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Monetary policy rule under financial deregulation in China

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Abstract

This paper examines the monetary policy rule in practice for China during the period from 1998Q1 to 2014Q2 by applying the Taylor rule and by estimating policy reaction functions. The analysis would be significant since during that period the monetary-policy instruments and targets have been more market-oriented in accordance with the progress in financial deregulation. The findings can be summarized as follows. First, the recent policy rule since 2003 has become synchronizing with the Taylor rule. Second, the response of policy-target interest rate to inflation, though identified in policy reaction functions, has been weak enough to accommodate changes in inflation, probably because the excess-reserve operation as another policy-target has worked together to respond to inflation. Third, the response to output gap has been robust in the backward-looking specification. Fourth, the response to exchange rate has been insignificant probably due to imperfect capital mobility and an increase in exchange rate flexibility.

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1. Introduction

China has taken gradual steps to liberalize its financial markets since the late 1990s. Until the early 1990s, China regulated almost all of interest rates in its financial markets. It was in 1996 when the deregulation of interest rates started as its initial step. The money market rate in the inter-bank call-market was liberalized in 1996 and the interest rates in bonds market were deregulated in 1999. The lending rate and deposit rate were, however, regulated for a long time, and it was in 2004 when the upper limit of the lending rate and the lower limit of the deposit rate were removed. The lending rate was fully liberalized in 2013, whereas the deposit rate still has a restriction on upper limitation.

In accordance with the deregulation in financial markets, the monetary policy in China also has experienced its changes in terms of policy instruments and operating targets. The four major policy instruments are "adjustments in regulated interest rates", "window guidance", "reserve ratio operation", and "open market operation". People's Bank of China has, however, shifted the weight of policy instruments from adjustments in regulated interest rates and window guidance towards reserve ratio operation and open market operation. It appears to be because the deregulation in financial markets and the subsequent financial deepening have made People's Bank of China prioritize the market-oriented operations in its monetary policy management. Regarding the policy targets, there are two major targets: excess reserves held by banks in People's Bank of China, and money market rate in inter-bank financial markets. People's Bank of China has put more priority on the money market rate as the policy target in recent times, while it still depends on the excess-reserves adjustment that is a key for controlling monetary base affected heavily by the fluctuations in foreign reserves. The shift of target priority may also be explained by the recent stance of People's Bank of China that expects the market-mechanism in which the money market rate has a ripple effect on the whole financial market.[1]

When it comes to the issue on monetary policy stances, the Taylor rule and policy reaction functions are widely used for analytical purposes. There were few studies, however, in which the analyses of the Taylor rule and policy reaction functions were applied to the monetary policy in China, since its policy rule was considered to be regulated too strictly for the market mechanism to work in financial markets. It should be noted that Xie and Luo (2002) ever applied the Taylor rule and policy reaction functions to the examination of monetary policy management in China. Its sample period was, however, the one from the first quarter of 1992 (1992Q1) to the fourth quarter of 2001 (2001Q4), when the key interest rates such as lending rates and deposit rates were strongly regulated as main policy instruments as stated above. Thus, their application of the market-based rules might be too

[1] The description on financial deregulation and monetary policies in China is based on the information retrieved from the materials of People's Bank of China.

early under the regulatory policy-regime before the 2000s in China.

This paper aims to examine the monetary policy rule in practice for China during the period from the first quarter of 1998 (1998Q1) to the second quarter of 2014 (2014Q2) by applying the Taylor rule and by estimating policy reaction function. Although it looks like simple update of Xie and Luo (2002), focusing our analysis on the period from 1998Q1 to 2014Q2 would be more significant, since during that period the monetary-policy instruments and targets have become more market-oriented in accordance with the progress in financial deregulation. The next sections will show the empirics: the application of the Taylor rule in Section 2 and the estimation of policy reaction functions in Section 3. The last section summarizes and concludes.

