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The Effect of the Scale of Shadow Banking on the China Monetary Policy

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Abstract: Based on determining the concept of the scale of shadow banking, this dissertation employs the VAR model to model China's monetary policy indicators and the scale of shadow banking, so that understands the underlying mechanism of its impact on monetary policy. The study found that the scale of China's shadow banking has undergone cyclical changes during the sample period and have a short-term and long-term effect on monetary policy in this dissertation.

Keywords: Shadow Banking; China Monetary Policy; Vector Autoregressive Model; Augmented Dickey-Fuller

1. Introduction

According to statistics from the Central Bank (2020), after the financial crisis, nearly half of new loans came from shadow banking, and now nearly one-third of new loans come from shadow banking. Since 2018, the central bank has adjusted the statutory deposit reserve as many as 12 times, such a high frequency of monetary policy implementation also proves the depth of interference from shadow banking. Hence, the purpose of this dissertation is to determine the vital function of shadow banking scale expansion in the monetary policy system of China under this background.

However, the relevant literature for developing countries is not sufficient as well as concentrated in the field of operation mechanism and risk prevention, while empirical analysis is relatively rare. Hence, this dissertation adopts the current mainstream core business aggregation method to measure the scale of shadow banking in China. Furthermore, to break through the limitations of a single variable of monetary policy, this paper adopts the changes of three variables of money supply, price level index, and GDP to reflect the effectiveness of monetary policy implementation.

The dissertation focuses on the three major issues of how the expansion of the shadow banking scale affects the implementation of monetary policy, whether the scale of shadow banking affects economic growth and price level, and how the interaction between the shadow banking scale and the money supply interacts. Meanwhile, assumptions expansion of the scale of shadow banking may adversely affect it through the intermediate transmission channel and the ultimate objectives of monetary policy implementation, thereby reducing the accuracy of policy formulation.

2. Literature Review

2.1 Definition and Concept of Shadow Banking

With the development of shadow banking theory, there is already a definition generally accepted by the public. In 2011, the International Financial Stability Board (FSB) defined broad shadow banking and narrow shadow banking, respectively. Its broad concept concerns the function of credit intermediation and its narrow concept emphasizes risk (Elliott, 2015). Thereafter, FSB (2017) has given the formal concept of shadow banking "credit intermediation involving entities and activities external the regular banking system." This dissertation adopted the concept of FSB (2017) as a practical definition.

2.2 The Composition and Characteristics of China's Shadow Banking

The composition of China's shadow banking scale has been controversial among scholars due to its different characteristics of businesses and institutions. On the one hand, Rui (2019) suggests that the main feature of various shadow banking institutions or businesses is

that it has different levels of supervision deficiencies. On the other hand, Elliott (2015) emphasized that the scale of shadow banking should be differentiated according to its core business and edge business. The particularity of China's shadow

banking system dominated by traditional commercial banks determines that its core business is trust loans, entrusted loans, and undiscounted bank acceptances (Tillmann, 2017).

The State Council of China, clarified the scope of shadow banking in 2013 based on the characteristics of shadow banking: core business and unobserved credit. The core business mainly includes entrusted loans, undiscounted bank acceptance drafts, and trust loans. Unobserved credit mainly includes personal loans and P2P network loans (Xi, 2014).

2.3 Development Status of China's Shadow Banking Scale in Monetary Policy

From 2004 to the time of the subprime mortgage crisis, as monetary policy was relatively loose and overall market liquidity was sufficient during this period(Wan, 2018), some non-bank financial institutions gradually emerged, which laid the foundation for the initial development of China's shadow banking (Gabrieli et al, 2017).

In 2013, the General Office of the State Council of the People's Republic of China issued the "Notice on Issues Concerning Strengthening the Supervision of Shadow Banking", which aimed at the rapid expansion of shadow banking. Besides, the Shadow banking scale was clearly defined during this period (Meiting and Hang, 2018).

The critical time for the turning point in the scale of shadow banking is 2017. The implementation of a series of regulatory measures aimed to prevent and mitigate financial risks has greatly limited the expansion of shadow banking. China's shadow banking has moved from the early stage of rapid expansion to the current stage of shrinking.

