

Asymmetric Adjustment of Interest Rate Pass-Through from Central Bank's Policy Rate to the Market Rate: Evidence from China

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Abstract

The paper investigates from the policy rate to the market rates under the Chinese interest rate marketization since 2014. The focus is on the pass-through (PT) of policy rates to the market target rates and therefore PT to interbank market rates. The results suggest that the long-run PT of the policy rates to the market target rates and the market target rates PT to the interbank market rates are all significant. The PT of the 7-day interest rate of the open market operations (Repo07) to market target rates which are 7-day depository-institutions pledged repo rate (DR007) and 7-day Shanghai interbank offered rate (Shibor07) are both complete for up to 28 days and 60 days, respectively. However, even though the PBC implements the interest corridor since 2014 and set the interest rate of standing lending facilities (SLF07) as the upper bound, the PT of SLF07 to the market target rates are not complete. Meanwhile, the PT of the market target rates DR007 and Shibor07 to the interbank market rates which are 7-day interbank pledged repo rate (R007) and 7-day interbank offered rate (Chibor07) are both complete. The results confirm that Repo07 as the PBC's policy rate takes an important leading role and DR007 as the PBC's market target rate takes an important intermediate role in the Chinese interest rate pass-through.

Keywords: interest rate pass through; interest rate marketization; policy rate; market target rate; interbank market rate

Introduction

Understanding the impact of monetary policy rate and the interest rate pass-through (IPT) mechanism on the economy is crucial to the study of macroeconomics and the practice of policy makers. The People's Bank of China (PBC) concerned about the PT of policy interest rate to the market interest rate, and implemented reforms to the interest rate framework to improve transmission. The interest rates gradually deregulated under the progress of Chinese financial liberalization. China has been continuously promoting the marketization of interest rates (Yi, 2018). The changes to the interest rate operating framework have been implemented with the aim of improving the IPT of policy rate to the market rate. The marketization of interest rates affects the

implemented interest rate control through financial capital allocation. In the early days, the PBC restraint policies and rapidly promote financial deepening. However, recently, the effect of interest rate controls has also declined. In order to achieve more effective financing and support the market-based transformation of monetary policy, the PBC gradually strengthens the interest rate transmission mechanism and establishes a market-based interest rate mechanism.

IPT is a mechanism for passing central bank policy aims to the real sector, at least allowing the central banks to lead the economy to the desired direction. The PT channel and its strength and speed determine the effectiveness of monetary policy. Table 1 summarizes the definitions of these interest rates.

Under the market-based framework, the interest rate corridor (IRC) is a common practice of central banks. The IRC system is a channel for monetary policy implementation and to set the target interest rate (Berentsen and Monnet, 2008). Practically, each central bank sets the IRC in

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different forms in lines with the country's policy objectives. The IRC in the Euro area is asymmetric currently, the policy rate is close to the lower bound of the IRC known as the floor type IRC. The United States IRC is also asymmetric. Canada adopts a typical symmetric IRC. The IRC generally guides the interbank market rates (Whitesell, 2006; Küçük et al., 2016). The standing lending facility (SLF) formally implemented by the PBC as the upper bound of the Chinese IRC since January 20, 2014 and the date is viewed as the start of implementing IRC in China. The PBC has operated the IRC symmetrically to guide the market rate since 2014. As the PBC's governor Yi's speech (2018) mentioned that the PBC uses the IRC to control the interest rates. The key features of IRC are the standing lending facility (SLF) as the ceiling/ upper bound of IRC that lends to and accepts deposits from commercial banks and also resembles the discount window. The deposit facility allows banks to earn overnight interest on excess reserves (ER) which is viewed as the floor/ lower bound of the IRC. While the market interest rate rises close to the upper bound of the IRC, the PBC will use the open market operations (OMO) such as repurchase agreements (Repo) or reverse Repo to keep the stability of the money market and reduce the panic.

This study specifically analyzes the current Chinese interest rate system to discuss its PT and marketization. Changes in policy rates affect market target rates and interbank market rates. A quicker and fuller PT strengthens monetary policy transmission and the price stability (de Bondt, 2005). This study contributes to the literature to assess the degree of PT and adjustment speed of market interest rates when official policy interest rates change in China. The following issues are analyzed. First, the long-term PT of official policy interest rates to market interest rates are considered. Second, the short-term PT and adjustment speed using an error correction model (ECM) are examined. Thirdly, the symmetry or asymmetry of adjustment and the adjustment speed of interest rates are tested.

