smaller the commercial banks' credit creation ability, and the smaller the money supply and vice versa.

$$\textcircled{1} \frac{dM}{da} = \frac{-vB}{[r_d + v(a - r_d) + r_e(1-v)]^2} < 0.$$

The equation shows an inverse relationship between the money supply and the shadow bank reserve deduction rate. The higher the shadow bank reserve deduction rate, the smaller the shadow bank's credit creation ability and the smaller the money supply and vice versa.

$$\textcircled{2} \frac{dM}{dv} = \frac{(r_d + r_e - a)B}{(r_d + v(a - r_d) + r_e(1-v))^2}. \text{ If } r_d + r_e > a, \text{ then } \frac{dM}{dv} > 0.$$

That is, the money supply has a positive relationship with the shadow bank leakage rate. When the sum of the reserve requirement ratio and the excess reserve ratio of the commercial bank is greater than the reserved deduction rate, the higher the shadow bank leakage rate, the greater the money supply. Conversely, when the sum of the reserve requirement ratio and the excess reserve ratio of the commercial

bank is less than the reserved deduction rate of the shadow bank, the higher the shadow bank leakage rate, the smaller the money supply. If $r_d + r_e = a$, the shadow bank leakage rate has no significant effect on the money supply.

According to the derivations above, the reserve deduction rate and the cash leakage rate to the shadow banking sector directly affects its credit creation ability. The more deposits shunted to the shadow bank and the lower its reserve deduction rate, the stronger its credit creation ability. As shadow banking is outside the financial supervision system, the reserved deduction rate is not controlled by the central bank. The shadow bank controls the reserve deduction rate according to its financing situation resulting in greater flexibility for the shadow bank.

When the economy is growing, shadow banks will begin a new round of expansion through regulatory arbitrage. Shadow banks will reduce the reserve deduction rate, which enlarges the credit creation function. The money supply will increase. In theory, if the reserve deduction rate is infinitesimal, the total assets of the shadow bank will expand towards infinity. From a practical point of view, since shadow banks do not have a reserve requirement ratio and other regulatory constraints, they can have a more substantial credit creation function than traditional commercial banks.

In an economic downturn, the general public investment expectation may not be optimistic. Shadow banks will increase the reserve deduction rate and reduce credit, which will lead to a reduction in the money supply in circulation. Meanwhile, the sum of the reserve requirement ratio and the excess reserve ratio of commercial banks may be less than the shadow bank reserve deduction rate, which reduces the money supply due to the shadow bank leakage rate.

Therefore, the credit creation function of Chinese shadow banking has different effects on the money supply in different economic cycles thus reducing the measurability, controllability and correlation of money supply, and increasing the difficulty of the central bank's regulation of monetary policy, affecting the realization of the ultimate goal of Chinese monetary policy. During an expansion, the shadow banking system has an expansionary impact on the money supply, while during a downturn, its impact is contractionary.

From the above analysis, we can see that China's shadow bank can divert the deposits of commercial banks and create credit, thereby affecting the intermediary goal of money supply and the effectiveness of monetary policy. Based on the previous analysis, this section draws on the CC-LM model constructed by Bernanke (1988) and introduces the credit market into the traditional IS-LM model. The CC-LM model integrates the credit, commodity, and currency markets. The CC-LM model can be used to analyze the mechanism of the credit creation function of China's shadow bank on economic growth.

We make the following assumptions: ①the banking system consists of a traditional banking sector and a shadow banking sector; ②banks' assets consist of loans, bonds, and cash reserves, and there are two types of interest rates: bond interest rates and loan interest rates; ③The ratio between traditional banking and shadow banking and the ratio between loans and bond purchases are determined by the rational choices of the banking system to maximize profits; ④Three markets are involved: the credit market, the commodity market, and the money market.

