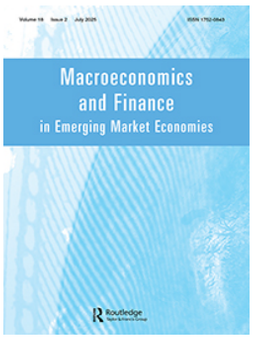

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Is Taylor rule applicable in China: a new understanding based on economic phases

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ABSTRACT

This research extends standard Taylor rule to examine its adaptation in China and reveals that PBC takes the rule as an important consideration while promoting the transformation and enriching of monetary tools. Specifically, PBC significantly responds to inflation and output indicators, especially the expectations. Furthermore, within four divisions since 1998 due to political fundamentals and exogenous shocks, it is found that PBC would adjust the weights on different objectives to adapt, and the tools were enriched to solve different liquidity problems. This research supplies new convincing evidence for Chinese adaptation of Taylor rule, and also reveals the change of China's monetary policy frame.

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1. Introduction

Taylor rule has effectively captured the fundamental principles behind monetary policy implementation in many countries. Consequently, it has emerged as the theoretical foundation guiding the monetary policy operations of prominent institutions such as the Federal Reserve, the European Central Bank, the Bank of England, and the Bank of Canada. A noteworthy fact is that the People's Bank of China (PBC) has executed a successful monetary policy which has maintained rapid Chinese economic growth for several decades.

Since the twenty-first century, scholars have initiated research on the application and relevance of Taylor rule in the Chinese market. China's contemporary investigation into Taylor rule can be attributed to the seminal work of Xie and Luo (2002). Nevertheless, there is still a lack of empirical evidence regarding the extent to which the Chinese monetary authorities employ either the conventional or modified version of the Taylor rule, as well as the appropriate modifications that should be made to the Taylor rule in the Chinese context. A substantial body of academic opinion posits that the classical Taylor rule holds explanatory power over the evolution of China's macroeconomy and that China's monetary policy is consistent with the expectations set by the classical Taylor

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rule. Conversely, other scholarly research argues that the applicability of the classical Taylor rule in China is constrained and advocate for the use of a modified Taylor rule to account for its idiosyncrasies, especially considering the transformation of PBC's monetary tools frame. However, the majority of prior studies have predominantly emphasized the application of foreign quantitative methodologies while neglecting the potential differences between China's monetary policy environment and those of other countries. Consequently, these studies have failed to accurately reflect the monetary policy considerations of China and lack a concrete empirical foundation.

This research extends the standard linear Taylor rule and incorporates forward-looking elements to examine the Chinese adaptation of the Taylor rule and reveals that the PBC takes Taylor rule as an important consideration while promoting the transformation and upgrading of monetary tools frame. All the findings indicate that the PBC effectively takes the Taylor rule into account but integrates distinct Chinese characteristics, particularly by employing different monetary policy instruments at various stages to manage diverse liquidity issues. The results suggest that the PBC's monetary policy essentially adheres to the Taylor rule, primarily targeting the CPI gap and output gap, but also pays attention to the stock market conditions. Moreover, the monetary policy of PBC is forward-looking in nature, and places greater emphasis on future consumption rather than current consumption levels. Based on China's political fundamentals and significant exogenous shocks, using monthly data, we divided the period from January 1998 to April 2025 into four distinct economic phases to show how PBC would adjust the weights on different objectives to adapt to the diverse economic phases and also reveal the process of that PBC has shifted its focus from quantity-based monetary policy instruments to price-based policy instruments. In conclusion, this research not only supplies new convincing evidence for the adaptation of Taylor rule in China but also reveals a dynamic change process of China's monetary policy frame during the economic growth miracle in past three decades.

This research is arranged as follows: the first part is an introduction; the second part is the literature review; the third part is the illustration of data, models and variables; the fourth part is the estimation of benchmark classic Taylor rule model involving considering about economic decomposition and different economic phases; the fifth part is the further estimation involving forward-looking considerations; the sixth part is the conclusion.

2. Literature review

In 1993, the Taylor rule was introduced, which incorporates interest rates as the operational variable. The rule assumes a linear relationship between the interest rate and both the inflation gap and the output gap, referred to as the 'Taylor rule', which has been studied as the benchmark to describe the Central Bank's monetary policy behavior.

2.1. The supports and limitations

The extant literature provides substantial evidence in favor of the existence of a Taylor rule. Mark and Davradakis (2006) discovered evidence of the Bank of England's non-linear Taylor rule implementation. Kulikauskas (2014) discovered comparable evidence in support of the European Central Bank. Maza and Sanchez-Robles (2013) discovered that the

European Central Bank's monetary policy decisions from 1999 to 2002 and 2007 to 2009 were exactly consistent with the Taylor rule.

