Taylor Rule in Transition Economies: A Case of China's Monetary Policy

Xie Ping[a] and Luo Xiong[b*]

[a]Research Department, the People's Bank of China, Beijing, P. R. China
[b]Reserve Management Department, the State Administration of Foreign Exchange (SAFE), Beijing, P. R. China

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Abstract

This paper employs the historical analysis and the reaction function method to examine China's monetary policy in the framework of the Taylor rule. By comparing the rule values with the actual values of the interest rate, we show that Taylor rule can provide a useful benchmark for measuring the stance of China's monetary policy. Deviations of actual value from rule value happen when the policy operation falls behind of the request of the development of economic situation. The GMM estimate of reaction function of China's monetary policy indicates that the adjustment coefficient of the interest rates to the inflation rates is lower than 1. In such an unstable monetary policy regime, the generation and development of inflation or deflation is of a self-fulfilling mechanism. Our research suggests that China's monetary policy should be transformed from an unstable rule to a stable rule, it calls for an implementation ofinterest rate reform and change to a new monetary policy regime with the interest rate of money market as the intermediate target.

JEL classification: E52; P24; P52

Keywords: The Taylor's rule, monetary policy, transition economies; China's monetary policy

* [a] Correspondence address: Research Department of the People's Bank of China, 32 Cheng Fang Street, West District, Beijing, P. R. China 100800, Email address: pingx@public.bta.net.cn
[b] Correspondence address: Reserve Management Department of the State Administration of Foreign Exchange, F/4 Pingan Building, 23 Jinrong Street, Beijing, P. R. China, 100032, Email address: luoxiong@mail.rmd-safe.gov.cn

1. Introduction

Prior to the analysis of the time-inconsistent problem by Kydland and Prescott (1977), the main issues that economists argue about are whether monetary policy should be conducted according to a uniform rule, such as the nominal monetary aggregate k% growth rate, or the policy should be conducted discretionarily by central banks. When the issue is raised in this form, the discretionary policy is often viewed as an optimal policy. But Barro and Gordon (1983) show, with the discretionary policy, the output cannot be enhanced systematically and the society as a whole experiences high inflation. This result changes the long-term "discretion vs. rule" debate. Taylor (1993) introduces an interest rate rule that adjusts interest rate according to output gap and inflation gap. This is called the Taylor rule, which captures the essence of successful monetary policy practice in many advanced economies.

The historical analysis and the reaction function are often employed to conduct empirical analyses in the Taylor rule framework. For example, Taylor (1999) and McCallum (2000) conduct counterfactual historical analysis of the Taylor rule. This analysis contrasts actual settings of instrument variables with values that would have been specified by the rules in response to prevailing conditions. Clarida, Gali and Gertler (1997, 2000) estimate the reaction functions of central banks. Judd and Rudebusch (1998), Gerlach and Schnabel (1999), and Nelson (2000) combine the two methods - analyzing the monetary history and estimating the reaction function. Many central banks' conduct of monetary policy, including that of the Federal Reserve Board, Bank of England, Bank of Japan, the Bundesbank, and European Central Bank, has been examined according to the Taylor rule. Although the research in the monetary policy in major industry countries has been mushroomed, there is lack of study in the conduct of monetary policy according to the Taylor rule in transition economies and emerging market economies.

The lack of studies perhaps reflects the existence of some obstacles in conducting such research. In the first place, the monetary policy in a transition and emerging market economy often lacks consistency. This may be due to the fact that the economy in these countries is under reconstruction or major reform. Indeed, many of these countries are in the course of major market-oriented reform. Moreover, the financial market in those economies is far from fully developed; and the interest rates are often distorted by the monetary authority, and there lacks the benchmark interest rate for the market. These practical obstacles frustrate this kind of research.

In this paper, we try to analyze China's monetary policy in the framework of the Taylor's rule. The empirical analysis is conducted in two steps, employing the historical analysis and estimating the reaction function respectively. The second part employs the historical analysis method, comparing the rule value with the actual value

of the interest rate in China's monetary policy. The third part estimates the reaction function of China's monetary policy. In the final part, we probe into its policy meanings. Since the practice of China's monetary policy is not entirely consistent with what implies by the Taylor's rule, we will explain the limitations of such rule in China and suggest for some improvements.

2. An Empirical Analysis of China's Monetary Policy in the Framework of Taylor Rule

Marked by decontrolling management of the loan scale and the expansion of the open market operations, the regulatory way of China's monetary policy experienced the shift from direct control to indirect control in the 90s. As showed in Table 1, the final target of China's monetary policy shifts from developing the economy and stabilizing the price level to maintaining the stability of the currency value to advance economic growth. The intermediate target and the operation target are shifted from credit quota to money supply and money base respectively.

Table 1
The Transmission Mechanism of China's Monetary Policy[1]

	Policy Instruments		Operation Target	Intermediate Target	Final Target
	Main Instruments	Complementary Instruments			
The nearly 20 years since adopting the reform and opening-up policy (1979-1997)	Credit Cash Plan Central Bank Lending	Interest Rate Policy Credit Policy Rediscount Open Market Operation Special Deposit	From credit quota to money base	From credit quota to money supply	Shift from developing the economy and stabilizing the price level to maintaining the stability of the currency value to advance economic growth
The initial stage of indirect control (1998-2000)	Central Bank Lending Interest Rate Policy Open Market Operation	Deposit Reserve Rediscount Instructive Credit Plan Credit Policy Window Instruction	Money Base (To monitor the liquidity)	Money Supply (To monitor interest rate and exchange rate)	To maintain the stability of the currency value to advance economic growth

The market interest rate is the basis of the whole interest system. One of its functions is that it acts as the signal origin and the reference parameter. In the industry countries for example, in the United States, the interest rate in the bond market is the benchmark interest rate of the financial market. This can be contributed to the flexible

[1] From Yi Gang (2001) "The Framework of China's Monetary Policy"

issuing mechanism, the active secondary market and the market behavior of the central bank. China's bond market has undergone the market-oriented reform. The issuing mechanism is being maketlized step by step. And the secondary market has developed rapidly. But due to the small scale of China's bond market, its interest rate cannot lead the market interest rate.