For the credit market, we set p as the loan interest rate, i as the bond interest rate, and y as the economic output. The loan demand function is:

$$L^d = L(p, i, y) \quad (2)$$

In equation (2), the following relationships exist: $\frac{dL}{dp} < 0$. It means that the higher the loan interest rate, the higher the interest cost, and the lower the loan demand. $\frac{dL}{di} > 0$. It reflects the substitution effect between bond financing and loan financing. When the bond interest rate decreases relative to the loan interest rate, the demand for loans increases. $\frac{dL}{dy} > 0$. It shows that the economic aggregate is positively correlated with the loan demand. That is, the larger the economic aggregate, the greater the demand for loans.

We assume that D is the commercial bank deposits, r_d is the reserve requirement ratio, r_e is the excess reserve ratio. We assume that the assets of the commercial banks' balance sheet include reserves--- R ,

bonds---B and loans--- L^s , and the liabilities include bank deposits---D and liabilities--- S_d generated by shadow banking. "Assets = Liabilities + Equity," for simplicity Equity can be set to zero; we get:

$$R + B + L^s = D + S_d \quad (3)$$

Also, we know that $R = r_d D + r_e D$, substituting it into equation (3), we can get:

$$B + L^s = D(1 - r_d - r_e) + S_d \quad (4)$$

We assume that P_x is the profit rate of shadow banking-related business of a commercial bank, and the liabilities generated by the shadow bank are a function of the profit rate:

$$s_d = S_D(P_x) \quad (5)$$

In equation (5), the larger P_x is, the greater the profit of the shadow banking-related business of a commercial bank, the more the commercial banks tend to expand the shadow banking business, and the size of the shadow banking increases. The smaller P_x is, the commercial banks do not tend to expand the shadow banking business, and the size of shadow banking decreases.

In the commercial banks' assets, the required deposit reserve $r_d D$ is determined exogenously by the central bank, and the excess reserve $r_e D$ is determined by the commercial bank, assuming the excess reserve ratio r_e is stable. The commercial bank determines the holding ratio of loans and bonds. The commercial bank determines the loan supply based on comparing the loan interest rate with the bond interest rate.

Assume λ , the loan supply ratio, is the proportion of loans in the total assets of the commercial bank. The loan supply allocation function is:

$$\lambda = \lambda(\rho, i) \quad (6)$$

In equation (6), $\frac{d\lambda}{d\rho} > 0$. It shows that the loan supply will increase with a higher loan interest rate. Also, $\frac{d\lambda}{di} < 0$. It shows that profit-maximizing-banks will invest more funds into bonds when the bond interest rate rises, resulting in a reduction of the money supply.

By equations (4), (5), and (6), we can get the loan supply function as:

$$L^s = \lambda(\rho, i)[D(1 - r_d - r_e) + S_D(P_x)] \quad (7)$$

The loan demand is equal to the loan supply when the credit market is in equilibrium. By equation (2) and (7), we can get the credit market equilibrium equation:

$$L(\rho, i, y) = \lambda(\rho, i)[D(1 - r_d - r_e) + S_D(P_x)] \quad (8)$$

From equation (8), we can see that shadow banking has expanded the bank's funding sources, thereby expanding the loan supply and leading to the expansion of loan demand. From $R = (r_d + r_e)D$, we can get:

$$D = \frac{R}{r_d + r_e} \quad (9)$$

Substituting equation (9) into equation (8), and solving for the loan interest rate, we obtain:

$$\rho = \varphi(i, y, R, P_x) \quad (10)$$

The loan interest rate is a function of the bond interest rate, economic output, the total reserve ratio, and the profitability rate of the shadow banking sector.

We can use the traditional IS curve equation when the commodity market is in equilibrium.

$$y = Y(\rho, i) \quad (11)$$

When the credit market and the commodity market are in equilibrium at the same time, the curve derived from combining formula (10) and formula (11) is the CC curve:

$$y = Y[\varphi(i, y, R, P_x), i] \quad (12)$$

Taking the first-order derivative of the equation (12) results in $\frac{dy}{di} < 0$. It shows that economic output is inversely related to the bond interest rate. It can be seen that the CC curve is consistent with the traditional IS curve and slopes to the lower right.