However, some of the suggested attractive qualities of this rule were promptly questioned. First, Taylor concept was not 'operational'. As McCallum (1993) pointed out, as it required information that the policymaker might not have on hand. Most importantly, this formula forces policymakers to make decisions and develop policies based on implicit presumptions about ideas that are widely recognized to be notoriously unreliable as policy indicators, such as potential output and the natural rate of interest (or the associated natural rate of unemployment or 'NAIRU'). These challenges, at the very least, provide a compelling argument for considering this specific regulation to be a tactic that could only be carried out with a significant degree of discretion. Chairman Greenspan (1997) underlined this point: these formulations are not rigid laws that take away discretion, but rather, they are, at most, 'guideposts' to assist central banks. Second, there was a lack of an explicit role for forecasts. It is not clear how projections and related assessments of potential future economic events fit within the traditional Taylor rule. Meyer (2002) points out that while the Taylor rule has been a useful guide for decision-makers, projections have had a significant impact on how monetary policy has responded in a way that is not reflected in the straightforward Taylor rule. Officials from the Federal Reserve have consistently stated that the process of formulating monetary policy is forward-looking; therefore, policy guidelines that do not include this knowledge in their historical evaluations of policy actions may show to be insufficient. Third, it is not flexible. 'The policy rule need not be a mechanical formula', according to Taylor (1993). This particular formula forces policymakers to adhere to a particular analytical framework and forbids the use of sound judgment when creating policy beyond the parameters of any set formula.

2.2. Adjustment of Taylor rule

Following Taylor, numerous studies have looked at other guidelines that are referred to as the extended Taylor rule (Darius 2014; Richard et al. 2000; John 2001; W. Michael 2001; Mark and Davradakis 2006; Olivier 2012). Clarida, Gali, and Gertler (2000) added the interest rate smoothing term and found that Taylor rule should take account of interest rate smoothing. Woodford (2001) considered the question in the context of the 'neo-Wicksellian' model derived in Woodford (2000), and this reduces to a pair of log-linear relations, an intertemporal 'IS' equation of the form and an expectations-augmented 'AS' equation of the form, argued that an optimal rule will generally involve a commitment to history-dependent behavior rather than a set on the basis of current measures of the target variables alone. Coibion (2012) introduced a time-varying inflation target and a time-varying output gap target into the rule. Hutchison, Sengupta, and Singh (2013) constructed the time-variant Taylor rule based on Markov transformation (MRS) model, and he found the change of monetary policy response parameter has the characteristics of regional system transfer due to the change of monetary policy system. Later, DSGE and Monte Carlo simulations were involved in the model to identify the monetary policy response to more micro-structural shocks (Carlstrom and Fuerst 2016; Iiboshi 2016; Yüksel, Metin-Ozcan, and Hatipoglu 2013, Zhu and Chen 2017). However, the classical form of the rule was still the widely used dominant equation when referring to the behaviors of

central Banks, with more consideration of policy lag and forward-looking such as interest smoothing to prevent overshooting (Bhattarai 2018).

2.3. Application for China

Further investigation of the application of the Taylor rule in China is highly significant from a research standpoint. Chinese academics have been conducting empirical innovation from a variety of perspectives since the start of the twenty-first century. They have studied and analyzed the implementation of the Taylor rule in China. Whether China's monetary policy fits the description of the Taylor rule, however, is still up for debate. For the first time, Xie and Luo (2002) examined the application of China's monetary policy using the conventional Taylor rule equation. Q. Li and Wang (2009) tested China's interest rate policy using the standard form of Taylor rule and discovered that while the Taylor rule can serve as a policy reference and measurement for China's monetary policy, the response function of China's monetary policy is unstable and cannot be better estimated. With the development and deepening of empirical research, some scholars believe that since the classical Taylor rule applies to countries with market-oriented interest rates, a floating exchange rate system, and the stability conditions of the Taylor rule (H. Lu 2005; Tan 2006), there are specific differences with China's national conditions, so it is necessary to revise the standard equation.

Some empirical studies have shown that the modified Taylor rule can better fit the empirical data of China and with the development of the reform of the exchange rate system and also the marketization of interest rates, its applicability would continue to increase, which has great potential in China's macroeconomic field: J. Lu and Zhong (2003) believed that the traditional or forward-looking Taylor rule can provide a description for China's interbank lending rate, and then reflect the policy direction of the central bank; Chen, Yang, and Tu (2006) constructed the forward-looking Taylor rule based on the introduction of exchange rate, and believed that the Taylor rule has some explanatory power for China's economic growth; Zheng and Liu (2010) pointed out that the nonlinear perspective of regional transfer can provide a new perspective for the applicability of Taylor rule; Liu (2011) argued that the forward-looking Taylor rule with additional expectations can effectively anchor inflation expectations, provides a key role for inflation management, and also help further promote the process of interest rate marketization; G. S. Wang (2014) found through research that introducing the volatility factor of the stock market into the Taylor rule can better improve the applicability of China's monetary policy.