In China, the interbank interest rate can reliably and rapidly reflect the information on money supply and money demand. Taking all these in account, we can take the interbank interest rate as the benchmark interest rate for the financial market. Based on the interbank interest rate and referring to the interest rate in the bond market, the central bank can adjust the benchmark interest rate and let it lead the market interest rate.

We will try to conduct the empirical analysis of China's monetary policy in the framework of the monetary policy rule initiated by Taylor in 1993. The well-known Taylor rule can be expressed as follows:

$$i_t = \bar{r} + \pi_t^a + 0.5\left(\pi_t^a - \pi^*\right) + 0.5\tilde{y}_t .$$

Here i_t is the short-term nominal interest rate that the central bank uses as its instruments or "operation target", i.e. the interest rate over which it exerts control on a daily or weekly basis. Next, $\bar{r}$ is the long-run equilibrium real interest rate, while π_t^a is the average inflation rate over the previous four quarters, i.e. $\pi_t^a = 0.25\left(\pi_{t-1} + \pi_{t-2} + \pi_{t-3} + \pi_{t-4}\right)$. And π^* is the central bank's target inflation rate. Finally, $\tilde{y}_t$ is a measure of the output gap, which is defined as $100\left(Y - Y^*\right)/Y^*$ where Y is the real GDP and Y^* is the potential GDP.

2.1. The Data

The PBOC began to release the statistical data of money supply since 1994 and gradually took it as the intermediate target. The interest rate has not been totally marketilized and does not serve as the operation target of China's monetary policy. We should take one kind of interest rate that has been marketilized as the proxy variable of the market interest rate, and at the same time take the assumption that such kind of interest rate is the instrument variable of China's monetary policy. Our choice should be in line with the requirement of market interest rate, i.e., could reflect the information on money supply and money demand.

China's money market began in 1984 when the interbank market was set up. With 1996 as the watershed, the development of China's interbank market can be divided into two stages. Before 1996, there existed separate interbank lending and borrowing activities. China's interbank market was unified in 1996 and the National Interbank Market was formed. In June 1996, PBOC lifted the upper limit of the interbank interest rate and since then the interbank interest rate has been determined

by the negotiation between the lender and the borrower.

In 1993, the lending and borrowing behaviors between financial institutions degenerated into a financial turmoil. The principal practice was that some financial institutions took the interbank market as the channel of long-run financing, channeling the borrowing money to securities investment and real estate investment. The interbank lending and borrowing were transformed to the principal mean to evade the credit quota (Xie, 2001).

Before 1996, Shanghai was the most active domestic lending and borrowing market and the fund gathered in this market accounted for the largest share in the domestic market. The transaction in Shanghai Interbank Market went along an orderly pace. In 1993, the lending and borrowing not in line with the regulations accounted for only 1.3% of the total turnover. The share of Shanghai Financing Center in Shanghai Interbank Market went up gradually (Chen, 1994).

Based on this situation, we choose the interest rate in Shanghai Financing Center to represent that in national interbank market before 1996.

We choose the quarterly data to apply Taylor rule to China's monetary policy. The sample period is from the first quarter of 1992 to the fourth quarter of 2001. There are total 40 sample points. The source of the data is *The People's Bank of China Quarterly Statistical Bulletin*.

(1) The interest rate[2]. From 1992 to 1995, we choose the quarterly weighted average interest rate in Shanghai Financing Center. The data source is from Shanghai Financing Center. From 1996 to 2001, we choose 7-day quarterly weighted average interest rate in the National Interbank Market[3].

(2) The potential real GDP. We estimate the potential real GDP by conducting liner trend estimate. Since the output level demonstrates the quarter-related varied characteristics, we append three dummy variables.

$$D_1 = \begin{cases} 1 & 1st\_quarter \\ 0 & other \end{cases} \quad D_2 = \begin{cases} 1 & 2nd\_quarter \\ 0 & other \end{cases} \quad D_3 = \begin{cases} 1 & 3rd\_quarter \\ 0 & other \end{cases}$$

We regress the natural logarithm value of the real GDP on the constant, the time trend, and the dummy variable. We finally get the following function:

LNGDP = 9.2648 + 0.0209 TREND - 0.6565 D1 - 0.7044 D2 - 0.5817 D3

(688.2633) (49.4541) (-47.5397) (-51.1295) (-42.2812)

[2] The average interest rate of all terms is the weighted average interest rate. The formula for computing the weighted average interest rate ($\bar{i}$) is: (in which the trading volume is the weight)

$$\bar{i} = i_1 \frac{f_1}{\sum f} + i_2 \frac{f_2}{\sum f} \cdots\cdots + i_n \frac{f_n}{\sum f} = \sum i \frac{f}{\sum f}$$

[3] Constrained by the data source, between 1992-1995 period the quarterly weighted average interest rate of Shanghai Financing Center is weighted for interest rates of all maturities, while between 1996-2001 period the quarterly weighted average interest rate is weighted for 7-day interest rate. The maturity does not match for the two periods. But since there existed small spread between interest rates of different maturities in Shanghai Financing Center between 1992-1995 period, the unmatched maturity would make little difference.

