An Empirical Study on the Effect of the Chinese Interest Rate Corridor on the Short-Term Interest Rate Fluctuation Based on EGAECH-M Model

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Abstract—After nearly seven years of exploration, the Chinese interest rate corridor has basically formed. However, it is not perfect at present, and the effectiveness of the Chinese interest rate corridor regulation still needs to be discussed. Therefore, this paper uses the high-frequency data of the overnight Shibor and the overnight Chibor from January 1, 2010 to April 30, 2021 as research samples, and constructs EGARCH-M model for research. Then, using the parameter estimation results of the model to calculate the eigenvalues of the sample interest rate volatility, so as to analyze the impact of the Chinese interest rate corridor on the short-term interest rate fluctuation and explore the effectiveness of the Chinese interest rate corridor regulation. The results show that the Chinese interest rate corridor can effectively alleviate the fluctuation of the short-term market interest rate, it can be seen that the Chinese interest rate corridor is more effective in regulating the short-term interest rate fluctuation.

Keywords: Interest rate corridor, Short-term interest rate, Interest rate fluctuation, EGARCH-M model

1 INTRODUCTION

Since 2013, the problem that the traditional monetary policy of China does not adapt to the stable development of the market economy has become prominent. In order to make up for the shortage of the traditional monetary policy on the market regulation, the Central Bank explored price-based monetary policy regulation models, and promoted the transformation of monetary policy. Since 2014, the Central Bank has begun to construct the interest rate corridor in monetary policy implementation. And it will be the main regulation mode of the short-term interest rate in the future.

Today, the interest rate corridor plays a key role in the reform of interest rate marketization in China, and it has become an important policy system arrangement for the transformation of the Chinese monetary policy from quantitative to price-based. However, it is still a short time for

ICIDC 2022, June 17-19, Qingdao, People's Republic of China

DOI 10.4108/eai.17-6-2022.2322625

China to take the interest rate corridor as the regulation mode of monetary policy, there are still many shortcomings in the interest rate corridor. Can the Chinese interest rate corridor slow down the short-term interest rate fluctuation effectively? This issue needs to be explored. Therefore, this paper explores the actual impact of the Chinese interest rate corridor on the short-term interest rate fluctuation in the money market, and tests whether the interest rate corridor has the expected effect of stabilizing the short-term interest rate fluctuation in the money market. It is of great significance to the effective application and better improvement of the Chinese interest rate corridor in the future.

2 LITERATURE REVIEW

The first systematic study of the principle of the interest rate corridor was Clinton (1997), he proposed the basic framework and operational processes of the interest rate corridor regulation model in the Bank of Canada Working Paper [1]. Since then, some scholars have analyzed the effectiveness of the interest rate corridor, Hande (2016) believed that the new monetary policy of the interest rate corridor is more effective in market regulation through the comparative study of various monetary policies [2]. After that, Ekinci (2018) conducted research against the background of the subprime mortgage crisis and found that over expansionary monetary policy is not conducive to the stability of the financial market, the interest rate corridor can stabilize the market interest rate effectively [3].

In China, some scholars used international experiences to provide suggestions for the construction of the Chinese interest rate corridor. Xie Jingmin(2016) introduced the mechanism and principle of the interest rate corridor, compared the framework of the interest rate corridor manipulation in various countries, so as to explore the path of constructing the interest rate corridor in China [4]. After that, Song Qinghua (2020) constructed a quantitative model for empirical research, the result showed that the interest rate corridor has the effect of reducing the fluctuation level of the interest rate in practical application [5]. Feifan and Fan Longzhen (2021) used DSGE model for research and explored the policy effect of the Chinese interest rate corridor through simulation analysis [6].

