

Monetary Policy Transmission: The Linkages between Repurchase Operations and Market Interest Rates

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Abstract—With the deepening of interest rate liberalization and financial reform in China, the Central Bank frequently uses repurchase and reverse repurchase to flexibly adjust market interest rates. Under the new monetary policy framework, investigating the linkages between central bank repurchase operations and major market interest rates provides effective reference for the selection of the future benchmark interest rate and improvement of monetary policies. Based on five-year data from 2013 to 2017, this study empirically analyzes the open market reverse Repo rate, short-term liquidity operation (SLO) interest rate, Shanghai Interbank Offered Rate (SHIBOR), and interbank pledged repo rate. Using the DCC-GARCH model, this study obtains the linkage effects between the central bank's reverse repurchase interest rate, SHIBOR, and interbank pledged repo rate. We find that the defects of the interest rate transmission mechanism and market expectations explain the reason why there are stronger linkage between central bank's repurchase operations and the SHIBOR.

Keywords—Monetary policy; Repurchase operation; Market interest rate; GARCH

I. INTRODUCTION

The central bank of China, on January 26 of 2019, injected 440 billion Chinese yuan into the market through reverse repurchase (repo) and various short- and medium-term operations, while avoiding the use of policies with obvious signaling effects. This operation sets a new high record for Central Bank's capital injection through open market reverse repo. In recent years, repurchase operations are becoming a main method for the Central Bank to adjust macroeconomic regulations, and it is also becoming a valuable tool for building the "interest rate corridor". On January 18 of 2013, the Central Bank launched the short-term liquidity operations (SLO). The combination of SLO and repurchase operations improved access to the open market. At the same time, it also strengthened the use of current short-term monetary policies to better reflect the actual market (Jiang and Zhao, [1]).

As China's interest rate marketization advances, the

effectiveness of monetary policies is significantly increasing, giving way to a sensitive and effective transmission mechanism (Jiang and Yu, [2]). By making public the changes to market operating interest rate, the Central Bank intend to promote a chain reaction between various interest rates (Peng and Shi, [3]). The addition of new monetary policies also modifies the impact of policy instruments on interest rates. Therefore, it is of great significance to examine the linkage between Central Bank's reverse repo operations and the interbank money market interest rate, to understand the transmission mechanism of monetary policies, and to select a benchmark interest rate for the currency market.

With gradual improvements of China's complex interest rate transmission system, the acceptance willingness of the money market towards policies is achieved on the basis of controllable impacts to the benchmark interest rate. The foreign interest rate marketization process is relatively advance, and the establishment of benchmark interest rate is been gradually improving. Duffie and Stein [4] indicate that in the UK, the one- or three-month London Interbank Offered Rate (LIBOR) is regarded as the core interest rate, which plays a leading role in modern financial markets. Whereas, the German Treasury yields are the best alternative to risk-free benchmark yields (Brooks and Skinner, [5]). However, China has yet to reach a consensus on a benchmark interest rate. At the present, the Shanghai Interbank Offered Rate (SHIBOR) has good benchmarking quality and outstanding stability (Wang, Yan, and Chen, [6]), it is therefore, becoming an operational target of Central Bank's monetary policies (Imam, [7]). Conversely, studies show that corporate bond interest rates and short-term pledged bond repo rates, with a certain level of risk, can effectively mitigate the volatility of financial markets when crisis breaks out, which would be more suitable as the benchmark interest rate (Wooldridge, [8]). Wang [9] states that the Chinese bond repo market is gradually expanding in recent years. The market performance of the 7-day bond repo market interest rate is better than the SHIBOR, and the pledged repo rate has become one of the candidates for the benchmark interest rate.

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In addition to considering the exact choice of benchmark interest rates, money market’s reaction to monetary policy operations, to an extent, determines the effectiveness of monetary policies. By analyzing interest rate transmission mechanisms, Amarasekara [10] indicate that the transmission from Central Bank’s repurchase rate to the short-term interest rate is quick and complete, but the transmission from short- to long-term interest rates is sluggish and incomplete. Forssbaeck and Oxelheim [11] believe that the 7-day bond repo rate reacts more quickly and achieve better transmission results to macro-policy changes. Porter and Xu [12] analyze the effects of conventional instruments, such as Central Bank issuance on short- and medium-term interest rates, proposing the deposits and loans benchmark interest rates as key factors guiding interest rate changes in the money market. Through empirical research, He and Wang [13] find when the deposit benchmark interest rate and deposit reserve ratio rise, the market interest rate also rises. Yuan, Wu, and Liu [14] believe the reverse repo rate makes timely and flexible adjustments to market liquidity through the pledged repo rate. At the present, most studies focus on analyzing the basic characteristics of benchmark interest rates and researching the interaction between different markets and different interest rates and their transmission efficiency. Little attention is placed on the innovative monetary policy tools recently introduced, there are few studies regarding the integration of these innovative tools on the overall interest rate system and policy transmission channels.