R-squared = 0.9945□ Adjusted R-squared = 0.9939

Durbin-Watson stat = 1.3120□F-statistic = 1584.768

Figure 1 shows the actual real GDP and the potential real GDP[4].

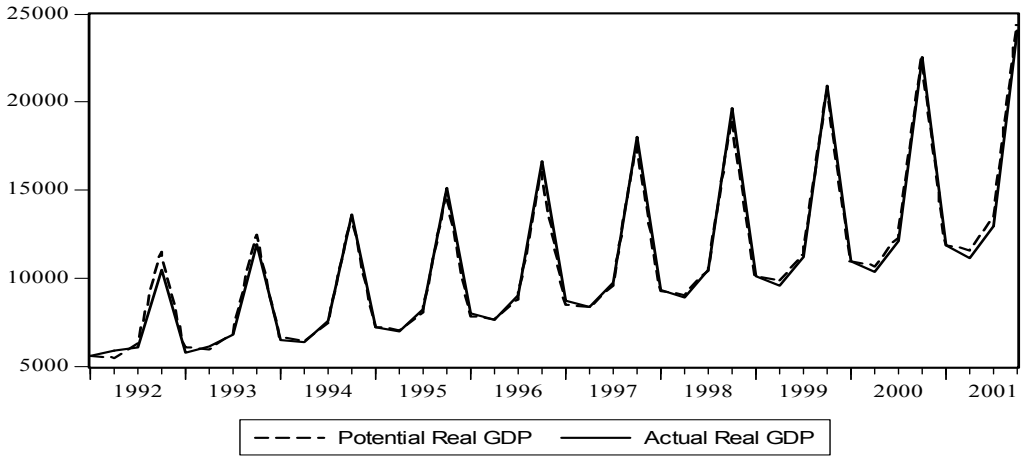

Fig. 1. The Actual Real GDP and the Potential Real GDP

(3) The inflation rate. The inflation rate is measured by using CPI.

(4) The long-run equilibrium real interest rate and the target inflation rate. If the sample period is long enough, we can employ the average real interest rate of the sample to estimate the long-run equilibrium real interest rate. By computing the ex post real rate[5] between 1992-2001 period, we get the average of 1.33% and the median of 2.82%. So we take the long-run equilibrium real interest rate $\bar{r}$ as 3%. According to the inflation target promulgated in the work reports[6] by the Prime and the chairman of State Development Planning Commission (SDPC) in the National People's Representative Congress, we take the target inflation rate π^* as 4%.

2.2. The Taylor Rule Value of the Interest Rate

Figure 2 shows the rule value and the actual value of the interest rate. Figure 2 and figure 3 are the components of Taylor rule respectively, the GDP gap and the CPI

[4] The quarterly data for GDP is the current quarter data, i.e. the number subtracting former quarter's grand totals of current year from current quarter's grand totals of current year.

[5] The real interest rate between 1992-1995 period is calculated by subtracting the CPI inflation rate from the quarterly average interest rate in Shanghai Financing Center. The real interest rate between 1996-2001 period is calculated by subtracting the CPI inflation rate from 90-day quarterly weighted average interest rate in National Interbank Market.

[6] The inflation target promulgated by the government between 1992-2001 period is as follows:

Year	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
RPI	6%	6%	10%	15%	10%	6%	3%	2%	2%	N.A.
CPI	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	5%	4%	4%	1%-2%

Date source: the chairman of SDPC, "The Report on Plan Implementation for National Economic and Social Development of the Year and the Draft Plan for National Economic and Social Development of the following Year".

inflation rate.

In the beginning sample period from the first quarter of 1992 to the first quarter of 1993, the rule value and the actual value of the interest rate are very close to each other. The two values converged. After the second quarter of 1993, the trend of two values began to divide. The rule value was higher than the actual value at that time and the gap between two values began to expand gradually. In the third quarter of 1995, the gap arrived at its peak, 24.78%. At that time, the rule value of the interest rate is 37.58%. From then on, the rule value and the actual value are converged again. The gap between two values becomes smaller and smaller. In the third quarter and the fourth quarter of 1997, the gap arrived at its bottom. After the fourth quarter of 1997, the path of two values began to divide again and the rule value was lower than the actual value. The gap was expanded to -6.22% in the second quarter of 1999, when the rule value is -1.98%. From then on, the rule value converged to the actual value and the gap became smaller. In the fourth quarter of 2001, the gap has decreased to -0.46%.