By combing the relevant literature, it is found that under the guidance of international experiences, the Chinese interest rate corridor has developed rapidly, and the relevant research is becoming more and more mature. However, the Chinese interest rate corridor is still in the stage of perfection. The actual effects of the Chinese interest rate corridor on the short-term interest rate fluctuation need to be studied

3 THE CURRENT SITUATION OF THE INTEREST RATE CORRIDOR IN CHINA

At present, domestic scholars generally believe that the upper and lower limits of the Chinese interest rate corridor are the SLF interest rate and the legal deposit reserve ratio respectively. Because there are many kinds of terms of the SLF interest rate, this paper will take the overnight SLF interest rate as an example for clarity.

In the practical application of the interest rate corridor, the central bank adjusts the upper and lower limits of the interest rate corridor appropriately by combining the market liquidity

situation and the demand of monetary policy in different periods. The table 1 shows that the overnight SLF interest rate has been adjusted 8 times since the beginning of 2014. Among them, the value was the highest from January 20, 2014 to March 4, 2015. From the first quarter of 2015, the central bank began to explore the upper limit function of the interest rate corridor of the SLF interest rate and lowered the overnight SLF interest rate twice, so the overnight SLF interest rate reached the lowest value on November 20, 2015. However, the legal deposit reserve ratio has been adjusted very infrequently and the ratio has been maintained at a low level. In addition, the width of the Chinese interest rate corridor has remained around 265BP in recent years. Compared with many developed countries that currently adopted the interest rate corridor, the Chinese interest rate corridor has a larger width.

TABLE 1. OPERATION OF THE INTEREST RATE CORRIDOR IN CHINA

Time	Interest Rate Corridor		
	Upper Limit	Lower limit	Width (BP)
	The Overnight SLF Rate (%)	The Legal deposit reserve ratio (%)	
2014.01.20—2015.03.04	5.00	0.72	428
2015.03.04—2015.11.20	4.50	0.72	378
2015.11.20—2017.02.03	2.75	0.72	203
2017.02.03—2017.03.16	3.10	0.72	238
2017.03.16—2017.12.14	3.30	0.72	258
2017.12.14—2018.03.22	3.35	0.72	263
2018.03.22—2019.12.31	3.40	0.72	268
2019.12.31—2020.04.07	3.35	0.72	263
2020.04.07—2020.04.10	3.35	0.35	300
2020.04.10 to now	3.05	0.35	270

Data source: Official website of PBOC

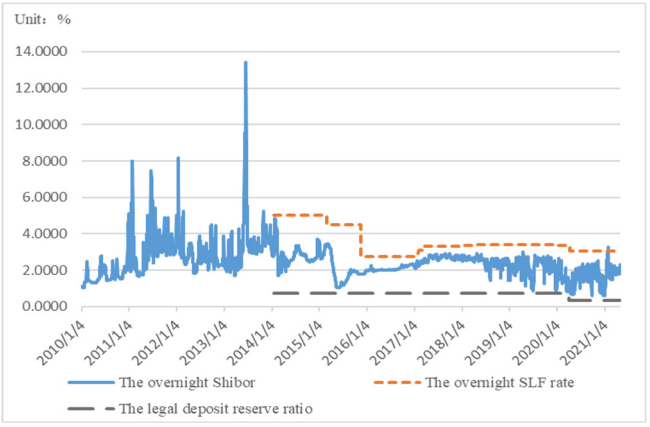

Figure 1. the Change trend of the overnight Shibor, thr overnight SLF and the legal deposit reserve ratio

Data source: Official website of PBOC and Wind

The figure 1 shows that China had not begun to explore the construction of the interest rate corridor model before 2014. During this period, the overnight Shibor fluctuated very violently. After 2014, China began to construct the interest rate corridor. During this period, the overnight Shibor fluctuation slowed down significantly, its fluctuation range narrowed and the amplitude decreased. It can be seen that the current interest rate corridor in China seems to slow down the market interest rate fluctuation and it has a certain positive effect on the regulation of the short-term interest rate. However, it is noteworthy that the overnight Shibor fluctuation has increased significantly since June 2018, and the rate has broken through the limit of the interest rate corridor from time to time.