Chinese interest rate marketization and the evolution of IPT

Marketization of Chinese interest started since October 1998. Feyzioglu et.al (2009) discuss the Chinese interest rate liberalization from 1998 to 2004. Liao and Tapsoba (2014) summarize the Chinese interest rate liberalization from 1998 to 2012. In recent years, the PBC implemented a series of new instruments and IRC to enhance the interest rate marketization since 2014, however, few

academic researches examine the current Chinese interest rate marketization. Therefore, our study emphasizes to examine the Chinese IPT from 2014 to 2018.

The bank's loan channels and its role in transmitting shocks to the credit market through supply side are worth noticed and IPT has drawn a large interest in the academic field. Jin et al. (2014) examine the degree and speed of PT and rigidity of interest rates in China. Apergis and Cooray (2015) investigate the policy rates of the central bank and market interest rates and find that the asymmetric IPT in developed countries.

The change of policy interest rate is transmitted to interbank rate, namely short-term money market interest rate. It is worth noting that the PT from policy to interbank interest rate observed in the literature is usually complete and instantaneous, because the interbank rate usually happens to be the target interest rate of monetary policy (Borio and Fritz, 1995). This study focuses on the effectiveness of the IPT mechanism with respect to the speed of response.

Data and Methodology

3.1 Data

This paper utilizes the Chinese monetary policy rates and interbank interest rates separately from the PBC and CEFTS. We collect the daily data from December 15, 2014 to December 28, 2018. We use the Repo07 and SLF07 as the policy rate. Repo07 is the repurchase transactions of the PBC's OMO viewed as the PBC's policy leading rate for decades. Meanwhile, under the IRC framework, the PBC uses the SLF07 as the upper bound of the IRC and set the ceiling for the lending market. We employ both as the main leading policy rate to verify the impact of implementing of the IRC. Shibor07 and DR007 are the main lending market interest rates. Shibor has been viewed as the leading money market interest rate indicator for the international investor. Meanwhile, the PBC uses DR007 as the market rate to guide the interest rate market. Therefore, we adapt Shibor07 and DR007 as the market interest rates.

Error Correction Model (ECM)

We apply the cointegration and error correction technique proposed by Johansen (1995). This cointegration methodology tests the long-run relationship between policy rate and market rates, and the ECM examines the short-run dynamics by which the interest rates converge on long-run equilibrium. The PT from the policy rate to the market target rate can be shown as follows (3a) and

(4a). The PT form the market target rate to the

$$\Delta TargetRate_t = c_{0,p} + \gamma_p \cdot \Delta PolicyRate_t + u_{t,p} \quad (3a)$$

$$\Delta InterbankRate_t = c_{0,T} + \gamma_T \cdot \Delta TargetRate_t + u_{t,T} \quad (3b)$$

$$\Delta ECM_{p,t-1} = \Delta TargetRate_{t-1} - c_{0,p} - \gamma_p \cdot \Delta PolicyRate_{t-1} \quad (4a)$$

$$ECM_{T,t-1} = \Delta InterbankRate_{t-1} - c_{0,T} - \gamma_T \cdot \Delta TargetRate_{t-1} \quad (4b)$$

where Repo07 and SLF07 employed as the PolicyRate, DR007 and Shibor07 employed as the TargetRate, R007 and Chibor07 employed as the InterbankRate. c_0 is to measure the mark-up or mark-down on the market interest rates. γ examines the long-run PT. $\gamma < 1$ implies an incomplete PT, $\gamma = 1$ implies a complete PT (de

$$\Delta TargetRate_t = c_{1,p} + \alpha_p \cdot \Delta PolicyRate_t + \beta_p \cdot ECM_{t-1} + \varepsilon_{t,p} \quad (5a)$$

$$\Delta InterbankRate_t = c_{1,T} + \alpha_T \cdot \Delta TargetRate_{T,t} + \beta_T \cdot ECM_{T,t-1} + \varepsilon_t \quad (5b)$$

$$\text{mean adjustment lag (MAL)} = \frac{1-\alpha}{\beta}$$

where α reflects the immediate or short-run PT. MAL shows the adjustment time of the PT of the official policy to the market interest rate (Scholnick, 1996). The higher the MAL, the slower the

$$ECM^+ = ECM \text{ if } ECM > \mu, \text{ otherwise } ECM^+ = 0$$

$$ECM^- = ECM \text{ if } ECM < \mu, \text{ otherwise } ECM^- = 0$$

where μ is the mean of ECM. The asymmetric specifications ECM+ and ECM- in (7) and (8) are the

