The Choice of China's Benchmark Interest Rate under the Condition of Interest Rate Marketization

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Abstract: China's interest rate marketization reform is in full swing, and the determination and cultivation of benchmark interest rate is the most important thing at this stage. Bond pledge repo rate, shibor and interbank offered rate are all candidates with high voices. This paper uses Granger causality test, EGARCH model and other methods empirically study the relevant data of 2015.10-2018.12 in five aspects: market representation, benchmarking, volatility, policy controllability and economic relevance, and concludes that the 7-day bond pledge repo rate is the best choice for China's benchmark interest rate at this stage. Then it gives policy suggestions on how to further develop the bond repo market and improve the benchmark for repo rate.

1. Current Status of Interest Rate Market Reform and Alternative Benchmark Interest Rates

China's interest rate market reform began with the liberalization of inter-bank lending rates in 1996. In order to avoid banks blindly raising deposit rates to compete for customers, leading to sharp rises in interest rates and curbing investment, China first liberalized the upper and lower limits of loan interest rates. With the continuous development of China's financial market, the management mechanism of financial institutions has become more and more perfect, and the central bank's ability to regulate and control the market has also continued to increase. China completely liberalized the range of deposit interest rate fluctuations in October 2015, the milestone event in the process marked the end of the era of interest rate control in China, and the reform of interest rate marketization has entered a new stage.

But as far as the current situation is concerned, there are still many problems in the process of my country's interest rate marketization, the most important of which is the lack of a recognized market benchmark interest rate. Despite the abolition of the upper and lower limits, the benchmark deposit and loan interest rates are still set by the central bank, and the dual-track interest rate system still exists. In the era of rapid growth of Internet financial products, bank deposit interest rates are still bound to a certain extent by official interest rates, and the yield rate is much lower than the money market. This has led to a large number of bank deposits being diverted and increased competitive pressure on banks. Therefore, it is extremely urgent to further improve the marketization of interest rates, and determining the market benchmark interest rate is the most important thing at this stage.

From an international point of view, the benchmark market interest rate is generally the overnight inter-bank lending rate or the bond market repo rate, mostly the actual transaction rate. As for China, the central bank's focus on cultivating the shibor, the long-established interbank lending rate, and the interbank bond pledge repurchase rate with a wide range of participants and huge trading volume are all potential "candidates". Regarding the choice of the benchmark interest rate in the Chinese market, domestic scholars hold different views.

Fang Xianming (2008) proceeded from the basic status and stability of the benchmark interest rate, and through Granger causality test and impulse response function, believed that shibor has basically met the conditions for becoming a benchmark interest rate, but its sensitivity still needs to be further improved. Wang Zhidong (2012) used the international mature benchmark interest rates

(FFR and LIBOR) as the reference standard, and verified the rationality of the 7-day interbank repo rate as the benchmark interest rate through the Granger causality test and the EGARCH model. Dai Guohai (2013) used the relevant data from 2006 to 2012 to verify the pricing basis, policy controllability and economic relevance of the alternative benchmark interest rate by using the Granger causality method, and tested its fluctuation rationality by using EGARCH model. He believed that shibor has basically possessed the core position of the short-end of the benchmark interest rate, but its long-term benchmark still needs to be further strengthened. Xiao Jie et al. (2015) believed that the central bank regarded the benchmark interest rate as the operational target of its monetary policy, and adjusted the interest rate through tight or loose monetary policy, thus affecting other market interest rates and asset prices, and ultimately realizing the central bank's policy will. Wan Guangcai (2017) analyzed the stability of shibor with different maturities through EGARCH model, and obtained that the shibor of 2 weeks is more effective as the benchmark interest rate.