Therefore, based on the policy interest rate transmission efficiency perspective, this study analyzes the interest rate, interbank market pledged repo rate, and Shanghai interbank interest rate after Central Bank’s implementation the reverse repo rate and unconventional SLO, for the period between January 1, 2013 and December 31, 2017. Through the DCC-GARCH model, we analyze the linkages between the reverse repo operation, pledged repo rate, and SHIBOR for the period between 2013 and 2017. We focus on monetary policy and time-dependent economic behavior’s impact on interest rate transmission. In this way, we observe the effectiveness of interest rate transmission mechanism and explore the causes for linkage variation.

II. DATA AND METHOD

A. Data Description

The purpose of this study is to investigate the linkages between policy operations and market interest rates. Therefore, we study the 7-day interbank pledged repo rate, central bank’s open market reverse repo rate, SLO’s interest rate, and 7-day interbank offered rate for the period from January 2013 to December 2017. First, China’s interbank bond repo business is divided into three types: open, pledged, and outright. Among them, the pledged repo’s trading volume far exceeds the outright and open repos. The largest and most frequently operated variety is the 7-day pledged repo transaction, and it accurately reflects capital supply, demand, and cost status of the bond repo market. Second, the 7-day interbank offered rate is obtained as the weighted quote price average of 16 varieties, it reflects the credit situation of commercial banks and the supply and demand of money market funds. This metric is widely used and considered as representative. Third, the 7-day repo transactions during the period, except for a large number of positive repo transactions conducted in 2014, are all reverse repos, and the number of 7-day repurchase operations was far greater than 14- and 28-day operations. Therefore, the 7-day reverse repo rate is selected to represent open market operations, so as to ensure that sufficient sample data is obtainable for empirical analysis.

Moreover, the SLO is an important supplement to open market operations. For data consistency, the SLO interest rates less than 7 days, such as 2 and 3 days, are adjusted as 7-day interest rates. Due to intermittent distribution of central bank repurchase operations during the sample period, 7-day reverse repo rates are combined with SLO interest rates, which is then time matched with the 7-day interbank pledged repo rate and the interbank offered rate (7 days). A total of 505 sets of valid data are obtained. The sample variable obtained by the logarithm of each interest rate is their logarithmic rate of return. The variables are simply labeled as the Reverse (for central bank reverse repo rate), Pledged (for interbank pledged repo rate), and SHIBOR. The data is obtained from the official website of the People’s Bank of China and Wind consulting system. For descriptive statistical characteristics of each variable group, see Table 1.

TABLE I DESCRIPTIVE STATISTICS FOR THE INTEREST RATE RETURNS

Variable	Mean	Min	Max	Median	Std. Dev.	Kurtosis	Skewness
Reverse	-0.0581	-26.3585	27.2644	0.0000	2.6952	52.6251	-0.5420
Pledged	0.0044	-52.5239	42.9574	0.1622	8.3632	9.3203	-0.3451
SHIBOR	-0.0184	-57.4221	43.0412	0.0656	5.7712	43.1445	-1.2922

The descriptive statistics in Table 1 show that the average values of the above interest rates after logarithm are close, floating within a small range around 0, but the difference between the minimum and maximum values is large, with the maximum of pledged and SHIBOR about twice of reverse repos. In addition, the standard deviation of the pledged repo is the largest at 8.3632. The skewness of the three groups is not zero, kurtosis is much larger than 3, they do not follow a normal distribution, and exhibit obvious peaks and thick tails. The substantially similar basic characteristics between reverse

repo (including SLO), pledged repo, and SHIBOR may be due to their interrelationship.