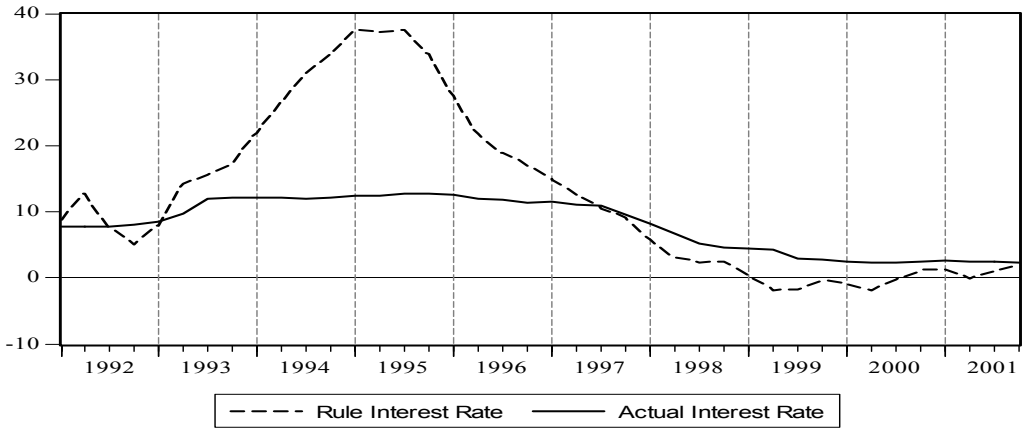

Fig. 2. The Rule Value of Interest Rate and the Actual Value of Interest Rate

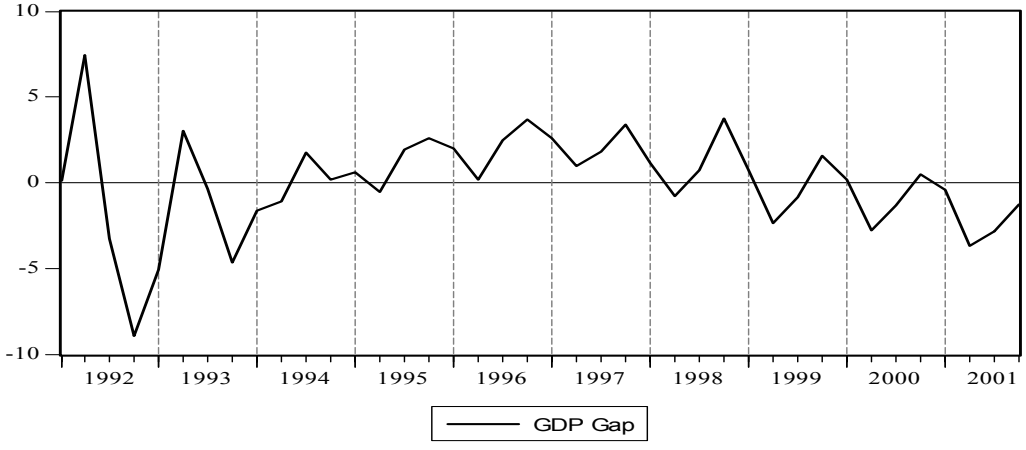

Fig. 3. The GDP Gap

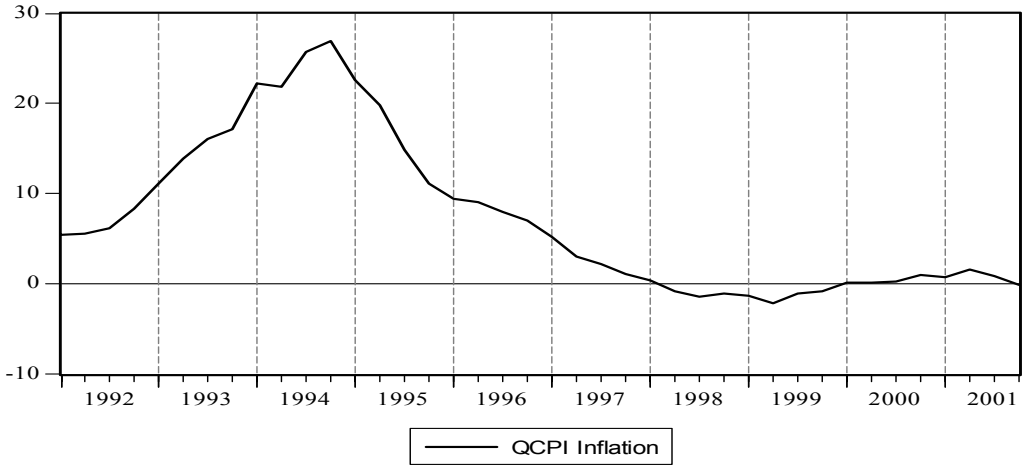

Fig. 4. The CPI Inflation Rate

According to the rule, the monetary policy was too loose around the first quarter of 1993 and the prevailing condition called for the monetary policy to be more active. Concerned with the overheat of China's economy around 1992, the PBOC began to put financial system in order and to implement the "moderately tight" monetary policy in the late 1993. In 1996, China's economy succeeded in realizing "soft-landing". After May 1996, the PBOC began to adjust the tone of monetary policy operation. Table 2 shows the major reform measures of central bank's monetary policy control and transmission mechanism. In 1998, the PBOC decontrolled management of the loan scale and expanded the open market operations, which marked the shift of the regulatory way of China's monetary policy from direct control to indirect control. As table 3 shows, the PBOC cut the interest rate on deposit and loan for three times successively in 1996 and 1997. In 1998 and 1999, the PBOC cut the interest rate on deposit and loan again for four times successively. If the first three cuts were the spontaneous adaptation to the drop of the price level, then the next four cuts were the major preemptive monetary policy measures that the central bank took on its own initiative to moderately expand the money supply.

Table 2
The Major Reform Measures of Central Bank's Monetary Policy Control and Transmission Mechanism

Time	Major Measures
1998	Cancel the credit quotas for the state-owned commercial banks[7]
1998, 1999	Reform depositary reserve system[8]
1998	Expand open market operation[9]

[7] On Jan. 1 1998, the PBOC cancelled the credit quotas for the state-owned commercial banks.
[8] As of Mar. 1998, Reserve Requirement and Excess Reserves were combined into Reserve Requirements. And the PBOC lowered the deposit reserve ratio from 13% to 8%. In Nov. 1999, the PBOC adjusted the deposit reserve ratio downward from 8% to 6%.