In my opinion, shibor has attracted much attention since it was established in 2007. Early studies have suggested that shibor has a benchmark position in the short end (Dai Guohai 2013), but its conductivity in the medium and long end is not significant. But in recent years, the rapid development of the inter-bank certificate of deposit market makes shibor's medium and long-term interest rate objectively reflect the financing cost of the quotation bank, which greatly improves the benchmark of shibor; at the same time, the number of bonds and derivatives based on shibor is increasing, and its reference value for financial product pricing is increasing.The DR series of interest rates was launched on December 15, 2014, and appeared in the central bank's third quarter monetary policy implementation report in 2016, after which the central bank announced the corresponding FDR series data. And the introduction of FDR007-based interest rate swaps shows how much the central bank attaches importance to it. On the other hand, the bond repurchase market started early in China, with a large scale and a relatively mature market; bond repurchase interest rates are based on real transactions, which can effectively eliminate credit risk premiums and effectively avoid incidents of artificial interest rate manipulation. Finally, the inter-bank lending rate is the benchmark interest rate in many countries. It appeared earlier in China and has a larger transaction volume, so this article also includes it in the scope of comparison.

Based on the above analysis, this article will focus on the comparison of short, medium and long term shibor, interbank lending rates, and DR series interest rates, and discuss the five aspects of marketability, benchmarking, volatility, correlation and conductivity. Although previous scholars have done a lot of research, they generally use R series interest rates for bond repurchase rates. This article uses the DR series interest rates that the central bank attaches importance to for comparative analysis. At the same time, the rapid market development will change various indicators. Therefore, using the latest data to make the best choice of China's current benchmark interest rate is still instructive.

2. Empirical Test of the Choice of Benchmark Interest Rate

The benchmark interest rate occupies a basic position in the financial market, and other interest rates and financial products use it as the basis for pricing. It is generally believed that the benchmark interest rate should have the characteristics of market representation, benchmarking, volatility, policy controllability, and economic relevance. This article successively tests the above five characteristics of candidate benchmark interest rates with different maturities.

2.1 Market Representation

Market representativeness means that the benchmark interest rate is formed with the participation of a wide range of market entities, which can truly reflect the supply and demand of funds in the money market and the level of risk-free returns. This article measures the market representativeness of alternative interest rates from two aspects of market participants and transaction scale.

Table 1. Total Market Transactions of Candidate Benchmark Interest Rates (Unit: Trillion Yuan)

Year	Lending market	%	Pledge repo market	%
2010	27.9	15.5	84.6	47.0
2011	33.4	11.9	94.7	49.1
2012	46.7	17.7	136.6	51.8
2013	35.5	15.1	152.0	64.6
2014	37.7	12.5	212.4	70.2
2015	64.2	10.5	432.4	71.0
2016	95.9	13.8	568.3	81.5
2017	79	11.4	588.3	84.6
2018	139.3	16.2	708.7	82.21

Shibor is based on the quotation system and has no trading volume. Therefore, this paper compares the total transaction volume between the interbank lending market and the bond pledge repo market. It can be seen from the table that in recent years, the total transaction volume of the pledge repo market has always accounted for more than 50% of the total transaction volume of the market, and there is a continuous upward trend; on the contrary, the proportion of the total transaction volume in the interbank lending market is becoming smaller and smaller. Therefore, the mortgage repo rate is more representative of the market.

Consider market participants again. Shibor is based on a quotation system, which is essentially the arithmetic average of the RMB call rates quoted by 18 high-credit commercial banks, with limited participants. The DR interest rate is based on actual transactions. It is the weighted average interest rate of pledged repo transactions conducted by all deposit financial institutions on the day. The participants include large, medium and small banks as well as various deposit financial institutions, with a wide range of participants and strong representativeness.

On the other hand, the transaction volume of bond pledge repurchase and inter-bank lending for different days is also different. Among them, the market transaction volume of short-term interest rates is huge, indicating that there are more short-term market participants and the market is more active, so that short-term interest rates are more representative. At the same time, according to the expectation theory of term structure, the long-term nominal interest rate depends on the average public expectation of short-term interest rates, which means that controlling short-term interest rates can achieve the effect of regulating long-term interest rates. Therefore, we choose overnight shibor (shibor_1d), 7-day shibor (shibor_1w), 14-day shibor (shibor_2w); overnight bond pledge interest rate (DR_1d), 7-day bond pledge interest rate (DR_1w), 14-day bond pledge interest rate (DR_2w); overnight inter-bank lending rate (IB_1d), 7-day inter-bank lending rate (IB_1w), and 14-day inter-bank lending rate (IB_2w) as the research objects, and analyze the possibility of them becoming the benchmark interest rate respectively.