2.4. Literature summary

In summary, a comprehensive review of existing literature shows that the Taylor rule has been widely explored in various countries. Moreover, since the early twenty-first century, a large number of studies have been conducted to evaluate the feasibility and applicability of the Taylor rule in China. However, there remains a lack of empirical evidence on the extent to which China's monetary authority has adopted either the conventional or modified version of the Taylor rule, as well as on what appropriate modifications should be made to the Taylor rule in the Chinese context.

Additionally, previous studies have two limitations. First, the data selected in existing research often has an insufficient time span to exclude the impact of exogenous shocks on the PBC. Second, past studies tend to use a single monetary policy tool, ignoring the richness of the PBC's monetary policy and its behavior of adopting different operations and tools in various economic phases. The organizational structure and functions of PBC have been shaped by China's unique national conditions and institutional evolution, standing in sharp contrast to the institutional frameworks of other central banks. As an important component of the government, the PBC gives priority to macroprudential stability and social development. It also places emphasis on market risks and financial risks, aiming to timely adjust the nation's monetary policies and supervise the integrity of financial markets.

Therefore, this research work aims to enhance the understanding of the PBC's uniqueness by building upon prior academic discourses. It seeks to expand the applicability of the Taylor rule by adapting it to China's context, incorporating variables that reflect Chinese characteristics – including different interest rate tools for long-, medium-, short-term liquidity, political phases and exogenous shocks – to construct a China-specific Taylor rule.

3. Data, models and variables

3.1. Data selection

This paper selects the reverse repo rate and the Shanghai Interbank Offered Rate (SHIBOR) from January 1998 to April 2025, the Standing Lending Facility (SLF) rate published from its announcement in 2013 to April 2025, the Medium-term Lending Facility (MLF) rate published from April 2014 to April 2025, as well as the monthly year-on-year growth rates of CPI, GDP and PPI, real estate prices, the year-on-year growth rate of U.S. GDP and the Shanghai Composite Index for corresponding years. All the Chinese domestic macro data was collected through the PBC database and China's National Statistical Yearbooks, and the foreign macro data was collected through the Federal Reserve Economic Data (FRED).

3.2. Benchmark models

Drawing on Taylor rule, this paper constructs two econometric regression models as follows:

$$y_i = i^* + \beta_{1i}(CPI - CPI^*) + \beta_{2i}(GDP - GDP^*) + \beta_{3i}(PPI - PPI^*) + \beta_{4i}Realestate\_price_i + \beta_{5i}USGDP + \beta_{6i}SHCompositeindex_i + \varepsilon_i \quad (M - I)$$

$$y_i = i^* + \beta_{1i}(CPI - CPI^*) + \beta_{2i}investchange + \beta_{3i}consumptionchange + \beta_{4i}exportchange + \beta_{5i}(PPI - PPI^*) + \beta_{6i}Realestate\_price_i + \beta_{7i}USGDP + \beta_{8i}SHCompositeindex_i + \varepsilon_i \quad (M - II)$$

Among them, y_t refers to *Repo_rate*, *Shibor_overnight*, *MLF_rate*, *SLF_rate*, *PBCbehavior*, *PBCbehavior_Reserve_requirement* and*PBCbehavior_interest_rates_Cut*, which are illustrated as below.

3.3. Variable illustration

3.3.1. Dependent variables

This research select different interest rate tools for long-, medium- and short-term liquidity to construct a China-specific Taylor rule equation.

Repo_rate denotes the reverse repo rate. As a long-term liquidity tool, it represents the 'core instrument' of the PBC's open market operations, directly reflecting the PBC's intention to regulate short-term liquidity and influencing market funding conditions. Bond-backed repurchase agreements are a form of financing with minimal risk, involving short-term loans obtained from multiple organizations.

Shibor_overnight refers to the Shanghai Interbank Offered Rate (overnight rate). As a long-term liquidity tool, it represents the benchmark interest rate of China's money market, reflecting the short-term funding costs among financial institutions and serving as a benchmark for bond pricing and derivative transactions. Interbank lending rates and bond repurchase rates are two key interest rates that exhibit a reciprocal relationship in Granger causality and perform similar functions in trading activities.

MLF_rate represents the Medium-term Lending Facility (MLF) rate. As a medium-term liquidity tool, it serves as the 'anchor' for the central bank's medium-term policy rate, guiding medium-term market interest rates and credit costs, and forming the pricing basis for the Loan Prime Rate (LPR).

SLF_rate denotes the Standing Lending Facility (SLF) rate. As a short-term liquidity tool, it embodies the central bank's role as the 'lender of last resort', used to address ultra-short -term liquidity strains in financial institutions and guard against systemic risks.