3. Model Formulation and Research

This paper discusses the impact of the scale of shadow banking on monetary policy and analyzes the interaction between the scale of shadow banking and money supply, GDP, and price index. In predicting economic time series and analyzing the dynamic effect of random disturbance items on the variable system, the VAR model is more reasonable. It could analyze the correlation between multiple variables and show the shock between economic variables (Tillmann, 2017).

The expression for the VAR model could be written as

$$Y_t = e_t + \alpha_1 Y_{t-1} + \alpha_2 Y_{t-2} + \cdots + \alpha_k Y_{t-k} \quad (1)$$

Among them, is the parameter matrix, is the time series column vector, and is the error term. In this paper, shadow bank scale R_SB, broad money supply R_M2, economic growth R_GDP, and consumer price index R_CPI together constitute the endogenous variables in the model, namely Yt=R_SB, R_M2, R_GDP, R_CPI. The model built as follows:

$$\begin{bmatrix} R\_SB \\ R\_M2 \\ R\_GDP \\ R\_CPI \end{bmatrix} = \sum_i^n \begin{bmatrix} \alpha 11i & \alpha 12i & \alpha 13i & \alpha 14i \\ \alpha 21i & \alpha 22i & \alpha 23i & \alpha 24i \\ \alpha 31i & \alpha 32i & \alpha 33i & \alpha 34i \\ \alpha 41i & \alpha 42i & \alpha 43i & \alpha 44i \end{bmatrix} \begin{bmatrix} R\_SB \\ R\_M2 \\ R\_GDP \\ R\_CPI \end{bmatrix} + \begin{bmatrix} e_1 \\ e_2 \\ e_3 \\ e_4 \end{bmatrix} \quad (2)$$

According to the credit activities of shadow banking, it is possible to squeeze and divert the total amount of credit at first, and then lead to an increase in the amount of capital in circulation in society, which affects the money supply, and then affects the transmission path of GDP, and finally affects the consumer price index. This paper sets the sequence of endogenous variables as R_SB, R_M2, R_GDP, R_CPI.

First, the ADF test is employed to detect sequence stationarity. There are three forms of ADF test, which are as follows:

$$\Delta X_t = \delta X_{t-1} + \sum_{i=1}^{m} \beta_i \Delta X_{t-i} + \varepsilon_t \quad (3)$$

$$\Delta X_t = \alpha + \delta X_{t-1} + \sum_{i=1}^{m} \beta_i \Delta X_{t-i} + \varepsilon_t \quad (4)$$

$$\Delta X_t = \alpha + \beta t + \delta X_{t-1} + \sum_{i=1}^{m} \beta_i \Delta X_{t-i} + \varepsilon_t \quad (5)$$

Then, in order to make better predictions of the variables and perform the Granger causality test, confirm whether the variable X is the Granger cause of the alter of the variable Y.

$$Y_t = \varphi_1 + \sum_{i=1}^{p} \alpha_i Y_{t-i} + \sum_{i=1}^{p} \beta_i X_{t-i} + \mu_{1t} \quad (6)$$

$$X_t = \varphi_2 + \sum_{i=1}^{p} \lambda_i X_{t-i} + \sum_{i=1}^{p} \sigma_i Y_{t-i} + \mu_{2t} \quad (7)$$

Where p is the maximum lag order of the Granger causality test, , , , are the estimated coefficients of the model. The null hypothesis: X cannot Granger cause Y, which means Y is not affected by the lag term of X. Analyze whether there is Granger causality between R_SB and R_M2, R_GDP, R_CPI. The sum of squared residuals of the former and the latter are represented by and respectively, Calculate the F statistic:

$$F = \frac{(RSS_X - RSS_Y)}{RSS_Y/(n-q)} \quad (8)$$

The q is the number of parameters to be estimated. If F >$F_\alpha(m, n-q)$, the null hypothesis is rejected, and X could cause Y by Granger.

After, in order to estimate the influence of a standard deviation of a random disturbance item of an endogenous economic variable in the system on other variables, an impulse response function is established for analysis (Yixue, 2019).