2.2 Benchmark

Benchmarking means that the benchmark interest rate is the basis of the entire market, and other interest rates are subject to changes in the benchmark interest rate. This article explores the relationship between the alternative interest rates from October 2015 to December 2018 through the Granger causality test.

The premise of Granger causality test is that the sequence is stable or the same order is single integer. Through the ADF test with intercept (see Table 2 for the results): shibor_1w and shibor_2w are stable after first-order difference, while other data are stable sequence. The results of the Granger causality test are shown in Table 3. From the regression results, it can be seen that for the overnight interest rate, the shibor and the repurchase interest rate are mutually causal and both are Granger reasons for the interbank lending rate; for the 7-day interest rate, three The inter-bank lending rate of 14 days and the shibor and repurchase rate of the same period are mutually causal, but the repurchase rate is the one-way Granger reason of shibor.

Table 2. ADF Test Result

rate	ADF test of original sequence		First order difference ADF test	
	t value	P	t value	P
Shibor_1d	-3.901***	0.0020		
Shibor_1w	-1.267	0.6443	-19.087***	0.0000
Shibor_2w	-1.130	0.7031	-20.751***	0.0000
DR_1d	-4.439***	0.0003		
DR_1w	-4.282***	0.0005		
DR_2w	-4.749***	0.0001		
IB_1d	-3.715***	0.0041		

Table 3. Granger Causality Test of Short-Term Benchmark Interest Rates

H$_0$	Lags	F	P
Shibor_1d is not the Granger cause of DR_1d	3	9.37994***	0.000
DR_1d is not the Granger cause of Shibor_1d	3	7.71978***	0.000
Shibor_1d is not the Granger cause of IB_1d	2	9.03518***	0.0001
IB_1d is not the Granger cause of Shibor_1d	2	0.96779	0.3804
DR_1d is not the Granger cause of IB_1d	2	16.3287***	0.0000
IB_1d is not the Granger cause of DR_1d	2	0.70413	0.4948
Shibor_1w is not the Granger cause of DR_1w	3	5.62863***	0.0008
DR_1w is not the Granger cause of Shibor_1w	3	3.68483**	0.0118
Shibor_1w is not the Granger cause of IB_1w	2	8.12362***	0.0003
IB_1w is not the Granger cause of Shibor_1w	2	13.5200***	0.0000
DR_1w is not the Granger cause of IB_1w	2	22.4839***	0.0000
IB_1w is not the Granger cause of DR_1w	2	16.3847***	0.0000
Shibor_2w is not the Granger cause of DR_2w	2	0.18587	0.8304
DR_2w is not the Granger cause of Shibor_2w	2	11.8578***	0.0000
Shibor_2w is not the Granger cause of IB_2w	3	5.83696***	0.0006
IB_2w is not the Granger cause of Shibor_2w	3	5.10688***	0.0017
DR_2w is not the Granger cause of IB_2w	2	51.3911***	0.0000
IB_2w is not the Granger cause of DR_2w	2	23.0865***	0.0000

2.3 Volatility

As the benchmark of the market, the benchmark interest rate must reflect the new information quickly, fully and rationally, which requires that the benchmark interest rate can respond in time and maintain reasonable volatility in the face of unpredictable shocks. At the same time, it should show an approximately equal rational response to good news and bad news. Only in this way, can the benchmark interest rate timely and reasonably reflect the tightness of market funds and the level of market risk-free interest rate.

This article uses the EGARCH model to test the volatility of the benchmark interest rate. The model is as follows:

$$\ln(\sigma_t{}^2) = \omega + \alpha \frac{|\epsilon_{t-1}|}{\sqrt{\sigma_{t-1}{}^2}} + \gamma \frac{\epsilon_{t-1}}{\sqrt{\sigma_{t-1}{}^2}} + \beta \ln(\sigma_{t-1}{}^2) \tag{1}$$

Among them, ω represents the mean of long-term fluctuation of interest rate; α represents symmetric coefficient; the coefficient γ belongs to asymmetric term, that is, leverage term. If $\gamma > 0$, it indicates that interest rate fluctuation is more easily affected by good news; conversely, bad news has greater impact on interest rate fluctuation, so coefficient γ is an important indicator to reflect rational fluctuation of benchmark interest rate; coefficient β reflects sensitivity of benchmark interest rate fluctuation, that is, current trading day pair The higher the response degree

of interest rate fluctuation on the previous trading day, the higher the sensitivity of the interest rate.

