# Simulation Study on Stability of Shanghai Interbank Offered Rate -Toward Supporting Monetary Policy of Central Bank with Agent-Based Simulations-

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The Shanghai Interbank Offered Rate (SHIBOR) is a simple, no-guarantee, wholesale interest rate calculated by arithmetically averaging all the interbank RMB lending rates offered by the price quotation group of banks with a high credit rating. It not only reflects the liquidity of the money market but also serves as the operation target for the monetary policy of the central bank. China attaches particular importance to the possibilities of macro control. Thus, it is not difficult to imagine how significant the impact of the monetary policy of the central bank is on SHIBOR. Since it was introduced, SHIBOR has been facing the consequences of abnormally high volatility in overnight and one-week interest rates (Tan et al., 2012). To answer the question of how macro indicators are formed as a result of market activities is difficult, because it is impossible to analyze the behavior of banks within conventional financial theory and statistical methods. In addition, the evaluation of institutional design with sufficient explanatory power requires a proper modeling of the complex market system. To address this, agent-based simulation, which has been used in recent years, is considered to be a very effective method. In this study, we created a model of the interbank market in China and carried out agent-based simulation experiments. Based on

the results, we analyzed the impact of the monetary policy of the central bank on the volatility of SHIBOR, and discussed policy proposals to maintain the stability of the money market.

Large cash transactions among banks are generally handled by the Real Time Gross Settlement (RTGS) system. A simulation study on the RTGS system will be able to clarify problems concerning the liquidity of the interbank market (Soramaki & Galbiati, 2008) and support policies that assist regulatory authorities in avoiding the systemic risk of the money market (Arciero & Biancotti, 2009). Moreover, Mishkin (2004) has pointed out that there is a strong correlation between changes in interest rates and changes in liquidity in the money market. Thus, we used the interbank trading model, in which the characteristics of the money market of China are introduced into a general RTGS system, in order to analyze policy effects on the money market in China.

In this model, three types of bank agents are introduced: central bank, big banks, and small banks, forming a hierarchical structure according to the level of liquidity. As the provider of liquidity, the central bank agent seeks to stabilize interest rate fluctuations and reduce systemic risk by controlling money supply. In the model, there are 16 big bank agents acting as the conductors of monetary policy to efficiently allocate the liquidity provided by the central bank agent to the money market. In addition, in response to the monetary policy of the central bank agent, the big bank agents decide their own offered rates and subsequently declare them. In the model, private financial institutions (so-called “shadow banks”) in China were set up in the form of 50 small bank agents. As the final consumers of liquidity, these small bank agents accept the liquidity provided by the central bank agent through the big bank agents.

Using the liquidity-SHIBOR model based on the characteristics of the interbank market in China, we analyzed how timing and quantity of the reserve requirement and open market operation (i.e., the monetary policy of central bank) affect the stability of the SHIBOR. The two main results of the simulation experiment are as follows:

1. Impact of open market operation: In the simulation experiment that alters the amount of liquidity provided/retrieved with open market operations during one period, increasing the amount has some to extent an effect in reducing the average value of the moving SHIBOR volatility, thus further stabilizing the SHIBOR when it is stable. However, a further increase in this amount unsettles the balance between the demand for liquidity in the market and the money supply of the central bank agent. As a result, the system falls into instability and eventually deteriorates sharply. These are two different states with phase transition occurring in between.
2. Impact of reserve requirement: In the simulation experiment of the reserve

requirement, the higher the upper limit of the standard of the adjustment of deposit reserve ratio, the lower the frequency of the central bank's operation to decrease the deposit reserve ratio. In addition, by raising the upper limit of the deposit reserve ratio, it is seen to remain high most of the time. As a result, the average value of the moving volatility decreases, implying a stabilized SHIBOR. However, setting a high deposit reserve ratio results in a sharp rise of the SHIBOR, which suppresses the activity of the financial market and also leads to a setback for the development of the economy.

The following two points are drawn from the simulation results:

1. For the open market operation, an increase in the amount of liquidity operated at one point in time also increases the stability of the SHIBOR. However, it is necessary to evaluate the demand for liquidity in the whole market to allow the practice of open market operations.
2. Maintaining the reserve deposit ratio at a somewhat high level and avoiding frequent adjustments contributes to the stability of the SHIBOR.

For policy proposals, this study proposes the following two points:

1. Intermediate target of monetary policy should be changed.
2. Build the bankruptcy and deposit insurance systems.

From this study, we found that the effects on the stability of the SHIBOR differ depending on policy practices. Therefore, proposing a path for policy practice can be considered as one direction for future research.