PBCbehavior is a dummy variable representing PBC's reserve rate and interest rate adjustment policies. Specifically, it equals −2 when the PBC simultaneously reduces the reserve rate and cuts interest rates; equals −1 when the PBC reduces the reserve rate or cuts interest rates (either policy alone); equals 0 when the PBC takes no action on reserve requirements or interest rates; equals 2 when the PBC simultaneously increases the reserve rate and hikes interest rates; equals 1 when the PBC increases the reserve rate or hikes interest rates (either policy alone).

PBCbehavior_Reserve_requirement is a dummy variable representing the PBC's adjustments to the reserve rate. Specifically, it equals −1 when the PBC implements a reserve rate cut; equals 0 when the PBC maintains or increases the reserve rate; equals +1 when the PBC implements a reserve rate hike.

PBCbehavior_interest_rates_Cut is a dummy variable representing the PBC's window guidance on interest rate adjustment. Specifically, it equals −1 when the PBC uses window guidance to implement an interest rate cut; equals 0 when the PBC maintains or uses window guidance to implement an interest rate hike; and equals 1 when the PBC uses window guidance to implement an interest rate hike.

3.3.2. Independent variables

gap_CPI_YoY represents the CPI gap, defined as $CPI_i - CPI^*$. The Consumer Price Index (CPI) and Retail Price Index (RPI) are widely recognized as primary metrics for measuring internal inflation trends in the Chinese economy. The key distinction between these two indicators lies in the inclusion of service prices in the CPI, whereas the RPI excludes the tertiary industry. As such, the CPI possesses a stronger capacity to comprehensively

characterize domestic price fluctuations in China, thereby establishing a more robust correlation with GDP. The target value of CPI is derived from the Annual Draft Plan for National Economic and Social Development released by the National People's Congress each year.

gap_CPI_YoY_back is the data extrapolated from the trend of *gap_CPI_YoY* over three quarters.

gap_GDP_YoY denotes the GDP gap, defined as $GDP_i - GDP^*$. This study employs the real GDP growth rate calculated at constant prices provided by the National Bureau of Statistics of China. The target value of GDP is sourced from the Annual Draft Plan for National Economic and Social Development published by the National People's Congress annually.

gap_GDP_YoY_back is the data extrapolated from the trend of *gap_GDP_YoY* over three quarters.

gap_PPI_YoY signifies the PPI gap, defined as $PPI_i - PPI^*$. The Producer Price Index (PPI) is a critical economic indicator that captures price fluctuations within the production sector over a specific time frame. The target value of PPI is determined using the Hodrick–Prescott (HP) filter method.

gap_PPI_YoY_back is the data extrapolated from the trend of *gap_PPI_YoY* over three quarters.

investchange represents the change in China's fixed asset investment completion amount. As the investment completion amount in the same period of the previous year can serve as an anchor for the current period, this study calculates the year-on-year monthly change in China's fixed asset investment amount. Meanwhile, since PBC's consideration of investment is more based on quarterly data, this study converts monthly averages into quarterly data.

investchange_back is the data extrapolated from the trend of *investchange* over three quarters.

consumptionchange denotes the change in China's total retail sales of social consumer goods. The calculation method for consumption change is the same as that for investment change.

consumptionchange_back is the data extrapolated from the trend of *consumptionchange* over three quarters.

exportchange signifies the change in China's export value. The calculation method for export change is identical to that for investment change.

exportchangec_back is the data extrapolated from the trend of *exportchange* over three-quarters.

3.3.3. Control variables

Realestate_price represents China's real estate prices, serving as an indicator for the country's real estate industry. China's real estate prices significantly impact the macroeconomy and financial markets: they influence household consumption and corporate investment through mechanisms such as the wealth effect and investment effect, thereby affecting overall economic growth. As such, they constitute a critical consideration in monetary policy objectives to promote growth. For financial stability, real estate serves as a key collateral for bank credit; housing price fluctuations directly affect credit risks, with rising/falling prices triggering bank credit expansion or non-performing loan risks,

respectively. Including housing prices as a control variable helps accurately assess the impact of monetary policy on financial stability and prevent systemic financial risks. Real estate prices are calculated as the average of price indices for newly constructed commercial housing and second-hand residential housing sales in China.

USGDP_YoY represents the year-on-year change in U.S. GDP, serving as a proxy for external economic shocks. First, both China and the U.S. have significant economic scales, exerting substantial influence on global economic stability and development. Second, their large trade volumes – with the U.S. as the world's largest exporter and China as the largest importer – create mutual interdependencies through frequent trade exchanges. Finally, the U.S. maintains a leading role in international financial markets, meaning any policy actions or decisions it undertakes can have profound impacts on other countries, particularly China. For these reasons, trade-related differences (proxied by U.S. GDP growth) must be included as control variables.