Finally, we analyze the money market where P is the price level, and M_s is the nominal money supply, which is controlled by the central bank. When the money supply is equal to the money demand, the money market is in equilibrium resulting in the LM curve. The LM curve is upward sloping in line with the trend of the IS-LM curve. The LM curve equation is:

$$M_d(i, y) = \frac{M^s}{P} \quad (13)$$

In summary, when the credit market, the commodity market, and the money market are in simultaneous equilibrium, the CC curve and the LM curve intersect at point E. The total economic output is Y_1 , as shown in Fig 1. However, due to the existence of shadow banks, the money supply of the whole society will change. In the credit market, because shadow banks have a high rate of return, idle social idle funds pursuing yield will transfer to shadow banks for a new round of expansion, stimulating investment and increasing output, causing the CC curve to move to the right to CC' .

In the money market, shadow banks divert some of the commercial banks' saved funds to create loans. Therefore, shadow banks can expand the economy's money supply, causing the LM curve to move to the right to LM' . As shown in Fig.1, the CC' curve and the LM' curve produce a new equilibrium point F. The corresponding economic output Y_2 will increase. It indicates that China's shadow banks' credit creation function can increase output and promote economic growth.

Figure 1: CC-LM model including the shadow banking

Findings

Model and Data Selection

Vector auto-regression (VAR) is a set of statistical models for multivariate time series analysis. It is commonly used to predict the dynamic impact of interconnected time-series systems and analyze disturbances on variable systems. It has comprehensive functions, including co-integration tests, the Granger Causality test, analysis of variance, and impulse function analysis. This paper uses the VAR model to study the impact of China's shadow banks' credit creation on monetary policy effectiveness. The mathematical expression of the VAR model is as follows:

$$y = A_1 y_{t-1} + \dots + A_q y_{t-q} + Bx_t + \varepsilon_t, \quad t = 1, 2, 3, \dots, T \quad (14)$$

Where y_t is the column variable of the dimensional endogenous variable; x_t is the dimensional external variable vector; q is the lag order; T is the number of samples. $A_1, \dots, A_q$, and B are the coefficient matrices to be estimated, and ε_t is the perturbation vector.

The first variable is the size of the shadow banks' credit creation. Based on previous literature, this paper selects bank entrusted loans, trust loans, and undiscounted bank acceptance bills to reflect the overall change of the size of shadow banks' credit creation. We use the monthly growth rate denoted by RSB.

The second variable is the money supply. China's current monetary statistics system divides the money supply into three levels: M_0 , cash in circulation; M_1 , narrow money supply; M_2 , broad money supply. As M_2 reflects the total social demand, we include its monthly growth rate, denoted as RM_2 , as a measure.

Another variable is the ultimate goal of Chinese monetary policy: stabilizing prices and promoting economic growth. Stabilizing prices is usually reflected by CPI. This paper adopts the monthly growth rate of CPI denoted by RCPI. Economic growth is generally measured by Gross Domestic Product (GDP). However, the current statistics on GDP data only have annual data and quarterly data. Therefore, this paper uses the quadratic-match average method to convert GDP quarterly data into GDP monthly data and uses the monthly growth rate, denoted by RGDP, as the measurement variable. This paper uses monthly data from January 2008 to December 2018 for a total of 132 observations. The data comes from the Chinese National Bureau of Statistics, the People's Bank of China website, and the Wind database.

Empirical analysis

We begin by performing a stationarity test on the selected time series data before establishing a VAR model, to avoid a pseudo-regression. The results of the augmented Dickey–Fuller (ADF) stationarity test of variables RSB, RM_2 , RCPI, and RGDP via the EViews 9.0 software are shown in Table 2.

Table 2: Result of ADF stationarity test.

Variable	Test Form (C,T,L)	Differential term	ADF Test Value	Threshold (5%)	P	Stationarity
RSB	(C,L,2)	0	-4.041071	-3.445030	0.0097	Stationary
RM_2	(C,T,7)	0	-6.684178	-3.446464	0.000	Stationary
RCPI	(C,L,0)	0	-9.799122	-3.444487	0.0000	Stationary
RGDP	(C,T,11)	1	-4.970787	-3.448021	0.0005	Stationary

Note : C is the constant term. T is the trend term. L is the lag term.

