ISSN 2616-5902 Vol. 6, Issue 10: 218-224, DOI: 10.25236/AJBM.2024.061032

Research on the transmission effect of China's medium-term lending facility from the perspective of systemic financial risk

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Abstract: *Against the backdrop of rapid development in financial markets, the urgency of managing and mitigating financial risks has escalated, with increasing demands for refining monetary policy. This paper empirically examines the transmission effects of the Medium-term Lending Facility (MLF) within the context of systemic financial risk. The findings indicate that in low-risk environments, both quantity-based and price-based transmission channels effectively mitigate risk shocks and maintain stability. In high-risk environments, however, the effectiveness of these channels is reduced, with the quantity-based channel proving more effective in bolstering market confidence. Additionally, in low-risk environments, the credit, price, and output effects of the MLF are relatively stable, whereas they become more complex and require a longer recovery period in high-risk environments.*

Keywords: *Medium-term Lending Facility, Monetary Policy Transmission Effects, Systemic Financial Risk, MS-VAR Model*

1. Introduction

Monetary policy is a crucial instrument for macroeconomic regulation, affecting economic performance through adjustments in the money supply and interest rates to achieve stable prices and promote economic growth. Meanwhile, systemic financial risk has become a focal point in academic research due to its significant economic impact, complex transmission mechanisms, importance for policy-making, lessons from financial crises, and challenges posed by financial innovation. Although traditional monetary policy transmission mechanisms have been extensively studied, research into the effects of monetary policy under different risk conditions, especially concerning novel structural monetary policies like the Medium-term Lending Facility (MLF), remains relatively limited. This study addresses this gap by analyzing the transmission effects of the MLF from both quantitative and price-based channels within the context of systemic financial risk. This analysis holds substantial academic and practical significance for the formulation of monetary policy in China. It provides a robust theoretical foundation for maintaining economic stability, refining the monetary policy framework, and enhancing the effectiveness of monetary policy.

2. Literature review

2.1. Research on the transmission effect of monetary policy

Monetary policy is a crucial component of macroeconomic policy, playing a significant role in the stable operation of the economy. Currently, there are two primary types of monetary transmission policies. One approach focuses on the quantity of money, influencing economic activity by adjusting the money supply [1]. The other approach involves adjusting price variables such as interest rates to affect the economy[2]. Numerous factors influence the effectiveness of monetary policy transmission, including changes in the macroeconomic environment, adjustments in the financial system structure, and the emergence of new technologies. These factors vary in their direction and magnitude of impact. Mishra et al. (2014)[3] argue that increased private sector participation can enhance the effectiveness of monetary policy transmission. Huber & Fischer (2018)[4] suggest that changes in the economic environment and financial innovations have marginal effects. Zhan Minghua et al. (2020)[5] find that the effects of digital finance on monetary policy vary across different transmission channels. Regarding

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the effectiveness of monetary policy transmission, the academic consensus is that an accommodative monetary policy benefits the real economy. Hu Yurong (2014)[6] indicates that tight monetary policy can suppress corporate risk-taking, with varying impacts across different industries.

2.2. Research on systemic financial risk and medium-term lending facilities

In recent years, significant advances have been made s in the research on systemic financial risks and the medium-term lending facility (MLF) tool. Zhang and Wu (2018)[7] find that MLF operations have a good transmission effect on medium-term interest rates, though their impact is relatively short-lived. Zhao and Liu (2024)[8] use a Time-Varying Parameter Vector Autoregression (TVP-VAR) model to reveal that structural monetary policy tools exert certain shocks on systemic financial risks. Different tools exhibit varying impact characteristics. Through impulse response analysis, it is observed that the MLF shows a short-term positive impact on systemic financial risks, somewhat increasing them. However, in the long term, the MLF does not significantly affect systemic financial risks.