The specific formula of the impulse response function is

$y_t = \varphi_1 y_{t-1} + \cdots + \varphi_p y_{t-p} + \varepsilon_t$ (9)

Finally, through the variance decomposition to examine the effect of shadow banking on the alters in various variables in the monetary policy transmission mechanism. Assume that the forecast error of the previous s period of the VAR (p) model is

$A_0\varepsilon_t + A_1\varepsilon_{t-1} + A_2\varepsilon_{t-2} + \cdots A_{s-1}\varepsilon_{t-s+1} \quad A_0 = I_k$(10)

The relative variance contribution (RVC) could be obtained:

$$RVC_{j\to i}(s) = \frac{\sum_{q=0}^{s-1}\left[\left(a_{ij}^{(q)}\right)^2 \sigma_{jj}\right]}{\sum_{j=1}^{k}\left\{\sum_{q=0}^{s-1}\left[\left(a_{ij}^{(q)}\right)^2 \sigma_{jj}\right]\right\}},\ i,j = 1,2,\cdots,k \quad (11)$$

The variables R_M2, R_CPI, R_GDP, and R_SB studied in this paper are analyzed in turn.

4. Empirical Results and Analysis

4.1 Introduce

The sample data selected in this dissertation is the monthly data from January 2007 to December 2019, excluding the impact of holidays. In order to reflect the volatility of the data, the month on month growth rate is employed to eliminate the impact of seasonal, representative by R_SB, R_M2, R_CPI, and R_GDP.

4.2 Unit Toot Test

It is necessary to test the stationarity of the time series of each variable before conducting the empirical analysis. This paper carried out an ADF inspection, and test results are shown in Table 1.

Table 1 The Unit Root Test

Variable	Type	t-Statistic	Test critical values			Prob*
			1%	5%	10%	
R_SB	(C,T,0)	-12.5450	-4.018748	-3.439267	-3.143999	0.0000***
R_M2	(C,T,11)	-3.205311	-4.023506	-3.441552	-3.145341	0.0979*
R_CPI	(C,T,11)	-12.54506	-4.018748	-3.439267	-3.143999	0.0000***
R_GDP	(C,T,12)	-1.636497	-2.581349	-1.943090	-1.615220	0.0959*

Note: * * *, * *, and * meaning variables are significant at 1%, 5% and 10% critical levels.

Table 1 illustrates that the t-Statistic value of R_M2 and R_GDP is 0.09, which shows that the original hypothesis is rejected at the 10% level and the variables are stable. In addition, the t-Statistic value of R_SB and R_CPI is 0.0000, which means that the original assumption of the 5% level is rejected, and the variables are also extremely stable. The above satisfy the prerequisites for creating a VAR model.

4.3 Granger Causality Test

The dissertation adopts the Granger causality test the selected sample variables R_SB, R_M2, R_CPI, and R_GDP. The results are as Table 2:

Table 2 Granger Causality Test

Null Hypothesis:	Obs	F-Statistic	Prob.	conclusion
R_M2 does not Granger Cause R_SB	151	3.22085	0.0005***	reject
R_SB does not Granger Cause R_M2		7.22178	0.0080***	reject
R_GDP does not Granger Cause R_SB	151	4.83401	0.0011***	reject
R_SB does not Granger Cause R_GDP		5.30975	0.0005***	reject
R_CPI does not Granger Cause R_SB	151	7.21820	3.E-07***	reject
R_SB does not Granger Cause R_CPI		3.58045	0.0015***	reject

Note: the optimal lag time is 4. * * *, * *, and * meaning variables are significant at 1%, 5% and 10% critical levels.

The consequents in Table 2 show that at the 1% significance level, there is a significant bilateral causal relationship between R_SB and R_M2. Similarly, R_GDP and R_SB are Granger Causes of each other. Under the 1% significance level, the null hypothesis is rejected. Moreover, there is also a bilateral causal relevance between R_CPI and R_SB. Meanwhile, changes in R_ CPI in the short term could cause R_SB changes, and R_ CPI has the ability to predict R_SB, vice versa.

4.4 Lag Order Selection

Table 3 VAR Lag Order Selection Criteria

Lag	LogL	LR	FPE	AIC	SC	HQ
0	1309.815	NA	2.26e-13	-17.76619	-17.68482*	-17.73313
1	1327.036	33.26977	2.22e-13	-17.78280	-17.37593	-17.61748
2	1338.373	21.28662	2.37e-13	-17.71936	-16.98701	-17.42180
3	1409.322	129.3489	1.12e-13	-18.46696	-17.40912	-18.03715
4	1436.846	40.60386*	7.91e-14*	-18.84755*	-16.16227	-17.75649
5	1445.545	14.91221	1.07e-13	-18.52442	-16.81560	-17.83011
6	1474.115	47.42207	9.05e-14	-18.69544	-16.66113	-17.86888
7	1491.116	27.29539	8.99e-14	-18.70907	-16.34927	-17.75026
8	1517.295	48.68238	9.63e-14	-18.62376	-17.24043	-18.06169*

LR, FPE, and AIC indicate that the best lag is fourth order. Thus, VAR (4) model is the best.