SHCompositeindex refers to the Shanghai Composite Index, representing China's stock market. Financial markets, especially equity markets, can serve as barometers of a country's fundamental economic conditions. The Shanghai Stock Exchange is China's largest and oldest securities exchange, characterized by strong scale, liquidity and leading market capitalization. The Shanghai Composite Index is widely regarded as a key benchmark for China's stock market.

4. Estimation of benchmark models

4.1. Baseline estimation of classic model

This study employs general linear regression as the empirical estimation method for the model, generating Table 1. The regression results show that PBC's monetary policy generally adheres to the Taylor rule, with significant attention paid to both the CPI gap and the output gap.

The CPI gap exhibits a significantly positive correlation with the four interest rates. When the CPI gap widens, inflationary pressures rise, prompting the central bank to adopt

Table 1. Benchmark estimation of the classic model.

Variables	Repo_rate	Shibor_overnight	MLF_rate	SLF_rate
gap_CPI_YoY	0.156***	0.172***	0.195***	0.243**
	(4.86)	(4.87)	(7.89)	(2.73)
gap_GDP_YoY	0.0426**	0.0702***	0.0307***	0.0605
	(2.72)	(4.07)	(3.45)	(1.90)
gap_PPI_YoY	−0.00470	0.0501**	0.0162	−0.0107
	(−0.30)	(2.95)	(1.77)	(−0.36)
Realestate_price	0.00552	−0.00704	−0.0110***	0.0125
	(1.33)	(−1.54)	(−3.93)	(1.38)
USGDP_YoY	0.0337	0.0416	0.00790	0.0369
	(1.54)	(1.72)	(0.67)	(0.88)
SHCompositeindex	−0.000803***	−0.000853***	−0.0000453	−0.000963***
	(−7.59)	(−7.33)	(−0.35)	(−4.40)
Constant	4.883***	5.135***	3.706***	6.373***
	(11.58)	(11.06)	(9.05)	(7.82)
Observations	171	171	102	135

statistics in parentheses.
*$p < 0.05$, **$p < 0.01$, ***$p < 0.001$.

a monetary tightening strategy; when the CPI gap narrows, inflationary pressures subside, leading the central bank to implement monetary easing. This aligns with the conventional logic of monetary policy regulation. The GDP gap is significantly and positively correlated with the reverse repo rate, SHIBOR rate and MLF rate, but not with the SLF rate. The GDP gap reflects the hot/cold status of economic growth: when the GDP gap expands, indicating overheating, the central bank adopts a monetary tightening strategy; when the GDP gap contracts, indicating cooling, the central bank implements monetary easing. It has a more pronounced impact on medium-to-long-term interest rates, such as the reverse repo rate, SHIBOR rate and MLF rate. As a short-term liquidity adjustment tool, the SLF primarily targets short-term market liquidity fluctuations and sudden fund demands. Its decisions are more influenced by the central bank's short-term policy intentions and real-time market liquidity conditions, focusing more on stabilizing short-term market sentiment and fund supply–demand relationships rather than adjusting solely based on the hot/cold status of economic growth (i.e. the GDP gap). The PPI gap is only significantly and positively correlated with the SHIBOR rate, while the housing price index is nearly significantly and positively correlated with the MLF rate. The U.S. economic development level is not correlated with the four dependent variables. This indicates limited attention paid by PBC to the PPI gap, housing price index, and U.S. economic conditions. The Shanghai Composite Index is significantly and negatively correlated with the reverse repo rate, SHIBOR rate and MLF rate with very small coefficients. On the one hand, this reflects that PBC's monetary policy takes stock market conditions into account – though not treating them as a primary target. On the other hand, it also embodies a reverse causality consistent with the Merrill Lynch Investment Clock, where the central bank's monetary easing policies stimulate economic recovery and benefit the stock market.

4.2. Estimation of economic growth decomposition

To enhance the identification and ease the endogeneity, this paper further decomposes output into year-on-year changes in investment, consumption, and exports, and re-conducts the regression. The results are shown in Table 2. Again, the CPI gap remains significantly positively correlated, indicating that PBC's monetary policy attaches great importance to the CPI indicator. The partial significance of the PPI gap also suggests that the central bank occasionally pays attention to the PPI indicator. The year-on-year change in investment is significantly negatively correlated with the reverse repo rate and SLF rate, while the year-on-year change in exports is significantly positively correlated with these two dependent variables. A rapid increase in investment often signals an expansion phase of the economy, but in this case, PBC chooses to cut interest rates to stimulate investment further and leverage the momentum to promote investment. When export growth slows, on the one hand, PBC may implement interest rate cuts to induce RMB depreciation and facilitate capital outflows, thereby enhancing China's export competitiveness; on the other hand, given exports' critical role in the Chinese economy, a decline in exports often signals a crisis in economic fundamentals. In response, the PBC adopts accommodative policies to inject liquidity, stimulate domestic consumption as a substitute for exports, and mitigate deflationary risks. The year-on-year change in consumption exhibits a significant positive correlation only with the MLF rate, indicating that under long-term liquidity conditions, traditional monetary policies pay limited attention to current

Table 2. Benchmark estimation of the decomposed economic growth.