$$\Delta TargetRate_t = c_{2,p} + \alpha_{1,p} \cdot \Delta PolicyRate_t + \beta_{1,p} \cdot ECM_{t-1}^+ + \beta_{2,p} \cdot ECM_{t-1}^- + \varepsilon_{p,t} \quad (9a)$$

$$\Delta InterbankRate_t = c_{2,T} + \alpha_{1,T} \cdot \Delta TargetRate_{T,t} + \beta_{1,T} \cdot ECM_{t-1}^+ + \beta_{2,T} \cdot ECM_{t-1}^- + \varepsilon_{T,t} \quad (9b)$$

$$MAL^+ = \frac{1-\alpha_1}{\beta_1}; \quad MAL^- = \frac{1-\alpha_1}{\beta_2} \quad (10)$$

A Wald test with $\chi^2(1)$ distribution on the restriction that $MAL^+ = MAL^-$ in equation (10) is to test for symmetry. Otherwise, the adjustment of IPT is asymmetry (Scholnick, 1996).

Empirical Results

4.1 Summary statistics

Summary statistics of the Chinese monetary policy rates and interbank interest rates are shown in Table 2. Repo07 is the interest rate of 7-day repurchase transactions. SLF07 is the interest rate of 7-day standing lending facilities as the upper bound of IRC. ER is the interest rate on excess reserves as the lower bound of IRC. Ljung-Box Q-statistics show the presence of significant autocorrelation for all series at 1% significance

interbank market rate can be shown as (3b) and (4b).

Bondt, 2005; Jin et al., 2014). We use a Wald test $\chi^2(1)$ on the restriction that $\gamma = 1$ is used to test whether the long-run PT is complete.

The short-run impact can be shown as equation (5a) and (5b) which computed from the above running equations and the symmetric adjustment as equation (6)

adjustment in the response of market interest rates to the policy rate changes.

We also examine asymmetric adjustment processes used by Neumark and Sharpe (1992).

dummy variables to split ECM into two series. The asymmetric adjustment can be running as equation (9a) and (9b) and computed as equation (10).

level. The LM tests for all series show the series are serially correlated and possibly exhibit heteroscedasticity, which gives justification to fit the models later on in this study. Figure 1 shows the time patterns of the Chinese interest rates. According to Figure 1, Shibor07 and DR007 all lie in the channel width of the IRC.

4.2 Contemporaneous correlation and panel long-run variances

Contemporaneous correlation analysis between the policy rates and market rates provide a first take on the strength and speed of IPT. As expected in Table 3, all of the pairwise correlations are significantly positive. We also compute the panel long-run variance-covariance matrix (Andrews

1991) in Table 4.

4.3 Cointegration test and ECM results

Pairwise results of Johansen (1995) multivariate cointegration procedure are reported in Table 5. The results indicate there are at least one cointegrating equation for each pair of interest rates at the 0.05 level.

4.3.1 Policy rate PT to the market target rates

Panel A of Table 6 shows the long-run PT results. The coefficients γ are all significantly positive. Wald test $\chi^2(1)$ for the hypothesis that $\gamma=1$ cannot be rejected means the existence of complete PT. It is found that the PT of Repo07 to DR007 and the PT of Repo07 to Shibor07 are complete. However, the PT of SLF07 to the market target rates are incomplete. The coefficients c_0 are all positive show that the markup on the market target rates. Panel B of Table 6 shows the symmetric short-run PT. The ECM coefficients β are all significant. While the Repo07 changes, DR007 shows a smaller symmetric MAL of 28.392 days indicating a quicker adjustment than Shibor07 which is with a symmetric MAL of 60.691 days.

The asymmetric short-run PTs are also examined in Panel C of Table 6. The ECM+ coefficients β_1 are all significantly positive, meanwhile, the ECM- coefficients β_2 are all insignificantly positive. Therefore, the Wald test $\chi^2(1)$ for the hypothesis $MAL+ = MAL-$ cannot be rejected means there is no significant asymmetric adjustment in the short-run.

4.3.2 The market target rate PT to the interbank market rate

Panel A of Table 7 shows the results obtained for the long-run PT. The coefficients γ are all significantly positive. The PTs of the market target rates to the interbank market rates are all complete. The coefficients c_0 are all positive show that the markup on the market target rates.