Egarch test results are shown in Table 4. By comparing the regression coefficients of candidate interest rates with different maturities and categories, it can be seen that among shibor, the 7-day shibor has better sensitivity and more rational fluctuations, but there is still a certain asymmetry: the response to good news is stronger than bad news. Among the repo interest rates, the fluctuation of the 7-day repo interest rate is relatively reasonable but the sensitivity is poor, and the two-week repo interest rate is highly sensitive but fluctuating widely. The two-week bank market lending rate is responsive and fluctuates reasonably. However, the average volatility of almost all alternative interest rates is greater than 1, indicating that interest rate volatility is relatively large, but ω represents the average long-term volatility of interest rates. The research time of this paper is relatively short, so it is difficult to explain its long-term stability, which is also the place that needs to be improved in future research.

Table 4. Egarch Test Results

rate	ω	Prob.	α	Prob.	γ	Prob.	β	Prob.
Shibor_1d	-2.452700^{***}	0.0000	1.619378^{***}	0.0000	-0.282853^{**}	0.0253	0.683061^{***}	0.0000
Shibor_1w	-1.764438^{***}	0.0000	0.688482^{***}	0.0000	0.096589^{***}	0.0000	0.829249^{***}	0.0000
Shibor_2w	-3.090377^{***}	0.0000	1.260166^{***}	0.0000	0.027872	0.2852	0.724054^{***}	0.0000
DR_1d	-2.532474^{***}	0.0000	1.605045^{***}	0.0000	-0.283158^{**}	0.0342	0.621297^{***}	0.0000
DR_1w	-2.333844^{***}	0.0000	0.963282^{***}	0.0000	0.161389^{***}	0.0035	0.592093^{***}	0.0000
DR_2w	-1.837292^{***}	0.0000	1.510208^{***}	0.0000	0.316005^{***}	0.0042	0.806017^{***}	0.0000
IB_1d	-2.456772^{***}	0.0000	1.565262^{***}	0.0000	-0.248357^{**}	0.0442	0.633562^{***}	0.0000
IB_1w	-1.217432^{***}	0.0000	0.607838^{***}	0.0000	0.364637^{***}	0.0000	0.808390^{***}	0.0000
IB_2w	1.677044^{**}	0.0129	0.577298^{***}	0.0000	0.157022^{***}	0.0070	0.792008^{***}	0.0000

2.4 Policy Controllability

The central bank sets a target benchmark interest rate to achieve specific policy goals, and guides the market benchmark interest rate to reach the target level through open market operations, adjustment of bank deposit reserve ratios, and rediscounting and other monetary policy tools to achieve the policy goals. This requires that the benchmark interest rate can reflect the central bank's monetary policy in a timely and accurate manner. According to the results of the volatility test, we conduct policy controllability tests on shibor_1w, DR_1w, DR_2w, and IB_2w.

According to the results (see Table 5): The central bank's policy tools are not the Granger cause of shibor_1w, which shows that the controllability of shibor_1w's policies is poor. The deposit reserve ratio is not the Granger reason for DR_1w, but at the significance level of 5% and 10%, the central bank reverse repo rate and the SLF operating interest rate are the one-way Granger reasons for the deposit reserve ratio respectively. This shows that the policy of DR_1w can be control. For DR_2w and IB_2w, the central bank's reverse repurchase interest rate is the Ganger reason, but both have nothing to do with the SLF operating interest rate and the deposit reserve ratio, and the policy controllability is poor. Combining the above results, it can be concluded that DR_1w has better policy controllability.