Variables	Repo_rate	Shibor_overnight	MLF_rate	SLF_rate
gap_CPI_YoY	0.167***	0.165***	0.178***	0.232**
	(5.13)	(4.44)	(7.02)	(2.73)
investchange	−0.0315**	−0.0165	−0.00493	−0.0690**
	(−2.67)	(−1.22)	(−0.70)	(−3.08)
consumptionchange	0.0143	0.0185	0.0141*	0.0377
	(1.49)	(1.69)	(2.54)	(1.98)
exportchange	0.0101**	0.00573	−0.00221	0.0137*
	(3.01)	(1.49)	(−1.00)	(2.13)
gap_PPI_YoY	−0.00905	0.0536**	0.0295*	−0.00258
	(−0.51)	(2.63)	(2.58)	(−0.07)
Realestate_price	0.0123**	−0.000619	−0.0109**	0.0211*
	(2.83)	(−0.12)	(−3.21)	(2.17)
USGDP_YoY	0.0475	0.0234	−0.0134	0.0658
	(1.79)	(0.77)	(−0.78)	(1.22)
SHCompositeindex	−0.000722***	−0.000768***	0.0000476	−0.000835***
	(−6.84)	(−6.35)	(0.35)	(−3.76)
Constant	4.344***	4.679***	3.443***	5.518***
	(10.11)	(9.51)	(7.84)	(6.60)
Observations	171	171	102	135

statistics in parentheses.
*$p < 0.05$, **$p < 0.01$, ***$p < 0.001$.

consumption, while emerging monetary policies are increasingly focused on it. Consumption changes stem from income changes and demonstrate a time lag in responding to short-term interest rates, making China's monetary policy more directly impactful on investment and exports in the short term. Long-term interest rate tools, however, may lead to overshooting. As such, consumption changes are primarily associated with the medium-term liquidity tool (MLF rate).

4.3. Estimation of the PBC's behavior

The regression results between PBC's reserve rate cuts and interest rate cuts and each indicator are shown in Table 3. The results indicate that the PBC's and interest rate cut behaviors exhibit a significant positive correlation with the CPI gap, GDP gap and PPI gap.

Table 3. Estimation of the PBC's behavior.

Variables	PBCbehavior	PBCbehavior_Reserve_requirement	PBCbehavior_interest_rates_Cut
gap_CPI_YoY	0.0869**	0.0569*	0.0300
	(2.62)	(2.41)	(1.39)
gap_GDP_YoY	0.0633***	0.0340**	0.0293**
	(3.91)	(2.95)	(2.78)
gap_PPI_YoY	0.0511**	0.0230*	0.0281**
	(3.21)	(2.03)	(2.71)
Realestate_price	−0.000118	0.00223	−0.00235
	(−0.03)	(0.73)	(−0.84)
USGDP_YoY	−0.0496*	−0.0337*	−0.0159
	(−2.20)	(−2.09)	(−1.08)
SHCompositeindex	−0.000108	0.0000405	−0.000148*
	(−0.99)	(0.52)	(−2.09)
Constant	0.318	−0.171	0.489
	(0.73)	(−0.55)	(1.72)
Observations	171	171	171

statistics in parentheses.
*$p < 0.05$, **$p < 0.01$, ***$p < 0.001$.

This suggests that when inflation intensifies or the economy overheats, the PBC implements monetary tightening policies, while it adopts monetary easing policies during severe deflation or economic downturns. The significant negative correlation between/ interest rate cut behaviors, and U.S. GDP implies that when the U.S. economy performs well, the Federal Reserve may adopt accommodative monetary policies to further boost economic prosperity, and the PBC tends to follow the Fed by cutting interest rates.

4.4. Estimation based on economic phase

When dividing China's economic phase, this study takes major economic events, such as the financial crisis and exogenous demand shocks, as well as China's political phase into account simultaneously. According to China's political phase and important exogenous shocks, such as the subprime mortgage crisis, the marketization of China's interest rates and the Sino-US trade disputes, the time period from January 1998 to April 2025 can be divided into four well-defined eras. Subsequently, a phased regression is conducted for each interest rate to analyze the focus of PBC's monetary policy in each stage.

The first stage is from January 1998 to December 2007, which is a stable period for the Chinese economy. The second stage covers the period from January 2008 to December 2012 and is characterized by the impact of the exogenous shock of the subprime mortgage crisis. The third stage is from January 2013 to December 2017. During this period, Xi Jinping became the General Secretary of the Central Committee of the Communist Party of China. Through a series of policies, PBC abandoned the 'flood-like' macro-economic policy, and the completion of the market-oriented reform of interest rates is also one of the criteria for dividing this stage. From January 2018 to April 2025 is the fourth phase, accompanied by significant exogenous demand shocks, such as the China–US trade disputes and the COVID-19 pandemic. Since the SHIBOR rate is more a result of money market liquidity rather than the PBC's benchmark rate, the phased regression analysis uses reverse repo

Table 4. Estimation of repo rate in diverse phases.