2. Application of Taylor Rule

Taylor (1993) showed that the average reaction of the Federal Reserve to US inflation and output gap could be captured by the following simple equation (1). The rule called the Taylor rule is, though it has no normative meanings, considered to be a useful standard for comparing monetary policy stances over time and across economies.

$$r = p + 0.5y + 0.5(p - 2) + 2 \quad (1)$$

where r is the federal funds rate, p inflation rate, and y output gap. The rule has the feature that the federal funds rate rises if inflation rate increases above a target of 2 percent or if real GDP rises above trend GDP. If both inflation rate and real GDP are on target, then the federal funds rate would equal 4 percent, or 2 percent in real term that can be interpreted as the "neutral" level of real interest rate.

Xie and Luo (2002) applied the Taylor rule to the monetary policy in China for 1992Q1 – 2001Q4. They modified the rule in such a way that the call-rate was used as a proxy of policy rate; a target inflation rate was 4 percent; and the neutral level of real interest rate was 3 percent. They found that the actual call-rate became closer to the Taylor rule rate for 1998 – 2001, while the call-rate was far lower than the Taylor rule rate for 1993 – 1996.

We now apply the Taylor rule to the recent monetary policy under the progress in financial deregulation for 1998Q1 – 2014Q2 in China. All the data for the calculation are compiled on quarterly base to make variables consistent with quarterly GDP data. For the policy rate, following Xie and Luo (2002), the call-rate for 7 days is used as a proxy and is processed into the quarterly average rate, the data of which are obtained from People's Bank of China. The inflation rate is derived as a year-on-year change rate of Consumer Price Index (CPI), the data of which are retrieved from National Statistics Office (NSO), Government of China. The output gap is calculated as the difference between quarterly

GDP in real term and a Hodrick-Prescott-filter of that series as a proxy of potential GDP level, the original data of which are retrieved from NSO.[2]

Figure 1 reports the comparison between the actual call-rate and the call-rate based on the Taylor rule. We observed that in the whole period of 1998Q1 – 2014Q2 shown in Graph A the trajectory of the actual call-rate did not appear to follow well that of the Taylor ruled call-rate. If we focused on the recent period of 2003Q1 – 2014Q2 shown in Graph B, however, the actual call-rate synchronized more with the Taylor-ruled call-rate though there was much discrepancy in the levels between them. It might be natural that the Taylor rule was not applied in the whole period of 1998Q1 – 2014Q2, since in China the deregulation of financial market was on the way, and its policy instruments and targets , as we stated in the introduction, were different from those of advanced economies targeting mainly on money market rate through open market operation. It should be noted, however, that in the recent period of 2003Q1 – 2014Q2 the actual policy rule has become synchronizing with the Taylor rule. It might reflect the recent changes in its monetary-policy stance towards more market-oriented one under its financial deregulation as we also stated in the introduction.

3. Estimation of Policy Reaction Functions

The policy reaction functions are one of the useful analytical tools to describe monetary policy rules in practices managed by central banks. Its standard specification is that a central bank adjusts the nominal short-term interest rate in response to the gaps between expected inflation and output and their respective targets. It can be interpreted as a more generalized rule of the Taylor rule – the simple backward-looking reaction function. The estimable policy reaction functions were presented for the first time by Clarida and Gertler (1997) for Bundesbank monetary policy, Clarida et al. (1998a) for the US monetary policy, and Clarida et al. (1998b) for monetary policies of two sets countries: the G3 (Germany, Japan, and the US) and the E3 (UK, France, and Italy). Among them, Clarida et al. (1998b) demonstrated the most comprehensive estimation of policy reaction functions. For estimating the G3 monetary policy rules, they took the forward-looking specification as the baseline and the backward-looking function as the alternative for their comparison, and they found that the G3 pursued forward-looking rules, responding to anticipated inflation as opposed to lagged inflation. As for the E3 estimation, they added such explanatory terms as German interest rate and exchange rate in their functions, to examine how the constraints of

[2] The quarterly GDP is published by NSO in nominal, accumulative terms. Thus, the accumulative level is converted into normal quarterly level first, and then the quarterly level is deflated by GDP deflator that is retrieved from World Economic Outlook Database of IMF. The real quarterly GDP is finally seasonally adjusted.