4.5 AR Root Test

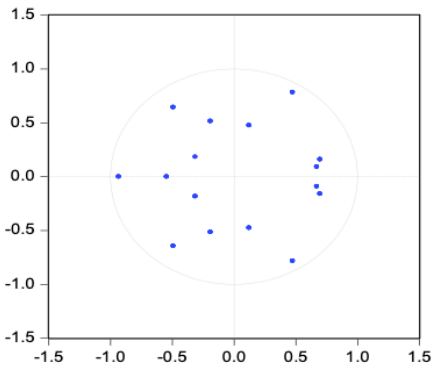


Figure 7 AR Root Figure

The established VAR model satisfies the stationarity condition. Therefore, the model could further analyze the specific relevance of the variables in the model.

4.6 Impulse Response Analysis

This paper analyzes based on the constructed VAR model with a lag period of 4.

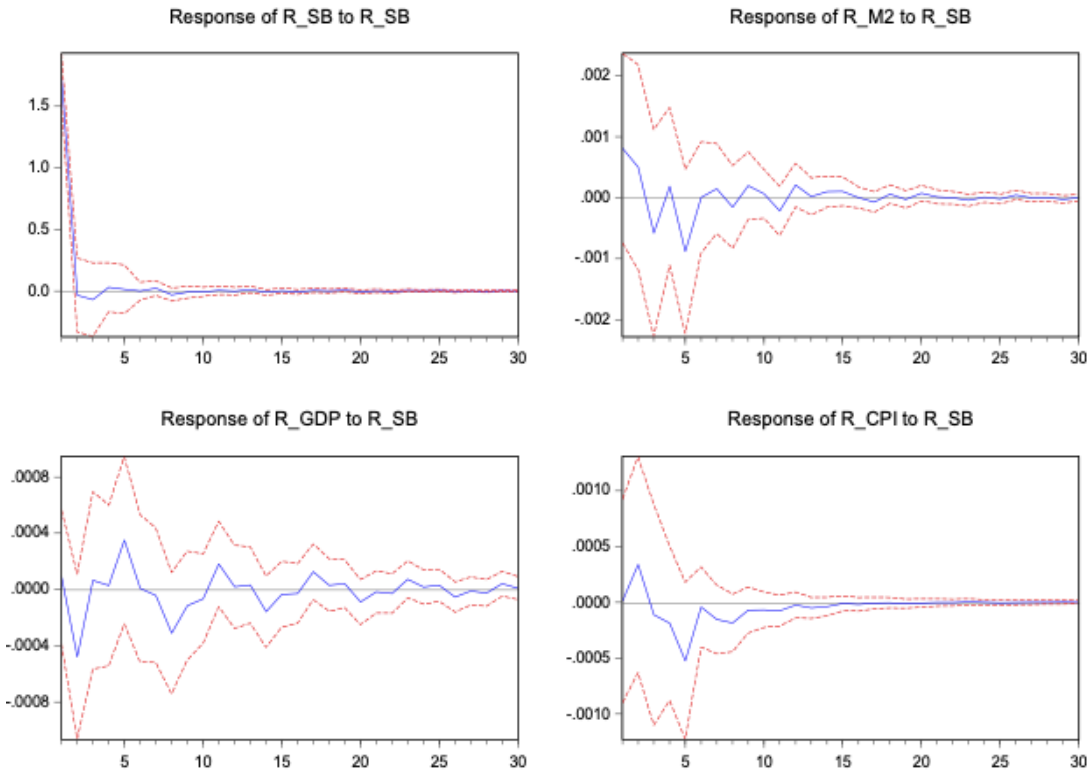
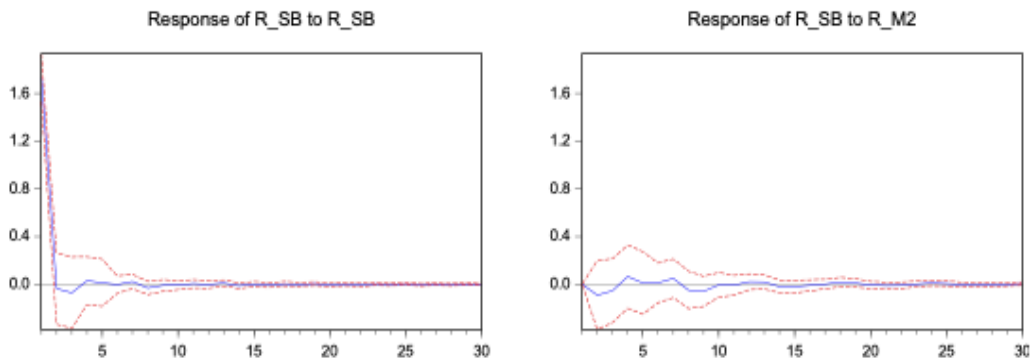