Variables	Repo_rate January 1998–December 2007	Repo_rate January 2008–December 2012	Repo_rate January 2013–December 2017	Repo_rate January 2018–December 2025
gap_CPI_YoY	0.214***	−0.0105*	−0.155	0.189***
	(11.42)	(−2.23)	(−1.05)	(9.35)
gap_GDP_YoY	0.0705**	−0.00535	−0.371	0.0368***
	(3.24)	(−0.83)	(−0.99)	(5.07)
gap_PPI_YoY	−0.0658***	0.0112***	−0.0389	0.00641
	(−4.04)	(4.49)	(−1.43)	(0.72)
USGDP_YoY	0.209***	−0.0213***	0.621***	−0.000400
	(9.21)	(−6.41)	(6.01)	(−0.04)
SHCompositeindex	−0.000184***	0.0000687***	−0.00110***	−0.000162
	(−5.00)	(4.10)	(−9.97)	(−1.60)
Constant	3.004***	3.326***	4.682***	2.966***
	(19.58)	(85.12)	(15.22)	(9.48)
Observations	120	60	60	84

statistics in parentheses.
*$p < 0.05$, **$p < 0.01$, ***$p < 0.001$.

Table 5. Estimation of MLF and SLF rates in diverse phases.

Variables	MLF_rate January 2013–December 2017	SLF_rate January 2013–December 2017	MLF_rate January 2018–April 2025	SLF_rate January 2018–April 2025
gap_CPI_YoY	−0.0398	0.115	0.218***	0.199***
	(−1.55)	(0.36)	(8.85)	(9.34)
gap_GDP_YoY	0.683**	−2.223*	0.0350***	0.0375***
	(3.73)	(−2.62)	(3.90)	(4.89)
gap_PPI_YoY	−0.0253*	0.0194	0.000657	0.00390
	(−2.30)	(0.34)	(0.06)	(0.41)
USGDP_YoY	0.109	1.004***	−0.000173	−0.00177
	(2.07)	(4.48)	(−0.01)	(−0.17)
SHCompositeindex	0.000367	−0.00127***	0.0000172	−0.000164
	(1.67)	(−5.01)	(0.13)	(−1.54)
Constant	1.474*	6.373***	3.159***	3.954***
	(2.42)	(9.71)	(7.50)	(11.98)
Observations	20	48	80	84

statistics in parentheses.
*$p < 0.05$, **$p < 0.01$, ***$p < 0.001$.

rates, MLF rates and SLF rates. The regression results are shown in Tables 4–5. Finally, this study conducts grouped regression analyses on reserve tools and interest rate tools in two periods: 1998–2012 and 2013–April 2025, to verify PBC's shift from quantitative monetary tools to a greater emphasis on price-based monetary tools.

Table 4's regression results on reverse repo rates show that PBC's monetary policy has gone through a process of 'following the Taylor rule – adjustment – return to the Taylor rule', indicating that the reform of monetary policy can be visualized. Before the subprime mortgage crisis, during a period of stable global economic conditions, policy largely conformed to the Taylor rule, adjusting interest rates based on the CPI gap and GDP gap. Between 2011 and 2017, China's macroeconomic policies were adjusted. President Xi Jinping's emphasis on preventing systemic financial risks, requiring the financial sector to shift from speculative activities to supporting the real economy, and strengthening the central bank's macroprudential management constrained the PBC's use of interest rate tools. The central bank's decision not to treat long-term liquidity instruments as primary monetary policy tools reflects China's resolve to abandon 'flood-like' monetary approaches. The regression results also show that the correlation between the reverse repo rate and economic fundamental indicators is not significant. After 2018, in response to exogenous demand shocks, such as the China–US trade disputes and the pandemic, PBC adjusted its policy focus and tool selection, reverting to the Taylor rule. It began using reverse repo rates to conduct counter-cyclical adjustments to economic fundamentals.

The results of the phased regression analysis on MLF and SLF rates are shown in Table 5. During 2013–2017, MLF and SLF rates exhibited a significantly positive correlation with the GDP gap. The primary objective of PBC in introducing MLF and SLF was to support economic growth, with GDP serving as the key target. In this phase, the insignificant impact of the two rates on CPI also indicates that this political phase remained in a state of liquidity suppression, with no large-scale use of monetary tools and restrictions on long-term, medium-term and short-term interest rate instruments. After 2018, to better address exogenous demand shocks, the central bank began using MLF and SLF to manage short-to-medium-term liquidity while also considering targets such as CPI.