B. Method

This study adopts the DCC-GARCH (Dynamic Conditional Correlation - Generalized Autoregressive Conditional Heteroskedasticity) model to study the linkage between the central bank’s reverse repurchase operations with the pledged repo rate and SHIBOR. The multivariate GARCH model can reflect the dynamic linkage between different markets (Tsai,

Wang, and Weng, [15], Wang, Tsai, and Lu, [16]; Wang, Tsai, and Li, [17]). Compared with the CCC-GARCH and BEKK-GARCH models, the DCC-GARCH model has simpler parameters and relatively distinct results. It can clearly reflect the dynamic correlation between variables and analyze their relationship. The specification of the DCC-GARCH model is as follows:

$$r_t = u_t + \varepsilon_t \quad (1)$$

$$\varepsilon_t | F_{t-1} \sim N(0, H_t) \quad (2)$$

$$H_t = \sqrt{h_{ii,t}} = D_t R_t D_t \quad (3)$$

$$D_t = \text{diag}\{\sqrt{h_{ii,t}}\} \quad (4)$$

$$Q_t = (1 - \sum_{m=1}^M \alpha_m - \sum_{n=1}^N \beta_n) \bar{Q} + \sum_{m=1}^M \alpha_m (\varepsilon_{t-m} \varepsilon_{t-m}) + \sum_{n=1}^N \beta_n Q_{t-n} \quad (5)$$

$$R_t = \text{diag}(Q_t)^{-1} Q_t \text{diag}(Q_t)^{-1} \quad (6)$$

F_{t-1} is all information sets of r_t at time t , ε_t is a random variable with a mean of 0, D_t is the conditional standard deviation obtained by univariate GARCH model; R_t is a dynamic conditional correlation coefficient matrix; DCC model parameters are α_m and β_n .

III. EMPIRICAL ANALYSIS

A. Analysis of individual policies of extreme points

As shown in Figure 1, the interbank pledged repo rate is similar to SHIBOR's overall trend. From June 4 to 8 of 2013, the interest rate sharply rose. On June 5, news announced China Everbright Bank and Industrial Bank's breach of contract, the repo rate and SHIBOR began to rise. In addition, the monetary authorities and financial institutions confronted

the "de-leveraging" policy, market investors and macro-control policies pushed the market interest rates ever higher. Subsequently, the Federal Reserve released signals of quantitative easing, then the stock market, following the international market, began to drop. Under multiple interweaving pressures, the pledged repo rate rose to 11.62%, and SHIBOR rose to 11.004%, both reaching their highest point. In fact, the "money shortage" outbreak was simply due to a mismatch between liquidity supply and demand in the financial market where the supply of funds did not keep up with excessively inflated capital demand. The Central Bank injected more than 760 billion yuan in liquidity to the market through expiration of Central Bank bills, repurchase operations, and standing lending facilities (SLF), which subsided the "money shortage" crisis. By December, the market's ability to withstand pressure has significantly increased. The Central Bank injected a total of over 300 billion yuan in the financial market via SLO, and restarted reverse repo operations on December 24, releasing liquidity and alleviated market fund pressures, causing interest rates to fall.

In 2014, under solid monetary policies, the market was generally stable. At the beginning of the year, the market interest rate had a higher extreme value, breaking above 6.0%. Subsequently, the SLF operations increased and the reverse repurchase efforts continued to inject funds into the market, which quickly eased liquidity tension at the beginning of the year. The effective downward movement of market interest rates and capital was caused by two targeted requirement reserve ratio (RRR) cuts and one interest rate cut in November of 2014. However, a surge of new-stock purchases occurred at the end of the year, considerable number of IPOs caused capital shocks, coupled with a bullish stock market and new bond repurchase rules triggered a market panic. Most institutions chose to sell bonds, which increased the year-end trend of tightening capital, interest rates began to rebound back to the levels before the rate cuts.