The symmetric short-run PT is shown in Panel B of Table 7. The coefficients β are all significant. The PT of DR007 to R007 is about 2.403 days and PT of Shibor07 to R007 is about 1.387 days. The PTs of DR007/Shibor07 to Chibor07 are both symmetric within 1 day. In Panel C of Table 7, the asymmetric short-run PT from DR007 to R007 is found with a symmetric MAL+ of 1.727 days and MAL- of 3.655 days.

Conclusions

Understanding the impact of IPT is one of the major key issue for the policy makers and market participants. This study investigates the IPT

between the policy rate and market rates in China under the Chinese interest rate liberalization. This study empirically analyses the IPT process in China. The PT of changes in the PBC's official policy interest rates to market interest rates. First, in the long-run, the IPT of changes in Repo07 of PBC's OMO through repurchase transactions completely to the market interest rates Shibor07 and DR007. The market participants shall follow the PBC's OMO closely. The IPT of SLF07, the upper bound of the PBC's IRC to the market interest rates are incomplete. Second, in the short run, the symmetric adjustments of IPT are found. DR007 can response to the changes in Repo07 with the shorter adjustment period. The interbank market rates are highly led by Shibor07 and adjust quickly within one day.

Our results suggest that the Repo007 plays an important role as the main policy rate in the current Chinese interest rate market under the Chinese marketization. Repo007 can completely pass through to the market interest rate. Meanwhile, though SLF07 incompletely pass through to the market interest rate, it is still worth noticed since SLF07 represents the upper bound of the PBC's IRC reflects the upper limits of the cost of borrowing. In the short-run, the quick adjustment of DR007 to the changes in policy rates reveals that DR007 has been viewed as the leading market target rate.

Meanwhile, the changes in market target rates DR007 and Shibor07 both completely passed through the interbank market rates R007 and Chibor07. The adjustment speed is fast from the market target rates to the interbank market rates. The asymmetric adjustment is found from DR007 to R007.

The results provide insights for the policy makers and investors. In addition, the results of this study will help to further understand the current situation of China's interest rate policy and interest rate market.

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Tables and Figures

Table 1 Chinese policy rates, market target rates and interbank market rates

Category A: Policy rates		
Monetary instruments	Description	
Repurchase transactions (Repo)	Repo/Reverse Repo is the main tool of the PBC's OMO. The PBC conducts flexible OMO, mainly with repos guiding market expectations with relatively stable OMO rates, to facilitate smooth operations in liquidity and market rates. The PBC oversees the operation of 7-day repo daily.	
Standing lending facility (SLF)	The PBC implements SLF to meet the liquidity demand of locally incorporated financial institutions. 7-day SLF interest rate (SLF07) is viewed as the upper bound of Chinese IRC.	
Category B: Market target rates		
	Description	
Depository-institutions pledged repo rates (DR)	DR is the interest rate on repos with rate securities as pledges for deposit-taking institutions in the interbank market. According to the PBC, 7-day DR (DR007) plays a positive role in fostering market benchmark interest rates.	
Shanghai interbank offered rate (Shibor)	Shibor are quoted by 18 commercial banks which are primary dealers of OMO in the Chinese foreign exchange market.	
Category C: Interbank market rates		
	Description	
Interbank pledged repo rate(R)	R is the interest rate on repos with rate securities as pledges for both deposit-taking and non-deposit-taking institutions in the inter-bank market.	
Interbank lending rate (Chibor)	The transactions of Chibor counts that are made through the trading system of CFETS.	

Notes: Data collected from the PBC and the CFETS.

Table 2 Summary statistics of Chinese interest rates from December 15, 2014 to December 28, 2018.

Interest rate(%)	Repo07	SLF07	DR007	Shibor07	R007	Chibor07
Mean	2.563	3.960	2.716	2.721	2.987	3.075
Maximum	4.100	7.000	6.168	5.782	6.937	6.261
Minimum	2.250	3.250	1.882	1.920	1.939	2.095
Std. Dev.	0.452	1.078	0.552	0.536	0.698	0.632
Skewness	2.156	1.572	2.523	2.543	1.546	1.377
Q (12)	11040	11119	9265.3	9858	5723.2	8356.3
LM (12)	42.797	0.0321	117.55	408.63	74.802	147.79
Unit-Root Test						
ADF	-3.915	-2.871	-2.980	-3.519	-5.301	-4.206

Notes: Q (12) and LM (12) represents Ljung–Box statistics and Lagrange Multiplier test at 12 lags, the numbers in parentheses denote the p-value. ADF test critical value of 5 % significance level is 2.864.