1996-2000	Promote the interest rate liberalization reform[10]
1998	Reform the mechanism for forming the rediscount rate[11]

Table 3
The Changes in the Interest Rates on 1-year Deposit and Loan (%)

Time	The Interest Rate on 1-year Deposit	The Interest Rate on 1-year Loan	Spread
1992	7.56	8.64	1.08
1993.05.15	9.18	9.36	0.18
1993.07.11	10.98	10.98	0
1995.07.01	10.98	12.06	1.08
1996.05.01	9.18	10.98	1.80
1996.08.23	7.47	10.08	2.61
1997.10.23	5.67	8.64	2.97
1998.03.25	5.22	7.92	2.70
1998.07.01	4.77	6.93	2.16
1998.12.07	3.78	6.39	2.61
1999.06.10	2.25	5.85	3.60
2002.02.21	1.98	5.31	3.33

After the fourth quarter of 1997, the actual value and the rule value of the interest rate divide, which calls for more active monetary policy operation. The monetary policy operation between 1998-2001 period addresses the requirement of the economic development. This is embodied in the convergence of the actual value and the rule value of the interest rate after the second quarter of 1999.

3. The Reaction Function of China's Monetary Policy

In this empirical section, we follow Clarida, Gali and Gertler (1997, 2000) to estimate the reaction function of China's monetary policy. We assume that within each operation period the central bank has a target for the nominal short-term interest rate, based on the state of the economy. We assume that the target depends on both expected inflation and output. Specifically,

$$i_t^* = \bar{i} + \beta\left(E\left[\pi_{t+n}\middle|\Omega_t\right] - \pi^*\right) + \gamma\left(E\left[y_t\middle|\Omega_t\right]\right) \quad (1)$$

[9] On May 26 1998, the PBOC restarted the open market operations, increased the operation strength, expanded the transaction objects, increased the transaction instruments, and took treasury bonds, the financing papers of the central bank, and the financial bonds of policy-based banks as the transaction instruments. The transaction mode includes fixed-rate quantity bidder and the lower-limit price bidder besides the lower-limit interest rate bidder. The trading volume was increased widely.

[10] From 1996 to 1999, the deposit interest rate was lowered seven times successively; the central bank decontrolled the money market interest rate, increased the floating range of interest rates on RMB loans, and reformed the system of interest rates on foreign currency deposits.

[11] In Mar. 1998, the PBOC unfastened the link between the rediscount rate and the re-lending rate for corresponding maturity. The rediscount rate became the independent benchmark interest rate for the first time.

where i_t^* is the target for the nominal short term interest rate in t period, $\bar{i}$ is the long run equilibrium nominal rate, π_{t+n} is the inflation rate between period t and t+n, π^* is the target for inflation rate, y_t is the output gap in period t, E is the expectation operator and Ω_t is the information available to the central bank at the time it sets interest rates.

We assume that the central bank has the tendency to smooth changes in interest rates. Traditional explanations for the smoothing interest rate changes include: fear of disrupting capital market, loss of credibility from sudden large policy reversals, the need for consensus building to support a policy change, etc. We assume that the actual rate partially adjusts to the target, as follows

$$i_t = (1-\rho)i_t^* + \rho i_{t-1} + \upsilon_t \tag{2}$$

where the parameter $\rho \in [0,1]$ captures the degree of interest rate smoothing, υ_t is i.i.d, reflecting the exogenous random shock to the interest rate.

Defining $\alpha \equiv \bar{i} - \beta\pi^*$, we rewrite equation (1) as

$$i_t^* = \alpha + \beta E[\pi_{t+n}|\Omega_t] + \gamma E[y_t|\Omega_t] \tag{3}$$

Combining the target model (3) with the partial adjustment mechanism (2) yields

$$i_t = (1-\rho)\alpha + (1-\rho)\beta\pi_{t+n} + (1-\rho)\gamma y_t + \rho i_{t-1} + \varepsilon_t \tag{4}$$

where the error term $\varepsilon_t \equiv -(1-\rho)\{\beta(\pi_{t+n} - E[\pi_{t+n}|\Omega_t]) + \gamma(y_t - E[y_t|\Omega_t])\} + \upsilon_t$.

Finally, let u_t be a vector of variables within the central bank's information set at the time it chooses the interest rate (i.e. $u_t \in \Omega_t$) that is orthogonal to ε_t. Since $E[\varepsilon_t|u_t] = 0$, equation (4) implies the following set of orthogonality conditions:

$$E[r_t - (1-\rho)\alpha - (1-\rho)\beta\pi_{t+n} - (1-\rho)\gamma y_t - \rho r_{t-1}|u_t] = 0$$

To estimate the parameter vector $[\beta, \gamma, \rho, \alpha]$, we use generalized method of moments. In our baseline model (n=4), the instrument set u_t includes lagged value of output gap, inflation rate, interest rate, and real GDP growth rate. Each of these variables is potentially useful for forecasting inflation and output and is exogenous with respect to the interest rate.

We use the same data as the previous section. As to short term nominal interest rate, we choose the interest rate in Shanghai Financing Center between 1992-1995 period and the 7-day interest rate in National Interbank Market between 1996-2001 period. The inflation rate we use is the quarterly CPI inflation rate. And we estimate GDP gap with the same method as the previous section. The sample period is from the

first quarter of 1992 to the fourth quarter of 2001. Table 4 reports GMM estimates of the interest rate rule parameters:

Table 4

The Reaction Function of China's Monetary Policy[12]

φ

		γ	ρ	α	$\overline{R}^2$	[13]
Monetary Policy Reaction Function	0.81 (2.76)	2.84 (1.49)	0.82 (8.49)	1.84 (0.68)	0.87	18.518 (0.001)

The elasticity of the interest rate to the inflation rate is 0.81, lower than 1. When the expected inflation rate increases by 1 percent, the central bank adjusts the nominal interest rate upward by 0.81 percent. Since the extent to which the nominal interest rate is adjusted is lower than that of the inflation rate, the real interest rate drops by 0.19 percent. This shows, when the inflation rate goes up, the extent of adjusting interest rate is larger than the extent of increased inflation rate. So the real interest rate drops and this stimulates the gross demand, causing the inflation rate to ascend further. When the inflation rate goes down, the extent to adjust the interest rate downward is lower than that of inflation rate. So the real interest rate ascends and this curbs the gross demand further, causing the inflation rate to descend. So such a monetary policy rule is an unstable rule. With the elasticity of the interest rate to the output gap 2.84, the nominal interest rate (and the real interest rate) is adjusted upward by 2.84 percent when the output gap increases by 1 percent. So China's monetary policy has an overreaction tendency to the output and does not adjust sufficiently to the inflation rate.