EMS that collapsed in late 1992 influenced the E3 monetary policy rules.

There were subsequent studies to apply the policy reaction functions developed by Clarida et al. (1998b) to the wider range of sample economies. Gagnon and Ihrig (2004) and Kim and Park (2006) adopted the forward-looking specification for estimating policy reaction functions in 20 industrial countries and in Korea, respectively. Meanwhile Siregar and Goo (2008) employed the backward-looking specification for the cases of Indonesia and Thailand.[3] Taguchi (2011a) and Taguchi (2011b) estimated both of forward-looking and backward-looking specifications for Indonesia, Korea, Philippines, Thailand and Malaysia, and found that Korea took an inflation-responsive and forward-looking policy stance while Indonesia and Thailand took inflation-responsive but backward-looking stances. Among these subsequent studies, the exchange-rate term was included in the policy reaction functions in Siregar and Goo (2008) and Taguchi (2011b), whereas not in Gagnon and Ihrig (2004), Kim and Park (2006) and Taguchi (2011a). For the case of China, It was Xie and Luo (2002) that applied the policy reaction function for the first time to describe its monetary policy rule. They identified an inflation-responsive and back-looking policy reaction without the exchange-rate term for its 1992Q1 – 2001Q4 monetary policy.

3.1 Methodology

This study targets the 1998Q1 – 2014Q2 monetary policy in China, and basically follows Clarida et al. (1998b) as the estimation methodology of policy reaction functions. We employ both of forward-looking and backward-looking specifications, since the emerging market economies including China may face the difficulties in forecasting inflation and output as Eichengreen (2002) suggested. In fact, only the backward-specification was valid for the policy reaction functions in such emerging market economies as Indonesia, Thailand and China, as were shown in Siregar and Goo (2008), Taguchi (2011a), Taguchi (2011b) and Xie and Luo (2002). Regarding the exchange-rate term, we conduct the estimation for both cases: the case including the exchange-rate and the one excluding it, since it is possible for the monetary policy in China to be used for stabilizing its exchange rate, in particular, during the period in which the value of renminbi was actually pegged to the US dollar for 1998 - 2005.

The original policy reaction function presented by Clarida et al. (1998b) is shown as the following equation (2).

$$r_t^* = \bar{r} + \beta(E[\pi_{t+n}|\Omega_t] - \pi^*) + \gamma(E[y_t|\Omega_t] - y_t^*) \quad (2)$$

[3] The estimated equation of Siregar and Goo (2008) includes the lagged inflation of $E_{t-1}\,\pi_{t}$, $E_{t-2}\,\pi_{t-1}$, and $E_{t-3}\,\pi_{t-2}$, thereby being classified as a backward-looking specification.

where r_t^* is a target for the nominal short-term interest rate, $\bar{r}$ is the long-run equilibrium nominal interest rate, π_{t+n} is the rate of inflation between periods *t* and *t+n*, y_t is the real output, π^* and y_t^* are respective bliss points for inflation and real output, *E* is the expectation operator and Ω is the information available to the central bank at the time when it sets the interest rate.

Equation (2) can be rewritten for empirical specification by defining $\alpha \equiv \bar{r} - \beta\pi^*$ and $x_t \equiv y_t - y_t^*$, and by replacing the unobserved forecast variables with realized variables as follows.

$$r_t^* = \alpha + \beta\pi_{t+n} + \gamma x_t + \varepsilon_t \tag{3}$$

where ε_t is a linear combination of the forecast errors of inflation and real output. Then we modify equation (3) in accordance with our analytical interests into the forward-looking specification in equation (4), the backward-looking specification in equation (5) and the backward-looking specification including the exchange rate term *z* in equation (6) as follows.