3. Research design

3.1. Model Construction

The MS-VAR model, or Markov-Switching Vector Autoregressive model, represents an enhancement of the traditional VAR model. Compared to linear VAR models, the MS-VAR model possesses the capability to partition sample data into multiple unobservable regimes, thereby enabling a deeper exploration of variable interactions under different economic conditions. This model encompasses various forms, which can generally be categorized into the Mean-Switching Model (MSM), the Intercept-Switching Model (MSI), the Autoregressive Parameter-Switching Model (MSA), and the Heteroscedasticity-Swiching Mode (MSH).

For the lagged P-order MS-VAR model, its general form is given by:

$$y_t = V(S_t) + A_l(S_t)(y_{t-1}) + \cdots + A_p(S_t)(y_{t-1J}) + \mu_t$$

$$\mu_t \sim i.i.d.\, N(0, \textstyle\sum(S_t))$$

The unobservable regime variable is denoted by S_t, while $P_{i.j}$ represents the probability of transitioning from regime i to regime j. Specifically:

$$P_{i,j} = Pr(S_{t+1} = j | S_t = i), \textstyle\sum_{j=1}^{m} P_{i,j} = 1, \forall i, j \in \{1,2,\dots,m\}$$

In the above expression, m represents the number of regime states. Assuming there are two regimes present in the sample data, denoted by S_t={1,2}, the transition probability matrix between these states is given by:

$$P=\begin{pmatrix} P_{11} & P_{12} \\ P_{21} & P_{22} \end{pmatrix}$$

Clearly, for each row in the matrix, the following holds:

$$P_{i1} + P_{i1} = 1$$

When m=1,2,…M, the general form of the MS-VAR model can be further expressed as:

$$y_t = \begin{cases} v_1 + A_{11} y_{t-1} + \cdots + A_{p1} + \sum_1^{\frac{1}{2}} \mu_t, & S_t \\ \vdots & \vdots \\ v_M + A_{1M} y_{t-1} + \cdots + A_{pM} + \sum_1^{\frac{1}{2}} \mu_t, & S_t = M \end{cases}$$

3.2. Data Source Description and Variable Declaration

The primary focus of this study is the Medium-Term Lending Facility (MLF) tool. The People's Bank of China first employed the MLF in September 2014. To ensure the availability of data for subsequent modeling, the sample period is defined from September 2014 to September 2023, with a monthly frequency. Table 1 shows the variables selected for the study, and all necessary data come

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from the Choice financial terminal.

Table 1: Table of Variable Definitions.

Dimensions	Variable Names	Summary	Economic Significance
	Systemic Financial Risk	SFR	Reflecting Potential Overall Risks in the Macroeconomic System
	Medium-term Lending Facility Balance	MLF	Measuring the Operational Level of the Medium-Term Lending Facility
Transmission Channels	Money Supply	M2	Reflecting the Channels of Quantity-Based Monetary Policy Transmission
	Shanghai Interbank Offered Rate(6-Month)	SHIBORI	Reflecting on the Channels of Price-Based Monetary Policy Transmission
Transmission Effects	Year-on-Year Growth Rate of Loan Balances in Financial Institutions	LB	Describing the Credit Effects
	Year-on-Year Growth Rate of the Consumer Price Index	CPI	Describing the Price Effects
	Year-on-Year Growth Rate of Industrial Value Added	Y	Describing the Output Effects

3.3. Data processing and testing

3.3.1. Verification of stationarity

To ensure the validity of the MS-VAR model estimation results, the time series data, which initially exhibited non-stationarity, were first differenced at the first order. Subsequently, as shown in Table 2, these differential sequences passed the stationarity test and are therefore suitable for further MS-VAR model analysis.

Table 2: Results of Unit Root Tests.