From the first quarter of 1993 to the fourth quarter of 1995, China's economy experienced two-digit inflation rate successively for two years. Since November 1997, the CPI first began the negative growth. For the next two years, the CPI has been of negative growth. The estimated reaction function of China's monetary policy is such a monetary policy rule as inflation coefficient is lower than 1. The instability of such a policy rule explains to a certain extent why China's economy maintained a relatively high inflation rate between 1993-1995 period and the CPI has kept at a negative growth rate after the late 1997.

4. The Policy Suggestions

4.1. The Limitation and the Improvement Direction

[12] Instrument variables include y_{t-1}, π_{t-1}, i_{t-1} and g_{t-1}, representing one period lag of output gap, inflation rate, interest rate, and real GDP growth rate; *t*-stats are reported in parentheses.

[13] *Q*-stat, null hypothesis of no fourth-order serial correlation.

4.1.1. The Estimate of GDP Gap

The estimate of GDP gap is initiated by Okun (1962). In practice, there exist multiple measures to estimate the GDP gap. Take the US for example. The measures cover a broad range of sources, including the Congressional Budget Office (CBO)[14], the International Monetary Fund (IMF)[15], the Organization for Economic Cooperation and Development (OECD)[16], and Standard & Poor's DRI[17]. In theoretical policy studies, there are also many different measures. In general, the measures are of two kinds. One utilizes the production function, the other detrends the time series of the real output. Taylor (1993) simply uses a linear trend of log real GDP over a short sample period (1984-1992) as a proxy for potential output. One could also use a segmented linear trend (Perron, 1989) or a quadratic trend (Clarida, Gertler, and Gali, 1997) or Hodrick – Prescott filter (McCallum, 2000) or other nonstructural methods (Cogley, 1997). McCallum and Nelson (1999) propose a measure based on the assumption of a Cobb-Douglas production function and utilizing values of manhours employed per member of the civilian workforce. Liu and Zhang(2001) employs four measures to estimate China's GDP gap, more specifically, the linear trend, HP filter, univariate state space – Kalman filter, and multivariate state space – Kalman filter.

The reliance of a policy rule upon any output gap measure is risky, for different measures gives quite different values and there is at present no professional consensus on an appropriate measure or even a concept. Linear detrending depends rather sensitively on the time period selected for fitting of the trend. So does quadratic detrending. With respect to the HP filter, the problem is that this procedure produces a "trend" that is so flexible that it follows the time path of actual GDP rather closely, thereby yielding measures of the output gap that would appear to underestimate (in absolute terms) the economically relevant gap values. More fundamentally, McCallum and Nelson (1999) argue that any gap measures based on an output detrending procedure, which excludes the effects of current shocks from the measured gap, is conceptually inappropriate. The point is that (e.g.) positive technology shocks serve to increase the capacity or natural-rate value of output, not the value of actual output relative to the latter; but many univariate detrending procedures presume just the opposite. The method using the production function can overcome this difficulty. This measure treats technological change appropriately and arguably, but the natural-rate values of capital and labor force are not the statistical variables that can be observed directly.

[14] CBO uses a production function approach to estimate historical values of potential output. The production function approach uses a neoclassical production function, combined with assumptions about the growth of the labor force and the rate of saving to determine how potential output will grow over the long term.
[15] The IMF uses a segmented trend approach to estimate an annual potential output series. This approach assumes that the rate of growth of potential output changes at specific structural points, but is constant between these points.
[16] The OECD uses a production function approach to estimate a semiannual potential output series.
[17] Standard & Poor's DRI also uses a production function approach to estimate the potential output.

4.1.2. The Controlled Interest Rate

In China, the interest rate is controlled and most kinds of interest rate including interest rate on deposit and loan are determined by the central bank. When the central bank sets the interest rate policy, besides the general economic conditions and the price level the most concerned issues are how to change the income allocation between the depositor, the borrower, and financial institutions. The policy is often oriented at supporting the reform of reconstructing the stated-owned enterprises (Yi, 2001).

In China, the interest rate is determined in the following way. In the first place, the central bank determines the interest rate on one-year time deposit. Then, it is followed by the interest rates on 3-month, 6-month, 3-year, 5-year time deposit. Then, the interest rate on loan is determined. Except for the interbank interest rate and the black-market interest rate, others are the plan-controlled interest rates. The central bank does not adjust certain kind of interest rate to affect other kind of interest rate. So there exists no benchmark interest rate in real term (Xie, 1996; Qian, 2000).

The interest rate in Taylor rule is the short-term interest rate used by the central bank as the policy instrument or target. In our empirical analysis of China's monetary policy in the framework of Taylor rule, we employ the interbank interest rate as the proxy variable. So the estimation under the controlled interest rate regime is a distorted analysis.

4.1.3 The Choice of Interest Rate and the Term Structure

In 2001, the trading volume in National Interbank Market is RMB 808.2 billion Yuan. Generally speaking, this scale is very small compared with the scale of China's financial system. Table 5 shows the term structure of National Interbank Market. In 1996, the interbank lending and borrowing within 7 days (including overnight) account for 28.8%. In 2001, the term structure has changed fundamentally. The interbank lending and borrowing within 7 days (including overnight) have risen to 82.2%. The change of this indicator illustrates that the interbank market has played an important role in adjusting the short-run position between financial institutions (Xie, 2001).