Table 3 Correlations of Chinese interest rates from December 15, 2014 to December 28, 2018.

	Repo07	SLF07	DR007	Shibor07	R007
SLF07	0.800 (42.353)				
DR007	0.732 (34.087)	0.512 (18.928)			
Shibor07	0.747 (35.636)	0.526 (19.657)	0.987 (196.553)		
R007	0.501 (18.379)	0.261 (8.571)	0.851 (51.349)	0.813 (44.382)	
Chibor07	0.642 (26.607)	0.356 (12.111)	0.917 (72.761)	0.908 (68.695)	0.894 (63.407)

Notes: The brackets report t-statistics.

Table 4. Panel Long-Run Covariance-Variance Matrix and Correlation from December 15, 2014 to December 28, 2018.

Panel A: Covariance-Variance Matrix						
	Repo07	SLF07	DR007	Shibor07	R007	Chibor07
REPO07	1.403					
SLF07	2.686	7.989				
DR007	1.259	2.099	2.026			
Shibor07	1.250	2.099	1.976	1.946		
R007	1.090	1.349	2.143	2.052	2.841	
Chibor07	1.264	1.668	2.140	2.089	2.507	2.559
Panel B: Panel Long-Run Correlation						
	Repo07	SLF07	DR007	Shibor07	R007	
SLF07	0.802					
DR007	0.747	0.522				
Shibor07	0.756	0.532	0.995			
R007	0.546	0.283	0.893	0.872		
Chibor07	0.667	0.369	0.868	0.936	0.930	

Table 5 Pairwise Johansen Cointegration Tests

Panel A: Policy rates to Market Target Rates				
Trace Test				
Null hypothesis	DR007, Repo07	Shibor07, Repo07	DR007, SLF07	Shibor07, SLF07
r=0	44.864	35.120	25.256	18.584
r≤1	16.847	12.638	7.831	7.861
Maximum Eigenvalue Test				
Null hypothesis	DR007, Repo07	Shibor07, Repo07	DR007, SLF07	Shibor07, SLF07
r=0	28.017	22.482	17.425	15.481
r≤1	16.847	12.638	7.831	7.861
Panel B: Market Target Rates to Interbank Market Rates				
Trace Test				
Null hypothesis	R007, DR007	Chibor07, DR007	R007, Shibor07	Chibor07, Shibor07
r=0	103.335	61.165	101.249	58.225
r≤1	13.440	14.425	8.270	8.880
Maximum Eigenvalue Test				
Null hypothesis	R007, DR007	Chibor07, DR007	R007, Shibor07	Chibor07, Shibor07
r=0	89.896	46.741	92.979	49.446
r≤1	13.440	14.425	8.270	8.880

Note: r denotes the number of cointegrating vectors. 5 % critical values for Trace Test r=0 and r≤1 hypothesis is 15.495 and 3.841, respectively. 5 % critical values for Maximum Eigenvalue Test r=0 and r≤1 hypothesis is 14.265 and 3.841, respectively.

Table 6 Policy rate pass-through to the market target rates based on ECM

	Repo07		SLF07	
	DR007	Shibor07	DR007	Shibor07
Panel A: Long- run IPT				
γ	0.911 (0.066)	0.902 (0.064)	0.261 (0.036)	0.261 (0.035)
c_0	0.386 (0.173)	0.412 (0.166)	1.678 (0.146)	1.684 (0.142)
$\gamma=1$	1.809	2.348	456.081	430.755
Pass-through	Complete	Complete	Incomplete	Incomplete
Panel B: Short-run IPT: Symmetric adjustment				
β	-0.034 (0.008)	-0.016 (0.006)	-0.022 (0.006)	-0.011 (0.004)
α	0.047 (0.122)	0.050 (0.080)	0.016 (0.036)	0.005 (0.023)
c_1	0.000 (0.003)	-0.001 (0.002)	0.000 (0.003)	-0.001 (0.002)
MAL	-28.325	-60.427	-45.246	-92.857
Panel C: Short-run pass through: Asymmetric adjustment				
β_1	-0.088 (0.015)	-0.045 (0.011)	-0.049 (0.011)	-0.028 (0.007)
β_2	0.003 (0.012)	0.002 (0.008)	0.010 (0.012)	0.009 (0.008)
α_1	0.027 (0.122)	0.038 (0.079)	0.006 (0.036)	-0.001 (0.023)
c_2	0.010 (0.004)	0.004 (0.003)	0.010 (0.004)	0.005 (0.003)
MAL^+	-11.094	-21.520	-20.420	-35.729
MAL^-	332.136	565.707	94.941	108.186
$MAL^+ = MAL^-$	0.081	0.000	0.035	0.000
Adjustment Effect	Symmetric	Symmetric	Symmetric	Symmetric

Notes: The brackets report standard errors in parentheses. Wald test of the restriction 5% critical value for $\chi^2(1)$ distribution = 3.841.