Variable Names	ADF Test	P-Value	Conclusion
SFR	-11.61658	0.0000	Stationarity
MLF	-8.947142	0.0000	Stationarity
M2	-11.03427	0.0000	Stationarity
SHIBORI	-6.192311	0.0000	Stationarity
CPI	-9.401101	0.0000	Stationarity
LB	-5.503631	0.0000	Stationarity
Y	-9.285668	0.0000	Stationarity

3.3.2. Stability test

To ensure that the model accurately reflects real-world conditions and maintains stable predictive capabilities, an AR root stability test was further conducted. The results of this test, illustrated in Figure 1 show that the inverse roots of all relevant variables fall within the unit circle. This not only confirms the appropriateness of the chosen optimal lag length but also demonstrates the robustness and reliability of the entire model construction process.

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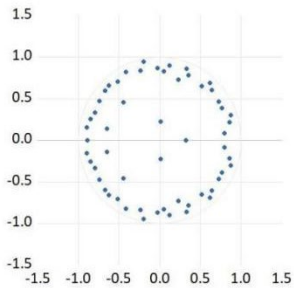

Figure 1. Unit Circle Test.

4. Analysis of empirical results

4.1. Analysis of MS-VAR model test results

Due to differences in the mean (M), intercept term (I), regression coefficients (A), and error terms (H) of the time series, the MS-VAR model can be further categorized into four types: MSM-VAR, MSA-VAR, MSI-VAR, and MSH-VAR (Krolzig, 1990). Based on the characteristics of the sample data, the MS-VAR software package developed on the OXmetrics platform was used for model specification and analysis across various combinations. The optimal lag length was determined according to the log-likelihood values, AIC, SC, and HQ criteria for each model type, leading to the selection of the appropriate model—MSH(2)-VAR(2). Additionally, the LR test value for the selected model is 593.7854, with both the chi-square statistic and Davies test p-value equal to 0.0000, which significantly rejects the null hypothesis of the linear system. This result underscores the validity and necessity of using the MSH(2)-VAR(2) model, highlighting its advantages and suitability for describing and analyzing state transitions in economic operations.

4.2. Analysis of monetary policy transmission effect based on the impulse response function

4.2.1. Credit Effects

As shown in Figure 2, under a low-risk regime, the impact of an MLF shock on LB initially results in a positive response, which subsequently turns negative. By approximately the fifth period, the credit effect converges to zero. In a high-risk regime, the direction and trend of LB's response are similar to those observed under the low-risk regime, but with greater fluctuations and a longer convergence time. Additionally, in the quantity-based transmission channel, when M2 is shocked under a low-risk regime, the available loan balance of financial institutions initially shows a negative response, then briefly turns positive before declining again, stabilizing by the seventh period. In a high-risk regime, the response direction and trend are similar, but with larger fluctuations. The shift to a positive response occurs earlier, and the market stabilizes around the eighth period. In the price-based transmission channel, under a low-risk regime, a SHIBOR shock leads to a consistently positive response in LB. Conversely, under a high-risk regime, LB initially shows a negative response which turns positive by the third period.

Regarding the impact of SFR on LB, under a low-risk regime, an SFR shock causes the available loan balance of financial institutions to first decrease and then increase, with the credit effect converging around the fifth period. In a high-risk regime, an SFR shock results in a significant negative response in LB, though a positive response emerges after the second period, albeit with notable fluctuations. By the seventh period, financial institutions gradually return to normal lending activities.

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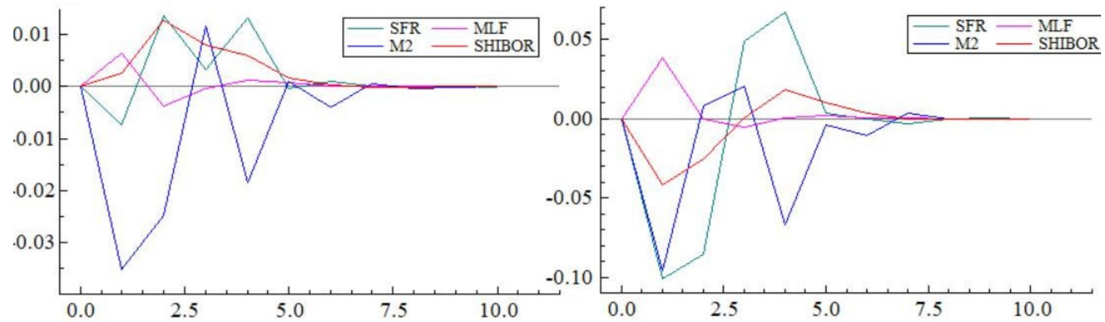