From Table 2, we can see that the ADF statistics of the four sets of data RSB, RM_2 , RCPI, and RGDP are all less than the critical value at the 5% significance level, and there is no unit root, and the stationarity test is passed. Among them, RSB, RM_2 and RCPI are zero-order single integer time series, and RGDP is a first-order, single-time time series. These indicate that the data are stable and meet the conditions for establishing the VAR model.

Based on data stability, this paper determines the optimal lag order of VAR model using the optimized log-likelihood objective function (LogL), the log likelihood ratio (LR), final prediction error (FPE), Akaike information criterion (AIC), Schwarz information criterion (SC), and Hannan-Quinn information criterion (HQ). Table 3 shows the results.

Table 3: Test results of the optimal lag order

Lag	LogL	LR	FPE	AIC	SC	HQ
0	1387.171	NA	4.83e-15	-21.61205	-21.52292	-21.57583
1	1414.523	52.56827	4.05e-15	-21.78943	-21.34380	-21.60837
2	1446.394	59.25840	3.16e-15	-22.03740	-21.23527	-21.71149
3	1512.977	119.6427*	1.44e-15	-22.82777	-21.66913	-22.35701
4	1565.933	91.84546	8.09e-16*	-	-	-
				23.40521*	21.89007*	22.78960*

Note : * indicates the optimal lag order selected in each column of criteria.

Based on the results in Table 3, we set the VAR model to the 4th order.

To further understand whether there is a causal relationship between shadow banking and other economic variables, we carried out the Granger causality test. The results are shown in Table 4.

Table 4: Granger Causality Test.

Null hypothesis	F	P	Conclusion
RSB is not the Granger reason for RM ₂	16.11452	0.0029	reject
RM ₂ is not the Granger reason for RSB	4.803838	0.3080	not reject
RSB is not the Granger reason for RCPI	23.57488	0.0001	reject
RCPI is not the Granger reason for RSB	1.234932	0.8723	not reject
RSB is not the Granger reason for RGDP	11.30682	0.0233	reject
RGDP is not the Granger reason for RSB	6.633243	0.1566	not reject

Based on the results in Table 4, the null hypothesis of the Granger causality test is rejected at the 5% significance level for RSB, RM₂, RCPI, and RGDP. It indicates that the change in the size of shadow banking credit creation in China will significantly impact the money supply, the price level, and economic growth. The analysis is consistent with the previous analysis.

From the Granger causality test, we find that RM₂, RCPI, and RGP are not the Granger reasons for RSB in the fourth-order, perhaps because their impact occurs earlier.

We should ensure that the VAR model is stable before performing the impulse response function and variance decomposition. Therefore, we conduct an AR test on the established VAR model. The results are shown in Fig. 2.

Figure 2: Result of AR Test

According to Fig.2, the reciprocal of the AR eigenvalues all fall within the unit circle, indicating that the VAR model is stationary. We can perform the impulse response function and its variance analysis on the data.

To further understand the impact of the size of China's shadow banking credit creation on the money supply, price level, and economic growth in different periods, this paper analyzes the impulse response function of RSB, RM₂, RCPI, and RGDP. The impulse function results are shown in Figure 3.

The broad money supply (RM₂) has an initial positive response to a one-unit standard deviation impulse of shadow bank deposits (RSB). However, the impact falls rapidly and becomes statistically insignificant after the first month. The initial response is consistent with the credit creation model as an increase in the shadow bank deposits leads to an expansion of the money supply when the shadow bank system reserve ratio is less than the reserve ratio of the commercial banking system. The credit creation model indicates that shadow bank deposits impact the money supply in subsequent periods through multiple lending rounds. The lack of statistically significant impulse response results for later periods may be caused by other factors confounding the analysis or by changes in the shadow bank reserve ratio during different economic conditions. Our analysis includes expansionary and contractionary periods. Affected by the financial crisis, when China's economy is in a downturn, shadow banks will increase their currency reserves, reduce their credit creation, and reduce the money supply. When the economy experiences an upswing, shadow banks will pursue regulatory arbitrage, reduce their currency reserves, expand the credit creation function of shadow banks, and increase the money supply.