4 EMPIRICAL STUDY

4.1 Variable selection and sample data description

4.1.1 Variable selection

At present, many scholars believe that the Shibor has the potential to become the benchmark interest rate in the market. Because the Chinese short-term market benchmark interest rate has not defined, drawing on the research of the benchmark interest rate selection by Fang Yi and Fang Ming (2012) [7], this paper chooses the overnight Shibor (Note: *SHR*01) and the overnight Chibor. (Note: *CHR*01) as explanatory variables for research.

4.1.2 Sample data description

In this paper, the high-frequency daily data of the overnight Shibor and the overnight Chibor are selected as sample data, the sample interval is from January 1,2010 to April 30,2021. According to the development course of the Chinese interest rate corridor, the overnight Shibor and the overnight Chibor of the sample range were divided into three periods for study. The first stage is from January 1,2010 to December 31,2013, the second stage is from January 1,2014 to

December 31,2018, and the third stage is from January 1,2019 to April 30,2021. The data comes from Wind and the official website of Shanghai interbank offered rate.

4.2 Model selection and construction

4.2.1 Model selection

Because the sample data selected by this study have obvious characteristics of volatility aggregation. Considering the asymmetry and volatility risk of the sample interest rate. This paper constructs EGARCH-M model for empirical research.

4.2.2 Model construction

Firstly, analyze the statistical eigenvalues of the variables in different stages. As shown in the table 2, the means of the overnight Shibor from the first to the third stages are 2.781, 2.392 and 1.890 respectively, it can be seen that the mean level of the overnight Shibor showed a decreasing trend and the decreasing range increased. In addition, the maximum of the overnight Shibor in the first stage is 13.44, and the range is 12.413. While the maximum of the overnight Shibor in the third stage is 3.28, the range is only 2.680. It indicates that the fluctuation area of the overnight Shibor has been tightened. At the same time, the standard deviation of the overnight Shibor in the first stage is the largest, and the standard deviation in the second stage is the smallest. While the standard deviation in the third stage is 0.565. Although this value is slightly higher than that in the second stage, it has little overall change. The change of standard deviation can indicate that the fluctuation level of the interest rates have decreased since the second stage.

TABLE 2. DESCRIPTIVE STATISTICS OF THE OVERNIGHT SHIBOR AND CHIBOR AT EACH STAGE

Variable	Stage	Mean	Maximum	Minimum	Std. Dev.	Observations
*SHR*01	I	2.781	13.444	1.027	1.243	999
	II	2.392	4.848	1.027	0.520	1248
	III	1.890	3.282	0.602	0.565	580
*CHR*01	I	2.798	13.828	1.031	1.257	999
	II	2.439	4.902	1.067	0.524	1249
	III	1.948	3.482	0.676	0.557	581

Comparing the statistical characteristics of the overnight Chibor at different stages, it is found that the changes of the relevant statistics are similar to that of the overnight Shibor. Based on the descriptive statistical analysis of the sample data and comparing the statistics of the overnight Shibor and Chibor at different stages, it is initially determined that the level of short-term interest rate fluctuation has decreased since the implementation of the interest rate corridor in China.

Secondly, in order to avoid the adverse effects of non-smooth time series on model construction, the stability tests of the overnight Shibor and Chibor at different stages are carried out. The table 3 shows that the ADF statistics of the two variables are less than the critical value of the 1% significance level at each stage, it shows that all the variables are stable in the different stages.

TABLE 3. ADF TEST OF THE OVERNIGHT SHIBOR AND CHIBOR AT EACH STAGE

Variable	Stage	ADF statistics	1% level	Prob.
*SHR*01	I	-7.087	-3.437	0.000
	II	-3.899	-3.435	0.002
	III	-4.792	-3.441	0.000
*CHR*01	I	-6.421	-3.437	0.000
	II	-3.691	-3.435	0.004
	III	-5.601	-3.441	0.000

The AC and PAC change graphs of the variables indicate that the variables are self-correlated. Compared with the information criteria such as AIC and SC of different models, this paper selects the AR (1) process for research.