Table 5. The Causality Test between Alternative Benchmark Interest Rates And Central Bank Policy Tools

H_0	Lags	F	P
DRR is not the Granger cause of Shibor_1W	4	1.95676	0.1336
SLF is not the Granger cause of Shibor_1W	2	0.35372	0.7050
CRR is not the Granger cause of Shibor_1W	2	1.74969	1.1911
DRR is not the Granger cause of DR_1W	2	2.09372	0.1403
SLF is not the Granger cause of DR_1W	4	2.67948[*]	0.0549
CRR is not the Granger cause of DR_1W	4	3.39683[**]	0.0238
DRR is not the Granger cause of DR_2W	3	0.78628	0.5121
SLF is not the Granger cause of DR_2W	4	1.57082	0.2142
CRR is not the Granger cause of DR_2W	3	4.13741[**]	0.0155
DRR is not the Granger cause of IB_2W	2	0.30662	0.7381
SLF is not the Granger cause of IB_2W	2	0.74144	0.4847
CRR is not the Granger cause of IB_2W	3	5.13804[***]	0.0059

2.5 Economic Relevance

As mentioned above, the benchmark interest rate has policy controllability, and the central bank regulates the benchmark interest rate through open market operations.In view of its benchmark position, other interest rates in the market will adjust themselves according to the changes of the benchmark interest rates, thus affecting the supply and demand of the money market. At the same time, the change of interest rate will cause the change of investment scale, and then affect the equilibrium of product market and labor market. This means that the change of the benchmark interest rate affects the market through a series of transmission mechanisms, and the central bank only needs to control the benchmark interest rate to achieve the ultimate goal of stabilizing prices and full employment. However, the transmission mechanism may not be completely smooth, there may be some obstacles, which may lead to the lag or inefficiency of the policy.This article selects Industrial Value Added (IAV) and CPI to represent macroeconomic indicators, and examines their relationship with shibor_1w, DR_1w, DR_2w, and IB_2w respectively. The test results are shown in Table 6.

Based on the Granger causality test, the candidate benchmark interest rates have little relationship with CPI growth rate and industrial added value, which can not effectively guide the change trend. This may be related to the short research time, but to a certain extent, it also shows that the economic correlation of representative benchmark interest rates in China is not strong or the economic transmission mechanism is hindered.

Table 6. Granger Causality Test of Candidate Benchmark Interest Rates and Main Macro Indicators

H_0	Lags	F	P
shibor_1w is not the Granger cause of CPI	4	0.80720	0.5328
shibor_1w is not the Granger cause of IAV	2	0.94965	0.4009
DR_1w is not the Granger cause of CPI	3	0.85506	0.4758
DR_1w is not the Granger cause of IAV	4	0.90714	0.6248
DR_2w is not the Granger cause of CPI	2	0.19632	0.8228
DR_2w is not the Granger cause of IAV	5	1.55969	0.3771
IB_2w is not the Granger cause of CPI	2	0.19334	0.8252
IB_2w is not the Granger cause of IAV	2	1.31659	0.2860

3. Conclusions and Policy Recommendations

Based on the data of China's deposit and loan interest rates fully liberalized, this paper makes an empirical study on the relevant properties of China's candidate benchmark interest rates through

Granger causality test and EGARCH model. The results show that: the bond repo market has a large trading volume and strong market representativeness; the three candidate interest rates have strong correlation and obvious linkage effect in the short term. In terms of volatility, shibor_1w and DR_1w have relatively better volatility performance, but the latter has greater uncertainty. In terms of controllability, DR_1w responds more sensitively to the central bank's monetary policy tools, which helps to convey the central bank's wishes to the market and form reasonable expectations of the public, thereby guiding the economy to achieve the central bank's policy goals. In terms of economic relevance, the candidate benchmark interest rates are weak in predicting the macro market conditions and need to be further improved.

In summary, this article believes that DR_1w is currently the best choice for my country's benchmark interest rate. First, the inter-bank bond pledge interest rate is formed based on actual transactions, which is highly transparent and not easily manipulated by others. After the libor manipulation scandal broke out, information transparency is particularly important. Secondly, the bond repurchase market has a wide range of participants and a huge transaction volume, which can more truly reflect the supply and demand of loan funds. Finally, the DR interest rate is based on the transactions of high-credit treasury bonds, central bank bills, and policy bonds, which can effectively eliminate counterparty risks and is more representative of risk-free interest rates. However, the current bond repurchase market in China is still immature and needs further improvement.

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