Table 7 Market target rates pass-through to interbank market rates based on ECM

	DR007		Shibor07	
	R007	Chibor07	R007	Chibor07
Panel A: Long- run IPT				
γ	1.053 (0.043)	1.058 (0.031)	1.052 (0.048)	1.075 (0.033)
c_0	0.127 (0.119)	0.200 (0.087)	0.127 (0.132)	0.151 (0.091)
$\gamma = 1$	1.522	3.493	1.183	3.548
Pass-through	Complete	Complete	Complete	Complete
Panel B: Short-run pass through: Symmetric adjustment				
β	-0.183 (0.018)	-0.292 (0.023)	-0.190 (0.019)	-0.284 (0.023)
α	1.440 (0.067)	0.799 (0.059)	1.263 (0.121)	1.010 (0.096)
c_1	0.001 (0.007)	0.000 (0.006)	0.002 (0.008)	0.000 (0.006)
MAL	2.403	-0.687	1.387	0.036
Panel C: Short-run IPT: Asymmetric adjustment				
β_1	-0.247 (0.023)	-0.401 (0.034)	0.021 (0.070)	-0.396 (0.034)
β_2	0.117 (0.070)	-0.059 (0.060)	-0.239 (0.025)	-0.039 (0.060)
α_1	1.427 (0.067)	0.779 (0.058)	1.184 (0.123)	0.990 (0.095)
c_2	0.043 (0.011)	0.033 (0.010)	0.036 (0.013)	-0.396 (0.034)
MAL^+	1.727	-0.552	-8.921	-0.026
MAL^-	-3.655	-3.723	0.768	-0.263
$MAL^+ = MAL^-$	73.437	0.635	0.657	0.011
Adjustment Effect	Asymmetric	Symmetric	Symmetric	Symmetric

Notes: The brackets report standard errors in parentheses. Wald test of the restriction 5% critical value for $\chi^2(1)$ distribution = 3.84.

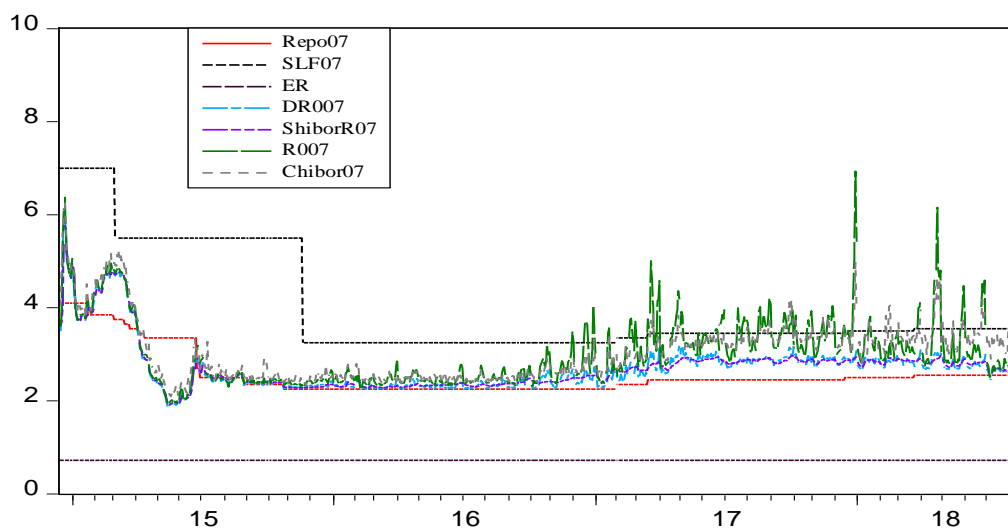


Figure 1 Chinese Policy and Market Interest Rates from December 15, 2014 to December 28, 2018. Repo07 is the interest rate of 7-day repurchase transactions of the PBC's OMO. SLF07 is the interest rate of 7-day standing lending facilities as the upper bound of IRC. ER is the interest rate on excess reserves as the lower bound of IRC.