In order to test the heteroscedasticity of the residual sequence of AR (1) model, ARCH tests are carried out. The results show that the probability values of the F statistic are 0. It means that the model has ARCH effect, so we should construct the GARCH model to eliminate it. At the same time, considering the asymmetry of variables and the volatility risk of interest rates, this paper constructs the AR (1)-EGARCH (1,1)-M model for analysis, and the expression of the model is as follows:

Mean equation (1):

$$SHR01_t(CHR01_t) = \alpha_0 + \alpha_1 AR(1) + \alpha_2 Ln(\delta_t^2) + \varepsilon_t \qquad (1)$$

Variance equation (2):

$$Ln(\delta_t^2) = \beta_0 + \beta_1 \left| \frac{\varepsilon_{t-1}}{\sqrt{\delta_{t-1}^2}} - \sqrt{\frac{2}{\pi}} \right| + \beta_2 \frac{\varepsilon_{t-1}}{\sqrt{\delta_{t-1}^2}} + \beta_3 Ln(\delta_{t-1}^2) \qquad (2)$$

TABLE 4. ESTIMATION RESULTS OF THE OVERNIGHT SHIBOR AND CHIBOR MODELS AT EACH STAGE

Equation	Variable	Parameter	*SHR*01			*CHR*01		
			I	II	III	I	II	III
Mean equation	C	α_0	4.879^{***} (0.128)	3.820^{***} (0.405)	1.713^{***} (0.191)	3.421^{***} (0.182)	3.776^{***} (0.624)	1.757^{***} (0.175)
	$AR(1)$	α_1	0.890^{***} (0.007)	0.989^{***} (0.003)	0.898^{***} (0.015)	0.894^{***} (0.009)	0.993^{***} (0.004)	0.886^{***} (0.016)

Variance equation	$Ln(\sigma_t^2)$	α_2	0.085*** (0.005)	0.003*** (0.001)	-0.014 (0.010)	0.052*** (0.007)	0.002* (0.001)	-0.017 (0.010)
	C	β_0	-0.061*** (0.015)	-0.349*** (0.011)	-0.729*** (0.135)	-0.881*** (0.047)	-0.228*** (0.008)	-0.693*** (0.130)
	$\left\lvert\frac{\varepsilon_{t-1}}{\sqrt{\delta_{t-1}^2}}-\sqrt{\frac{2}{\pi}}\right\rvert$	β_1	0.426*** (0.017)	0.326*** (0.010)	0.337*** (0.084)	0.556*** (0.020)	0.267*** (0.008)	0.348*** (0.078)
	$\frac{\varepsilon_{t-1}}{\sqrt{\delta_{t-1}^2}}$	β_2	0.551*** (0.015)	0.019*** (0.009)	-0.185*** (0.045)	0.326*** (0.016)	0.027*** (0.009)	-0.163*** (0.041)
	$Ln(\sigma_{t-1}^2)$	β_3	0.947*** (0.005)	0.969*** (0.001)	0.844*** (0.036)	0.783*** (0.017)	0.986*** (0.001)	0.858*** (0.035)
	Adjusted R^2		0.849	0.965	0.815	0.846	0.960	0.806

Note: (1) the values in brackets are the regression standard error of each coefficient. (2) *、**、*** are significant at the confidence level of 1%, 5% and 10%.

4.3 Empirical Analysis

The table 4 shows the model estimates of the overnight Shibor and Chibor at each stage, it can be seen that the adjusted R^2 of models are above 80%, indicating that the model has a higher applicability and strong explanatory ability.

As can be seen from the parameter estimations of the mean equation, the α_1 of the overnight Shibor and Chibor in the various stages are all positive, their values are above 0.88, and are all significant at the 1% level, the results show that the previous value of the overnight Shibor and Chibor has a significant positive effect on the current value. The α_2 are significantly positive except that at the third stage, it indicates that when the interest rate fluctuation intensifies, the level of the interest rate will rise.