Figure 8 The Response of Monetary Policy

From the perspective of the degree of impact, R_M2, R_GDP, and R_CPI reflect the characteristics of volatility. The shadow banking scale has a negative impact on money creation and price effects, while the impact on economic output is stable. However, from the perspective of the impact time, R_SB may have an impact on R_M2, R_CPI, and R_GDP in the short term, while also having long-term sustainability. Through the above analysis, the development of shadow banking can not only influence economic growth in the short term but also increase the difficulty for the central bank to control inflation.



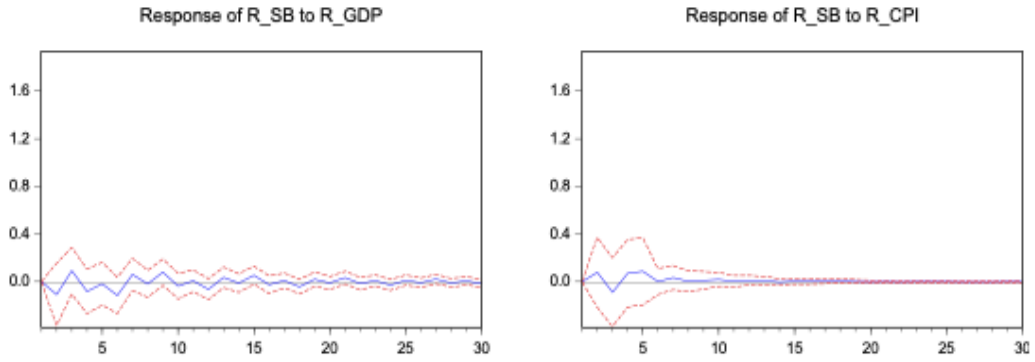


Figure 9 The Response of the Shadow Banking Scale

4.7 Variance Decomposition

The following would sequentially perform variance decomposition on R_SB, R_M2, R_GDP, and R_CPI.

Table 4 Variance Decomposition

Variance Decomposition of R_SB:

Period	S.E.	R_SB	R_M2	R_GDP	R_CPI
1	1.730590	100.0000	0.000000	0.000000	0.000000
2	1.738380	99.14478	0.264405	0.381712	0.209107
3	1.745271	98.52448	0.352256	0.663096	0.460170
4	1.750026	98.02037	0.490509	0.867780	0.621343
5	1.752355	97.76609	0.493252	0.875073	0.865581
6	1.756139	97.34526	0.496446	1.296393	0.861897
7	1.758403	97.11191	0.578512	1.410891	0.898688
8	1.759372	97.03477	0.647620	1.419662	0.897946
9	1.762199	96.72628	0.753129	1.621587	0.899000
10	1.762702	96.67276	0.753248	1.663946	0.910047
11	1.762744	96.66911	0.754629	1.665714	0.910542
12	1.764034	96.52783	0.768634	1.790684	0.912856
13	1.764608	96.46908	0.781938	1.833784	0.915203
14	1.764799	96.45288	0.793870	1.837941	0.915309
15	1.765765	96.34740	0.805112	1.932347	0.915138
16	1.765975	96.32664	0.807191	1.950814	0.915355
17	1.766012	96.32330	0.807228	1.954028	0.915443
18	1.766595	96.25980	0.818424	2.006223	0.915556
19	1.766759	96.24302	0.822325	2.019197	0.915457
20	1.766810	96.23873	0.823187	2.022594	0.915490