Table 5
The Term Structure of National Interbank Market[18](Unit: percent%)

Year	Overnight	Within 7 days	8-20 days	21-30 days	31-60 days	61-90 days	91-120 days

[18] Data Source: National Interbank Lending and Borrowing Center. The number in the table represents the proportion of trading volume for the corresponding maturity in the overall trading volume.

1996	2.16	26.62	9.99	15.32	25.49	13.10	7.32
1997	6.50	26.15	10.63	13.74	23.14	12.91	6.93
1998	5.91	22.52	14.53	22.62	18.31	10.55	5.56
1999	10.90	28.63	7.39	21.19	27.92	3.30	0.66
2000	7.71	63.75	12.01	4.97	9.19	2.26	0.11
2001	12.85	69.38	11.55	4.37	1.16	0.58	0.11

Before 1997, the interbank market dominates China's money market. The transaction instrument of the money market is simple. Since 1997, relying on the development of interbank bond market, bond repurchase has developed rapidly. Currently, the market members taking part in bond repurchase in interbank market include Chinese-funded commercial banks and their chaptered branch, foreign-funded & joint venture banks, branches of foreign banks, insurance companies, securities companies, fund management companies, and rural credit cooperatives. The total financial assets of all members account for 95% of those of China's financial system. From table 6, the trading volume of bond repurchase is higher than that of interbank and bond repurchase has become the most active transaction type. Since the member in the interbank bond market is broader than the interbank market and the risk of bond repurchase is lower than that of the credit lending, the repurchase transaction is more active and the repurchase interest rate is more stable compared with the lending. Therefore, the repurchase interest rate is more sufficient in representing the liquidity of the financial market.

Table 6
The Trading Volume of the Interbank Lending and Borrowing and Repurchase (Unit: one hundred billion)[19]

Year	Interbank Lending and Borrowing	Repurchase
1997	4149.26	309.87
1998	988.91	1021.48
1999	3291.62	3956.93
2000	6728.08	15781.74
2001	8082.04	39941.72

4.2. The Policy Suggestions

Although the research has many limitations, we still can draw some instructive conclusions from the research result.

Firstly, Taylor rule can provide a benchmark for China's monetary policy and measure the tightness and looseness of monetary policy. Figure 5 compares 7-day bond repo rate, interbank interest rate and open market rate. Table 7 is the correlation matrix of three kinds of interest rate. The correlation degree is enhanced and the term

[19] Data Source: National Interbank Lending and Borrowing Center.

structure of money market tends to become reasonable. And lending and repurchase have become the principal measures to manage the liquidity in the financial institutions. The lending rate and repurchase rate have become the benchmark interest rates of money market. This indicates that it is reasonable to use the interbank interest rate as the proxy variable of the short-term interest rate of central bank's policy instrument. At the same time, the analysis of China's monetary policy in the framework of Taylor rule indicates that the rule value and the actual value are in convergence to some extent. The departure of the rule value from the actual value signals the lag of monetary policy operation from the development of economic situation. Therefore, Taylor rule can provide a benchmark for China's monetary policy operation.

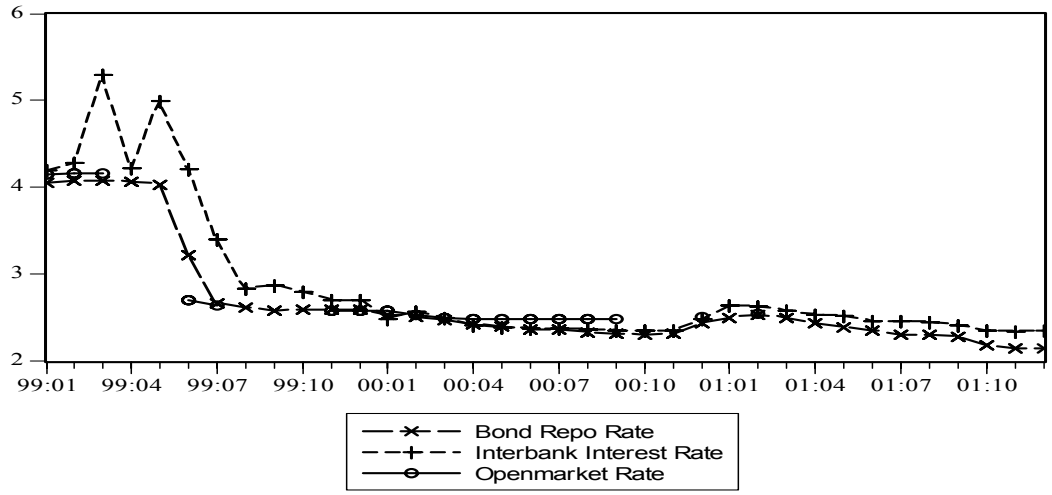

Fig. 5. 7-day Bond Repo Rate, Interbank Interest Rate, and Open Market Rate[20]

Table 7
The Correlation Matrix of 7-day Bond Repo Rate, Interbank Interest Rate, and Open Market Rate

	Bond Repo Rate	Interbank Interest Rate	Open Market Rate
Bond Repo Rate	1.00	0.94	0.97
Interbank Interest Rate	0.94	1.00	0.87
Open Market Rate	0.97	0.87	1.00

Secondly, Taylor rule can enhance the transparency of China's monetary policy and can help implement "forward-looking monetary policy". It is found (Qian, 2000) that the effect of China's monetary policy on consumer price has 6-quarter lag. Taylor rule can shorten the policy lag with the enhanced transparency.