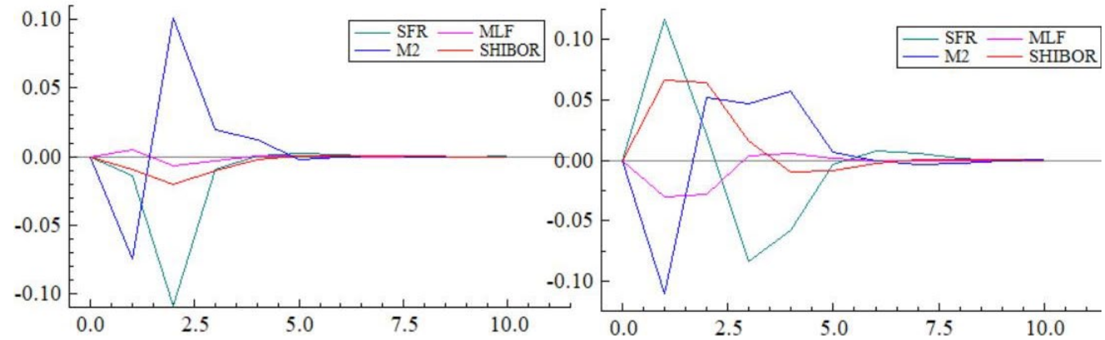
Response of Low-Risk Regime to LB. *Response of High-Risk Regime to LB.*

Figure 2. Response situation of LB under different regimes

4.2.2. Price Effects

As shown in Figure 3, in a low-risk regime, the response of the Consumer Price Index (CPI) to a Medium-term Lending Facility (MLF) shock initially turns positive before becoming negative, converging to zero by the fourth period. Under an M2 shock, the CPI first exhibits a negative response, then turns positive, converging by the fifth period. A SHIBOR shock causes the CPI to first decline before converging to zero. An SFR shock results in a substantial negative response initially, with a brief positive response observed in the fourth period before converging.

In a high-risk regime, the impulse response of the CPI to an MLF shock is opposite to that observed in a low-risk regime and exhibits greater magnitude, converging by the sixth period. Under an M2 shock, the negative response is more pronounced, while the positive response is less significant. A SHIBOR shock leads to a positive response initially, which then turns negative, beginning to converge after the fourth period. An SFR shock causes an initial positive response, which then becomes negative, with convergence only beginning in the eighth period. Overall, in high-risk environments, the effects of various factors on the CPI are more complex and severe, with greater fluctuations in response and longer adaptation and absorption times. In contrast, in a low-risk regime, the market reaction is relatively quicker, and the price effects dissipate or converge more swiftly. These variations under different risk regimes reflect the impact of market liquidity, confidence, and expectations on price levels.



Response of Low-Risk Regime to CPI. *Response of High-Risk Regime to CPI.*

Figure 3. Response situation of CPI under different regimes

4.2.3. Output Effects

As shown in Figure 4, under a low-risk regime, an increase in the Medium-term Lending Facility (MLF) initially stimulates market liquidity, leading to growth in industrial production, with output (Y) initially responding positively. However, due to supply-demand imbalances or reduced investment efficiency, the response turns negative by the third period and converges to zero by the fifth period. Under an M2 shock, output responds positively for the first three periods, but shifts to a negative response by the fourth period due to excess liquidity and inefficient investment, eventually converging by the sixth period. An increase in SHIBOR initially suppresses industrial production, resulting in a negative response from Y for the first four periods. Subsequently, as firms optimize their financial structures, the output response turns positive, converging by the sixth period. A shock from the Shanghai Interbank Offered Rate (SFR) initially leads to a negative response in Y, but as risk dissipates and confidence recovers, the response becomes positive from the third period, with industrial production normalizing by the fifth period.