Variance Decomposition of R_M2: Period	S.E.	R_SB	R_M2	R_GDP	R_CPI
1	0.009561	0.723877	99.27612	0.000000	0.000000
2	0.009786	0.954103	94.93053	2.379467	1.735896
3	0.009928	1.267135	94.24993	2.654059	1.828879
4	0.010523	1.159287	93.06593	4.092784	1.681994
5	0.010873	1.743168	89.38986	4.313491	4.553484
6	0.010883	1.739882	89.38379	4.323525	4.552803
7	0.011016	1.716373	88.87801	4.926095	4.479519
8	0.011089	1.712815	88.02077	5.111892	5.154520
9	0.011106	1.739365	87.99863	5.122707	5.139301
10	0.011129	1.735507	87.65099	5.432202	5.181303
11	0.011191	1.753626	87.55151	5.380703	5.314162
12	0.011199	1.785663	87.44568	5.449125	5.319534
13	0.011215	1.780830	87.19555	5.702798	5.320826
14	0.011217	1.787955	87.16801	5.711571	5.332465
15	0.011223	1.794677	87.15229	5.720235	5.332795
16	0.011232	1.791614	87.04824	5.825189	5.334957
17	0.011237	1.794118	87.05299	5.820868	5.332022

The change in the growth rate of each variable is mainly interpreted by itself, while its contribution to itself would continue to decline as the number of periods increases and eventually stabilize. R_SB has a certain degree of influence on R_M2, R_CPI, and R_GDP. Among them, it has the most significant impact on changes in R_GDP and the least impact on R_CPI changes.

5. Conclusion and Suggestion

5.1 Empirical Conclusion

First, the Granger causality test points out that changes in R_SB are the cause of changes in R_M2, R_GDP, and R_CPI. At the same time, changes in R_M2, R_GDP, and R_CPI would reverse the changes in R_SB and have stable relevance between variables in the long term.

Second, the consequents of the impulse response function analysis indicate that the growth of the shadow banking scale has inhibited the flow of funds and reduced the money supply. Moreover, the development of the scale of shadow banking may affect inflation, while its effect on the price level is limited.

Third, the results of variance decomposition indicate that R_SB has an explanatory effect on R_M2, R_CPI, and R_GDP. Its impact on R_GDP exceeds the impact on R_M2 and R_CPI, which means that the development of the shadow banking scale has a greater degree of impact on the ultimate objectives than the intermediate target, and its impact has long-term effects.

In general, the development of the scale of shadow banking has provided partial support for the development of China's real economy, expanded the boundaries of financial services, and it would beneficially promote China's economic growth in the short term (Veronae and Martins, 2013). However, at the same time, it also interfered with the effective transmission, and brought challenges to the effective implementation of monetary policy. Thus, the above conclusions are basically consistent with the previous assumptions in this chapter.

5.2 Policy Suggestion

The intermediate target and ultimate objectives of reforming and improving monetary policy are based on the fulfillment of monetary policy. It is recommended that the credit creation of shadow banks be included in the scope of money supply statistics, which probably impel statistical data valid and accurately reflect market liquidity. It also could achieve monetary policy goals more comprehensively and accurately.

Furthermore, consider adjusting the monetary policy intermediate targets and replacing M2 with a more representative scale of social financing. Besides, the official statistics of the scale of shadow banking would pay attention to its role in price levels and economic growth and conduct standardized monitoring of it.

Additionally, there are two suggestions based on the supervision of shadow banking. On the one hand, fair transaction standards are a significant guarantee for the stability of the economy market. It is recommended to improve the construction of the legal and regulatory system, clarify the supervision entities of all parties, and send corresponding regulations on the information disclosure, asset-liability ratio, source of funds, and uses of shadow banking institutions.

On the other hand, the occurrence of the financial subprime mortgage crisis proves that the malicious extend of shadow banking is highly likely to spark a more severe financial crisis and bring huge losses to the financial market (Nersisyan and Wray, 2010). Therefore, it is necessary to actively learn from the experience and lessons of shadow banking in developed countries and regulate the development of the shadow banking scale.

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