$$r_t^* = \alpha + \beta\pi_{t+1} + \gamma x_t + \varepsilon_t \tag{4}$$
$$r_t^* = \alpha + \beta\pi_t + \gamma x_t + \varepsilon_t \tag{5}$$
$$r_t^* = \alpha + \beta\pi_t + \gamma x_t + \delta z_t + \varepsilon_t \tag{6}$$

We further modify equation (4), (5) and (6) for obtaining estimable equations since the central bank tends to conduct smooth changes in interest rate in their practices. By assuming that the actual rate partially adjusts to the target as $r_t = (1-\rho)r_t^* + \rho r_{t-1} + \upsilon_t$ where ρ is the degree of smoothing with $0 < \rho < 1$ and υ is the disturbance term, equations (4), (5) and (6) can be rewritten into equation (4)', (5)' and (6)' as follows.

$$r_t = (1-\rho)\alpha + (1-\rho)\beta\pi_{t+1} + (1-\rho)\gamma x_t + \rho r_{t-1} + \varepsilon_t \tag{4}'$$
$$r_t = (1-\rho)\alpha + (1-\rho)\beta\pi_t + (1-\rho)\gamma x_t + \rho r_{t-1} + \varepsilon_t \tag{5}'$$
$$r_t = (1-\rho)\alpha + (1-\rho)\beta\pi_t + (1-\rho)\gamma x_t + (1-\rho)\delta z_t + \rho r_{t-1} + \varepsilon_t \tag{6}'$$

For the technique to estimate the parameter vector [α, β, γ, δ, ρ], we adopt generalized method of moments, since the equations above entail endogeneity problem in that the interest rate may affect explanatory variables. The instrumental set includes 1-2 lagged values of inflation π and output gap *x*, and 2 lagged value of interest rate *r* in equation (4)', (5)' and (6)', and adds 1-2 lagged values of exchange rate *z* in equation (6)'. The J-statistic implies that we cannot reject the over-identifying restrictions of the models above (see note

4 in Table 1). The sample data are the same as those in the previous Taylor-rule analysis for interest rate, inflation and output gap, and includes the data for exchange rate in terms of the quarter-to-quarter percentage change of renminbi per US dollar. The sample period of estimation is from 1998Q1 to 1994Q2.

3.2 Estimation Outcomes and Discussion

Table 1 reports the estimation outcomes of policy reaction functions in three specifications: the forward-looking specification in equation (4)', the backward-looking specification in equation (5)', and the backward-looking specification including the exchange rate term in equation (6)'. In the forward-looking specification, the coefficient of inflation, the magnitude of which is less than unity, is discernable at 10 percent significant level. In the backward-looking specification, both coefficients of inflation and output gap are significant at 5 percent significant level, while the magnitude of inflation coefficient is still less than unity. The inclusion of the exchange rate in the backward specification is not significant in the last specification in equation (6)'. Since the backward-looking specification in equation (5)' appears to be a core-estimation, we conduct a diagnostic test to examine the robustness of equation (5)' estimation. We apply the redundant variables test, which investigates whether a subset of variables in an equation all have zero coefficients and might thus be deleted from the equation. Table 2 reports the test results of the restricted regressions dropping all the combinations of explanatory variables in equation (5)'. The results show that the hypothesis that the coefficients are jointly zero is rejected in any combinations of explanatory variables at conventional significant levels. Figure 2 describes the traceability of the call-rate based on equation (5)' to the actual call-rate.

We interpret the estimation results in the following ways. First, although the response to inflation is identified in any specifications, its magnitude is small enough to accommodate changes in inflation; even if the central bank raises the nominal interest rate in response to a rise in inflation, it does not increase it sufficiently to keep the real rate from declining. This less-than-unity response of policy rate to inflation is also shown in the previous studies in China by Xie and Luo (2002). This result is, however, quite different from the policy rules of advanced nations described by Clarida et al. (1998b), which are inflation-responsive enough to affect real interest rates in forward-looking manner. We speculate that People's Bank of China still now depend as its operating target not only on money market rate but also on excess reserves; the excess-reserve control together with such regulatory instruments such as window guidance seems to contribute still to responding to inflation, too.