Therefore, in different stages of the economic cycle, China's shadow banking credit creation has a cyclical effect on the money supply. This reduces the measurability, controllability, and correlation of the money supply, increasing the difficulty of the central bank's regulation of monetary policy and the realization of the ultimate goals of monetary policy.

The response of RGDP to the RSB impulse is negative in the first month but becomes significant and positive in the fourth month. These results are consistent with the IS-CC model showing an increase in equilibrium output with the introduction of a shadow bank credit sector. The increase in the scale of shadow banking credit creation can increase the total amount of credit, provide financing for entities to meet the credit needs of SMEs, and support economic growth. The lag between deposits, credit creation, and economic activity may explain the delayed response.

As shown in Fig. 3, the impulse response results for RCPI are statistically insignificant. As with the RM2 results beyond the first period, this may be due to confounding factors overwhelming the RSB results or different responses during contractions and expansions.

Figure 3: Impact of RSB on RM2, RGDP, and RCP

Note: The red analytic asymptotic in the multiple graphs shows standard errors in calculating impulse responses.

To further understand the degree of impact between the respective variables, we analyzed the variance decomposition of RSB, RM₂, RGDP, and RCPI. The results, shown in Fig. 4, indicate that the vast majority of variance in the RM₂ is endogenously driven with RSB, RGDP and RCPI contributing negligibly to its variance. Less of the variance of RGDP is endogenously driven. RM₂, RSB and RCPI contribute slightly more than 40% of the RGDP variance with shadow bank deposit changes adding approximately 7% of the variance. The variance in RCPI is similar to RGDP, with slightly less than 40% contributed by RM₂, RGDP, and RSB. As expected, RM₂ and RGDP play a more significant role than RSB in contributing to RCPI's variance.

Figure 4: Variance decomposition

Discussion and Conclusion

We use the economic indicators of money supply, economic growth, and price levels, to analyze the influences of credit creation of China's shadow banks on monetary policy from the theoretical and empirical aspects. Using a credit creation model, we show that bank deposits shunted to the shadow banking system impact the money multiplier. The impact can have a cyclical aspect based upon the shadow banking reserve ratio responding to economic conditions. Shadow banking can have a multiplicative effect during expansions and a dampening effect during slowdowns, which increases the uncertainty of monetary policy. Using a CC-LM model, we show that shadow banking can shift the CC and LM curves, resulting in a higher economic output.

Finally, we use a vector autoregressive statistical analysis to estimate the impact that the rate of shadow banking deposits has had on monetary policy goals. The Granger Causality test indicates that the growth rate of shadow banking deposits has Granger Causality for the growth rates of the broad money supply, GDP, and the CPI. The impulse response analysis indicates shows that shadow bank deposits have an initial positive impact on the money supply implying a multiplicative effect during an expansion and a dampening impact during a contraction. Later impacts are not statistically significant, which merits further study. Consistent with the CC-LM model, the impulse response analysis indicates that shadow bank deposits positively impact GDP with a lag of four periods. The impulse response analysis did not find a statistically significant effect of RSB on RCPI. The variance decomposition analysis indicated that RSB, along with RGDP and RCP, had a negligible impact on the RM2, indicating that the broad money supply is endogenously determined. The variance decomposition showed that RSB explains approximately 7% of the variance of RGDP and a negligible amount of the RCPI variance.

Our results are consistent with the previous studies (Liu et al.,2019), indicating that shadow banking may be a powerful amplification mechanism that impairs monetary policy transmission and reduces its effectiveness. We find that shadow banking can have a multiplicative effect during expansions and a dampening effect during slowdowns, which increases the uncertainty of monetary policy. Regulation seeks to strike the right balance between the costs and benefits of policy intervention. Future research can determine the type of shadow bank regulation that would promote coordinated monetary policy and increased economic stability without stunting economic growth.

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