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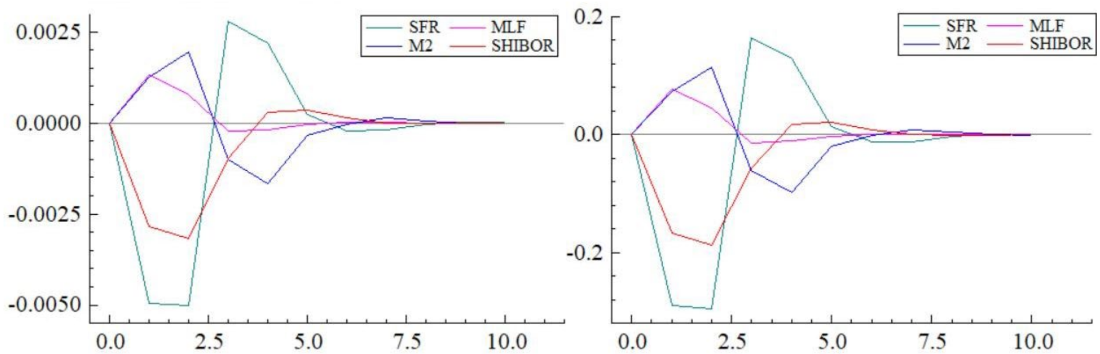
In a high-risk regime, the effects of various factors on Y are highly similar to those observed in a low-risk regime, but they are more pronounced. Although an MLF shock provides liquidity support, the market response is more volatile, resulting in increased fluctuations in Y. An M2 shock also causes greater volatility in Y, as market participants remain cautious and funds are not fully converted into effective production investments. Under a SHIBOR shock, the rise in financing costs and decreased market demand, compounded by market panic, leads to increased volatility in industrial production. An SFR shock exerts a more significant negative impact on Y, posing greater challenges to the stability of industrial production. Although there is a positive response in the later periods, its magnitude and persistence are weaker compared to the low-risk regime.



Response of Low-Risk Regime to Y. *Response of High-Risk Regime to Y.*

Figure 4. Response situation of Y under different regimes

5. Conclusion

Based on the empirical analysis presented above, it is evident that the impact of different risk environments on the Medium-term Lending Facility (MLF) tool's transmission channels—both quantity-based and price-based—varies significantly. The M2-oriented quantity-based transmission channel and the SHIBOR-oriented price-based transmission channel exhibit notable differences in their effects under varying risk conditions. In a low-risk environment, both transmission channels can handle risk shocks relatively smoothly and achieve policy objectives. However, in a high-risk environment, increased market sensitivity and uncertainty lead to a weakening of the transmission effects of the MLF tool under both channels.

Nevertheless, compared to the price-based transmission channel, the quantity-based channel is more effective at enhancing market confidence and increasing the money supply through increased MLF allocations, thereby alleviating market tensions. The impact of systemic financial risk on the transmission effects of the MLF tool also varies across different risk regimes. In a low-risk environment, the market operates robustly, and financial institutions have strong lending capacities to manage risk shocks and monetary policy changes effectively. Consequently, the credit effect of the MLF tool is relatively stable, the price effect effectively drives up prices, and the output effect remains stable with good recovery capacity.

In contrast, in a high-risk environment, heightened market sensitivity and uncertainty result in significant shocks to financial institutions' lending behavior, rendering the credit effect of the MLF tool more complex and volatile. The price effect becomes more erratic with extended convergence times, and the output effect experiences increased volatility and prolonged recovery periods.

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