Strengthening the communication between the central bank and the public can

[20] All kinds of interest rates are weighted average interest rates. Data sources: *China Securities and Futures Statistical Yearbook 2000*, China Financial and Economic Publishing House,2000. *China Securities and Futures Statistical Yearbook 2001*, Baijia Publishing House, 2001.

also enhance the transparency of monetary policy. Currently, the public information that the central bank uses to communicate on monetary policy is just by China Financial Outlook, which is turned to The PBOC Annual Report in 2001. So some internal reports such as Monetary Policy Report and The Meeting Summery of Monetary Policy Committee can be released to the public. Such practice can help communicate the viewpoint of the central bank on current economic situations to the public. Such communications not only guide the public's expectation but also improve the transmission efficiency.

Since the march of 1998, PBOC has kept on holding an economic and financial situation analysis meeting each month (Dai, 2000). In this meeting, the central bank reports on national financial conditions and predicts the trend of monetary policy based on the development of the economy. Each general economic department introduces the condition of economic operation and each commercial bank introduces each bank's situation and put forward monetary credit policy requirement to the central bank. From the first quarter of 2001, the monetary policy analysis team of PBOC researches on each quarter's monetary policy implementations and releases the report to the public. The situation analysis meeting and the implementation report have enhanced the transparency of China's monetary policy. The communication channel and the feedback mechanism, which are set up between the public and the central bank, are helpful to the transmission and the formulation of monetary policy.

Thirdly, according to our estimate of China's monetary policy reaction function, China's monetary policy is an unstable monetary policy rule. The adjustment of the interest rate to inflation is accommodative. In this institution, the generation and development of inflation and deflation are of the self-fulfilling mechanism. China's monetary policy should increase the adjustment coefficient of the interest rate to the inflation and the unstable monetary policy rule should be transformed to the stable monetary policy rule.

Fourthly, the interest liberalization reform should be actively implemented. The objective of interest liberalization reform is the market interest system and formation mechanism, in which the central bank's interest rate is the benchmark. The interest rate of the money market is the intermediate and the interest rates on deposit and loan are determined by the information on money demand and supply. The central bank will indirectly control the market interest rate by employing monetary policy instruments.

Appendix: The Actual Value and the Rule Value of the Interest Rate and the Components of Taylor Rule in China's Monetary Policy

Time	The Actual Interest Rate	Taylor Rule Interest Rate	GDP Gap	CPI Inflation Rate	Average CPI Inflation Rate
1992:1	7.6786	8.7581	0.1246	5.3667	5.1305
1992:2	7.7195	12.7778	7.4555	5.5333	5.3667
1992:3	7.8094	7.5550	-3.2399	6.1667	5.4500
1992:4	8.0504	5.0763	-8.9142	8.3000	5.6889
1993:1	8.4799	7.9665	-5.0919	11.1000	6.3417
1993:2	9.6427	14.1877	3.0505	13.9000	7.7750
1993:3	11.9675	15.6212	-0.3576	16.1000	9.8667
1993:4	12.1284	17.1952	-4.6596	17.1333	12.3500
1994:1	12.1000	22.0238	-1.6274	22.2333	14.5583
1994:2	12.1660	26.4806	-1.0637	21.8667	17.3417
1994:3	12.0286	30.8851	1.7703	25.7000	19.3333
1994:4	12.1621	33.6914	0.1827	26.9000	21.7333
1995:1	12.3822	37.5657	0.6065	22.6000	24.1750
1995:2	12.4910	37.1397	-0.5206	19.7333	24.2667
1995:3	12.7998	37.5756	1.9512	14.8000	23.7333
1995:4	12.7119	33.8254	2.6258	11.1333	21.0083
1996:1	12.5406	27.5829	1.9658	9.3667	17.0667
1996:2	11.9618	21.7287	0.1825	9.0667	13.7583
1996:3	11.7756	18.8633	2.4516	7.9333	11.0917
1996:4	11.4327	16.9111	3.6972	6.9667	9.3750
1997:1	11.4552	14.7967	2.5933	5.1667	8.3334
1997:2	11.1417	12.4071	0.9642	2.9333	7.2834
1997:3	10.8967	10.5373	1.8245	2.1333	5.7500
1997:4	9.6037	9.1415	3.3830	1.0000	4.3000
1998:1	8.2176	5.7869	1.1488	0.3000	2.8083
1998:2	6.6451	2.9922	-0.7905	-0.8700	1.5917
1998:3	5.1116	2.3290	0.7356	-1.4330	0.6408
1998:4	4.6333	2.4905	3.7333	-1.1000	-0.2508
1999:1	4.3861	0.2104	0.7480	-1.4000	-0.7758
1999:2	4.2397	-1.9819	-2.3616	-2.1667	-1.2008
1999:3	2.8914	-1.6994	-0.8241	-1.1667	-1.5249
1999:4	2.7084	-0.4090	1.5570	-0.8333	-1.4583
2000:1	2.5075	-1.0062	0.1627	0.1000	-1.3917
2000:2	2.3823	-1.9053	-2.7607	0.1000	-1.0167
2000:3	2.3553	-0.3293	-1.3086	0.2667	-0.4500
2000:4	2.4083	1.0896	0.4541	0.9333	-0.0917
2001:1	2.6070	1.3158	-0.4185	0.7000	0.3500
2001:2	2.4975	-0.0965	-3.6930	1.6000	0.5000
2001:3	2.4379	0.9058	-2.8134	0.8000	0.8750
2001:4	2.3370	1.8731	-1.2787	-0.2000	1.0083

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