Second, the response to output gap is rather robust in the backward-looking specification. It is a different finding from Xie and Luo (2002) that identified only

inflation-responsive rule for the 1992Q1 – 2001Q4 monetary policy, and it may be in line with Zhou (2013) emphasizing on the role of People's Bank of China to respond to output gap in recent times.

Third, the insignificant response to exchange rate might be explained by the following reasons. First, since the foreign capital flows, in particular, in terms of portfolio investment, are still regulated in China[4], its monetary autonomy might be secured so that its targeting call-rate can be set independently from the exchange rate movement. Second, since July in 2005, China has taken a managed floating system as its currency regime, and under this regime the value of renminbi has appreciated by around 30 percent from 2005 to 2014. This flexibility of exchange rate might also allow some autonomy of monetary policy in China, which seems to be consistent with the fact that the intervention to foreign exchange market is sterilized by the central bank through reserve-ratio operation.

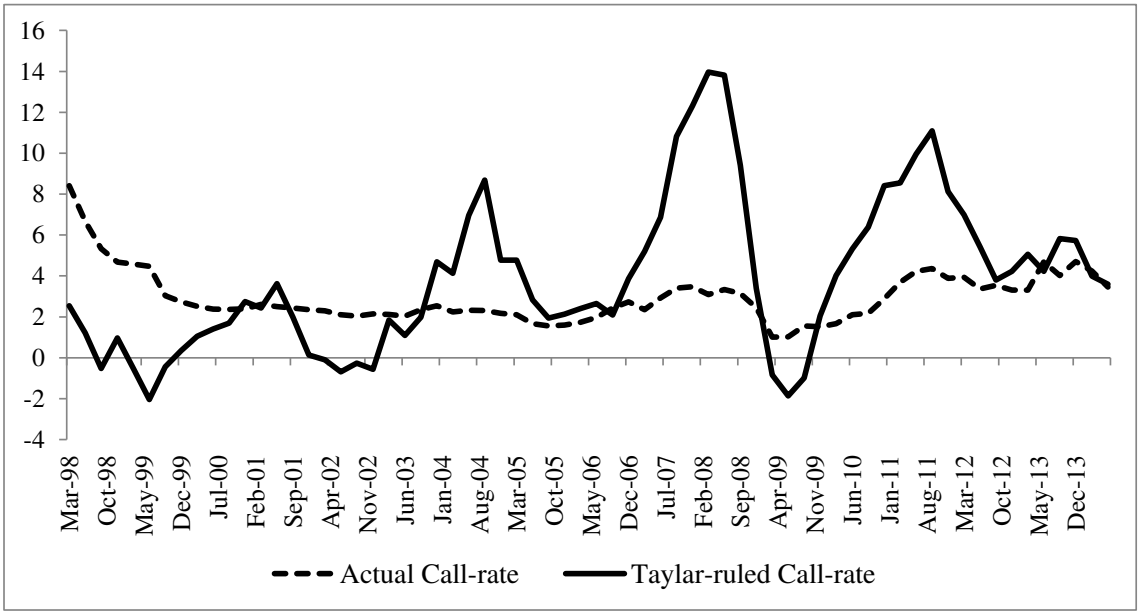
4. Concluding Remarks

This paper examined the monetary policy rule in practice for China during the period from 1998Q1 to 2014Q2 by applying the Taylor rule and by estimating policy reaction functions. The analysis would be significant since during that period the monetary-policy instruments and targets have been more market-oriented in accordance with the progress in financial deregulation. The findings can be summarized as follows. First, the recent policy rule since 2003 has become synchronizing with the Taylor rule. Second, the response of policy-target interest rate to inflation, though identified in policy reaction functions, has been weak enough to accommodate changes in inflation. This finding is common with the previous policy-rule estimation in China made by Xie and Luo (2002), but quite different from the policy rules of advanced nations described by Clarida et al. (1998b), which are inflation-responsive enough to affect real interest rates in forward-looking manner. This weak response of policy rate to inflation might come from the fact that the excess-reserve operation as another policy-target has worked together to respond to inflation. Third, the response to output gap has been robust in the backward-looking specification, and this finding is different from Xie and Luo (2002) that identified only inflation-responsive rule for the 1992Q1 – 2001Q4 monetary policy. Fourth, the response to exchange rate has been insignificant probably due to imperfect capital mobility and an increase in exchange rate flexibility.