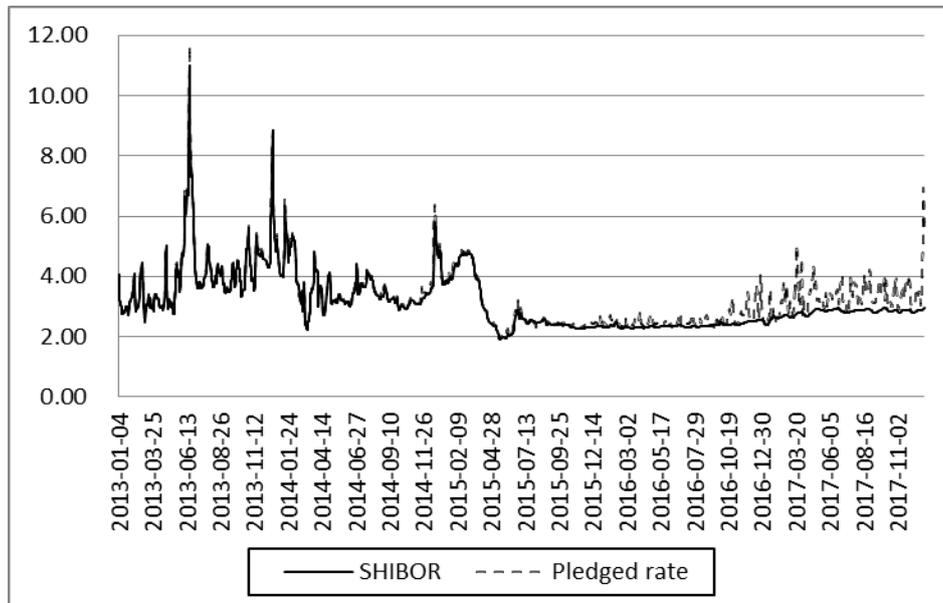


Fig. 1 Evolution of the SHIBOR and pledged Repo rate in 2013-2017

In 2015, the Central Bank drastically loosened its monetary policies and repeatedly lowered its interest rate, leading to abundant market liquidity. The repo rate and the offered rate both fell, and operations gradually stabilized. As the size of the repo transactions continues to grow, its market influence gradually increased, and the volatility of the pledged repo rate also increased. The extensive use of innovative tools since 2016 may be one of the factors that led to increase the market volatility. The financial side was disrupted in the short term due to reverse repurchase operations, open market operations represented by medium-term lending facility (MLF), and gradual frequent use of innovative tools. At the same time, the monetary policies tightened, the Central Bank vigorously promoted “de-leveraging”, and the Macro Prudential Assessment (MPA) in banks became stricter. The impact of

these multiple factors had a greater effect on the repo rates and contributed to its volatility.

B. Analysis of dynamic correlation between interest rates

This study employs the DCC-GARCH model, obtaining a dynamic correlation coefficient graph shown in Figure 2. The overall linkage of the open market operation to the pledged repo rate and SHIBOR has remained unchanged for several years. From 2013 to 2015, the linkage greatly fluctuated, and the linkage range of the pledged repo rate fluctuated even more severe. After August 2015, the size and fluctuation of the SHIBOR linkage between the Central Bank’s reverse repo and SLO interest rates is greater than the linkage to the repo interest rate.