In the variance equation, all parameter estimates passed the significance test at the level of 1%. Among them, the symbols of the β_3 are positive, and their estimated values are higher than 0.78. It shows that there is a positive correlation between the current interest rate fluctuation level and the previous interest rate fluctuation level of the two overnight interest rates, and the current interest rate fluctuation level is highly affected by the previous interest rate fluctuation. In addition, the estimated values of the β_1 are significantly positive. Meanwhile, the β_2 are significantly negative at the third stage and significantly positive at the other stages. It is shown that the two overnight rates are asymmetric, their volatility has differences in response to past positive disturbances and past negative disturbances at different stages.

Use the table 4 to get the volatility series of the overnight Shibor and Chibor at each stage. Then, calculate the statistical characteristic values of each volatility series, the results are shown in the table 5.

TABLE 5. STATISTICAL VALUES OF THE OVERNIGHT SHIBOR AND CHIBOR VOLATILITY AT EACH STAGE

Variable	Stage	Mean	Maximum	Minimum	Std. Dev.	Observations
*SHR*01	I	0.367	3.328	0.087	0.322	998
	II	0.081	0.770	0.014	0.069	1247
	III	0.243	0.446	0.125	0.066	579
*CHR*01	I	0.412	5.780	0.157	0.451	998
	II	0.092	0.593	0.015	0.072	1248
	III	0.247	0.449	0.124	0.067	580

As can be seen from The table 5, the means of the overnight Shibor volatility shows a downward trend and then an upward trend from the first to the third stage, it is similar to the change of the means of the overnight Chibor volatility. It shows that the mean of the short-term interest rate volatility level was high before the construction of the Chinese interest rate corridor. And then, it decreased greatly with the continuous progress of the construction of the interest rate corridor. It can be seen that the implementation of the interest rate corridor can reduce the short-term interest rate fluctuation. Although the means of the interest rate volatility at the third stage is lower than that at the first stage, there is still a higher level of volatility compared to the second stage. One reason may be Chinese economic downward pressure has significantly increased since 2019, in order to promote the development of the real economy, the central bank lowered the deposit reserve interest ratio three times in 2019, it could affect the public expectation of the market. The other reason may be that the outbreak and subsequent development of the novel coronavirus have greatly affected the development of the Chinese real economy and financial industry since 2020, it had a certain impact on the short-term interest rate fluctuation of the currency market.

In addition, the ranges of the overnight Shibor volatility from the first to the third stage are 3.241, 0.756 and 0.321 respectively, while the ranges of the overnight Chibor volatility are 5.623, 0.578 and 0.325 respectively. At the same time, the standard deviation of the interest rate volatility also shows a downward trend. It means that with the continuous exploration and improvement of the Chinese interest rate corridor, the variation range of the short-term market interest rate volatility is gradually tightened, and the dispersion of volatility becomes smaller. It can be seen that the application of the interest rate corridor can effectively tighten the fluctuation range of the short-term interest rate and stabilize the fluctuation of the market interest rate.

5 CONCLUSIONS

Based on the development process and the current situation of the Chinese interest rate corridor, combined with the function principle of the interest rate corridor, this paper explores the practical role of the Chinese interest rate corridor in the regulation of the short-term interest rate fluctuation. The results show that since the implementation of the Chinese interest rate corridor, the fluctuation level of the short-term interest rate has decreased significantly and the fluctuation range of the interest rate has been tightened, it can be seen that the Chinese interest rate corridor has a significant effect on the regulation of the short-term interest rate fluctuation. The Chinese

interest rate corridor not only can alleviate the short-term interest rate fluctuation, but also can reduce the volatility of the short-term interest rate effectively.

Acknowledgments: This paper is one of the phased achievements of Shaanxi Social Science Fund Project named Research on innovation of new urbanization financing model in the process of building a well-off society in Shaanxi (2016d023).

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