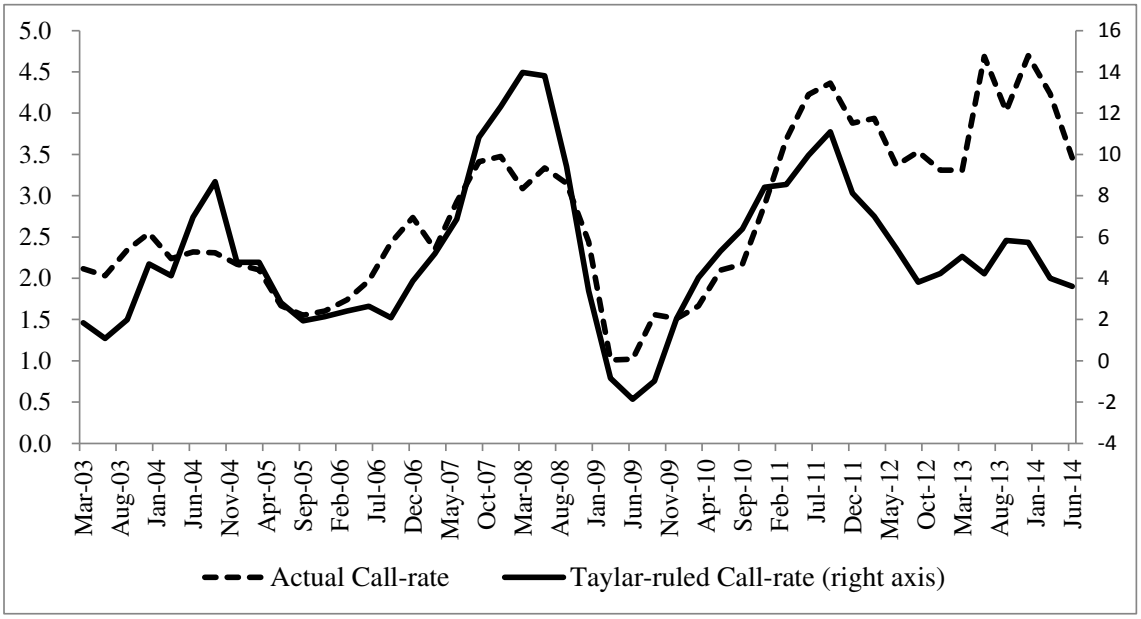
[4] For instance, the ranking of China in Financial Openness Index is 110 among 182 countries according to Ito and Chinn (2013).

Figure 1 Comparison between Actual Call-rate and Taylor-ruled Call-rate

A: 1998Q1 – 2014Q2



B: 2003Q1 – 2014Q2



Sources: People's Bank of China and National Statistics Office (NSO), Government of China

Table 1 Estimation Outcomes of Policy Reaction Functions

	α	β	γ	δ	ρ
Forward-looking Specification Equation (4)'	2.34 *** (2.71)	0.16 * (1.78)	0.48 (1.32)	-	0.70 *** (7.68)
Backward-looking Specification Equation (5)'	2.47 *** (4.05)	0.14 ** (2.02)	0.68 ** (2.30)	-	0.63 *** (8.25)
Inclusion of Exchange Rate Equation (6)'	2.49 *** (4.56)	0.18 ** (2.60)	0.64 ** (2.64)	-0.25 (-0.74)	0.64 *** (11.43)