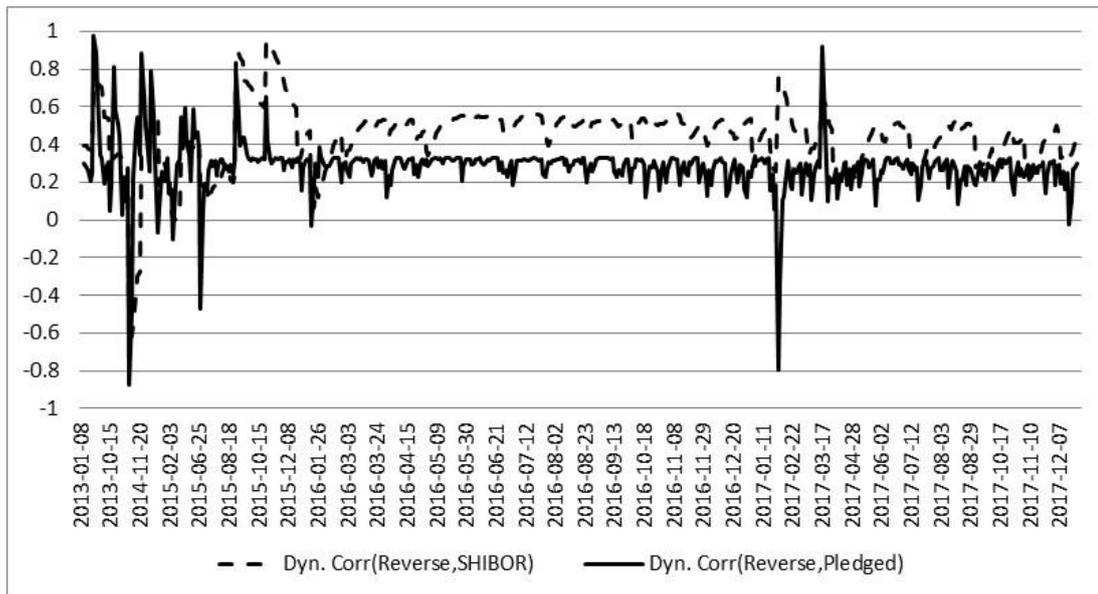


Fig. 2 Dynamic correlation between interest rates in 2013-2017

In 2013, the domestic and international economic environment was complicated. Due to frequent repurchase expiration, reverse repurchase operations, SLO, and other frequent operations required to cope with the second “money shortage”, the market suffered large fluctuations, greatly influencing the linkage of interest rates. Since the reverse repurchase interest rate directly and quickly passes through the open market, it has a greater impact on the linkage effect of the pledged repo rate. SHIBOR requires signal transmission and indirect interest rate transmission, so the linkage effect is small. However, since 2015, the linkage of reverse repo rate to SHIBOR has been higher than the linkage to repo rate, which is roughly maintained at around 0.5. The same is true for the volatility of linkage strength.

The following points can explain this phenomenon. First, from 2013 to 2017, SHIBOR has been operating for many years, and the overall stability is greatly improved compared to before. In recent years, the market has continuously to develop financial products based on SHIBOR. SHIBOR is gradually showing characteristics as a benchmark interest rate. Therefore, the market tends to default to SHIBOR as China’s benchmark

interest rate. Market expectations have affected the open market operation’s linkage to the SHIBOR. Second, after 2013, China has successively announced a series of non-conventional open market operations, such as short-term liquidity adjustments in the open market, SLF, etc., and its increasing frequency of use and quantity of delivery are still unclear. As a result, China’s complicated interest rate system is imperfect, which makes it difficult for investors to form a consensus on interest rate changes. Finally, this study only selects the reverse repo operation of three open market operation types to explore the interest rate transmission effect. The results only partially explain the true guiding relationship between the Central Bank’s monetary policy and the market interest rate. Repurchase operations are not the only factors that affect interest rate changes. In addition, the Central Bank does not only adopt a single monetary policy to develop the financial market, but rather employs a combination of policies to adjust the overall economic operation and development. Therefore, based on a combination of reverse repo and SLO interest rates, this paper shows that the correlation effect between the interbank offered rate and the interbank pledged repo rate is

moderate. Releasing liquidity through reverse repo has a greater impact on the SHIBOR.

IV. CONCLUSION

This study selects the 7-day reverse repo rate, short-term liquidity adjustment interest rate, the SHIBOR, and the interbank pledged repo rate, from 2013 to 2017, as research variables. Through unit root test, ARCH effect, DCC-GARCH model, and other measurement methods, we examine the linkage between reverse repo rate, SLO interest rate, and market interest rate. The results show that money market interest rates sensitively respond to Central Bank's open market operations, and SHIBOR changes are more effective. Analysis of the extreme points show that the pledged repo rate and SHIBOR's changes and fluctuation range fully reflect the impact of macroeconomic policies and major events in the financial market. In addition, defects of the interest rate transmission system, market expectations, and so on expresses the linkage relationship. This study only considers the correlation between reverse repo operations and interest rates, other policies that are not examined may be reasons of the limitations.

In recent years, the Central Bank has adopted various periods for repurchase operations to flexibly adjust the liquidity of the money market. An inevitable direction for China's future development is to realize the interest rate transmission mechanism with the open market interest rate as an operational target. Therefore, it is important to study the linkage between policy interest rates and market interest rates. The policy interest rate is transmitted to the benchmark interest rate as the first step of the interest rate transmission mechanism, its importance is self-evident. Therefore, relevant policy recommendations are proposed: First, China needs to focus on the effects of policy interest rate signal transmission, improve financial market's reaction effect of state control measures, and clarify the benchmark interest rate, which can be more effectively realized by increasing the diversity of monetary policy tools to effectively implement pre-adjustment and fine-tuning of the economy.

Furthermore, the Central Bank should establish the "interest rate corridor" for repo and reverse repo rates. When the pledged repo rate or SHIBOR rate exceeds the corridor's range, primary dealers can choose to borrow and lend to the Central Bank at the repo and reverse repo rates, and then arbitrage the profit in the interbank money market, which will ultimately contain fluctuate of the interest rate to be between the repo and reverse repo rates. Thereby, the Central Bank can intervene in the interest rate level through repo and reverse repo operations, effectively regulate the market interest rate

trend, and form a stable, open, and simple interest rate policy operation.

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