Notes:
1) The sample period is 1998Q1 – 1994Q2.
2) ***, **, and * indicate that the coefficient is significant at the 1, 5, and 10 percent levels, respectively. The t-statistic is in parentheses.
3) The instruments are: π_{t-1}, π_{t-2}, x_{t-1}, x_{t-2}, r_{t-2} in equation (4)' and (5)'; and π_{t-1}, π_{t-2}, x_{t-1}, x_{t-2}, z_{t-1}, z_{t-2}, r_{t-2} in equation (6)'.
4) The J-statistics in equation (4)', (5)' and (6)' are 0.55, 0.86 and 0.90, all of which are small enough compared to one-percent significant criteria of chi-squared distribution that the J-statistics follows. Thus, the over-identifying restrictions of the models are not rejected.

Sources: People's Bank of China and National Statistics Office (NSO), Government of China.

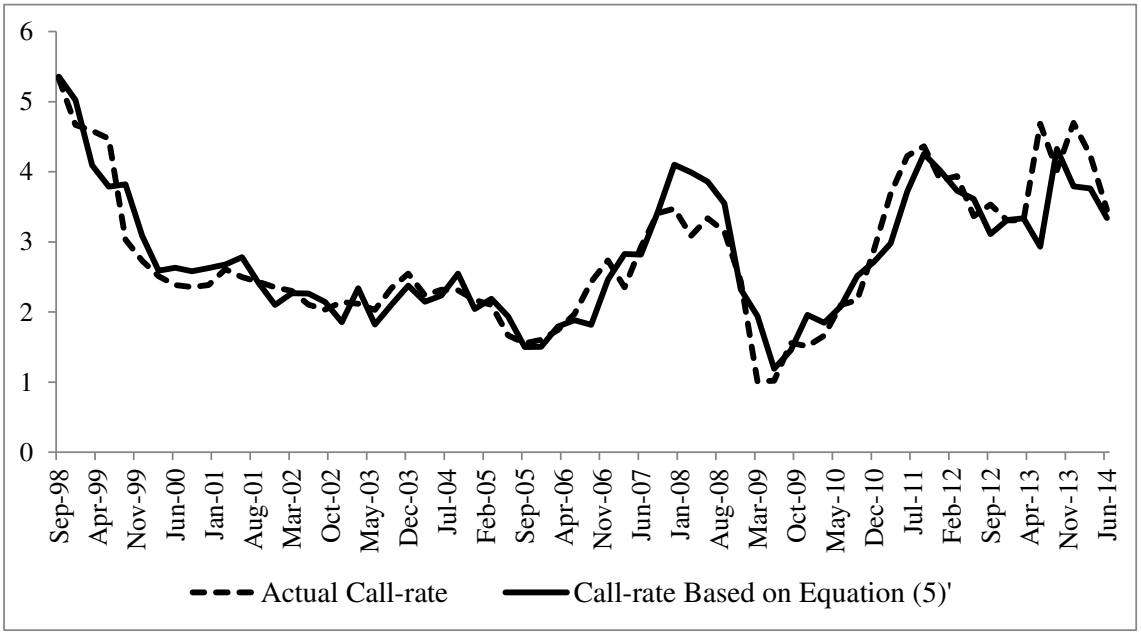
Table 2 Redundant Variables Test for Equation (5)' Estimation

Redundant Variables	Difference in J-statistic	df	Probability
π_t & x_t & r_{t-1}	495.21	3	0.000
π_t & x_t	10.02	2	0.007
π_t & r_{t-1}	72.92	2	0.000
x_t & r_{t-1}	459.57	2	0.000
π_t	4.36	1	0.037
x_t	5.66	1	0.017
r_{t-1}	72.59	1	0.000

Note: The hypothesis for the test is that the coefficients on a subset of variables are jointly zero. Regarding the detailed test-methodology, see Chapter 20 (pp. 55-83) of EViews 7 Users Guide II.

Sources: People's Bank of China and National Statistics Office (NSO), Government of China.

Figure 2 Actual Call-rate and Call-rate Based on Equation (5)'



Sources: People's Bank of China and National Statistics Office (NSO), Government of China

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