Table 6. Estimation of reserve rate and interest rate in diverse phases.

Variables	Reserverate_YoY January 1998–December 2012	Repo_rate January 1998–December 2012	Shibor_overnight January 1998–December 2012	Reserverate_YoY January 2013–April 2025	Repo_rate January 2013–April 2025	Shibor_overnight January 2013–April 2025
gap_CPI_YoY	−0.0000625	0.193***	0.392***	−0.00943	0.181***	0.134*
	(−0.00)	(11.81)	(6.13)	(−0.48)	(3.54)	(2.57)
gap_GDP_YoY	0.0728***	0.0231	−0.0157	0.00666	0.0501**	0.0621**
	(3.54)	(1.31)	(−0.31)	(0.93)	(2.69)	(3.27)
gap_PPI_YoY	0.0134	−0.0798***	−0.105**	0.00737	0.00538	0.0449*
	(0.87)	(−5.99)	(−3.20)	(1.11)	(0.31)	(2.55)
USGDP_YoY	−0.0173	0.00380	0.0387	−0.0108	0.0341	0.0304
	(−0.77)	(0.20)	(0.76)	(−1.18)	(1.43)	(1.25)
SHCompositeindex	0.000106*	−0.000135**	−0.000577***	−0.0000337	−0.000884***	−0.000740***
	(2.06)	(−3.04)	(−3.91)	(−0.87)	(−8.77)	(−7.21)
Constant	−0.316*	3.694***	3.790***	0.0429	5.395***	4.496***
	(−2.09)	(28.37)	(10.22)	(0.38)	(18.42)	(15.09)
Observations	179	180	75	144	144	144

statistics in parentheses.
*$p < 0.05$, **$p < 0.01$, ***$p < 0.001$.

Table 7. Forward-looking estimation of the classic model.

Variables	Repo_rate	Shibor_overnight	MLF_rate	SLF_rate
gap_CPI_YoY_back	0.198***	0.166***	0.326***	0.605***
	(5.29)	(3.97)	(11.47)	(5.12)
gap_GDP_YoY_back	0.0504	0.134***	0.101***	0.157*
	(1.61)	(3.81)	(6.27)	(2.34)
gap_PPI_YoY_back	0.000520	0.0548**	0.0215**	−0.0121
	(0.03)	(2.93)	(2.95)	(−0.39)
Realestate_price	0.00481	−0.00929	−0.00494	0.0241*
	(1.12)	(−1.93)	(−1.83)	(2.46)
USGDP_YoY	0.0398	0.0190	0.00998	0.0349
	(1.42)	(0.60)	(0.84)	(0.68)
SHCompositeindex	−0.000735***	−0.000821***	−0.000185*	−0.000685**
	(−6.78)	(−6.75)	(−2.03)	(−3.16)
Constant	4.720***	5.143***	4.107***	5.578***
	(10.88)	(10.57)	(13.59)	(6.81)
Observations	171	171	102	135

statistics in parentheses.
*$p < 0.05$, **$p < 0.01$, ***$p < 0.001$.

The verification results of whether the focus of PBC's monetary policy has shifted are presented in Table 6. During the 1998–2012 period, PBC more frequently adopted quantitative monetary tools but shifted to greater use of price-based monetary tools in the 2013–2024 period. The reserve rate showed no significance with the CPI indicator, but a significantly positive correlation with the GDP indicator in the 1998–2012 phase. This indicated that as a super-long-term liquidity tool, its focus was on output rather than inflation though after 2013 the reserve rate became insignificant for both CPI and GDP indicators. While the reverse repo rate and SHIBOR rate showed no significance for the GDP indicator in the 1998–2012 phase, but became significant for both CPI and GDP indicators after 2013, suggesting that PBC shifted the focus of monetary policy tools from quantitative to price-based ones after 2013. And as China's commercial banking system attached great importance to systemic risk after maturity and often held excess reserves, the impact of the reserve rate tool on the market was limited.

5. Further estimation of forward-looking model

Due to there would be a time lag in the central bank's monetary policies, such as two or three quarters as mostly revealed in the literature, this paper conducts trend extrapolation for three quarters on the CPI gap, GDP gap and PPI gap before re-regression, with results shown in Table 7. Both the CPI gap and GDP gap exhibit a significantly positive correlation with the interest rate tools, the PPI gap is mostly significantly positive, and the Shanghai Composite Index is mostly negatively correlated, similar to the benchmark regression results (Table 1). This indicates that PBC incorporates forward-looking factors into the Taylor rule when formulating monetary policy.

Table 8 shows the regression results after a three-quarter forward-looking analysis of the CPI gap, PPI gap, investment changes, consumption changes and export changes. Compared with the benchmark regression (Table 2), the significance of the CPI indicator, investment changes and export changes is similar, indicating that forward-looking factors still hold in PBC's monetary policy. In addition, forward-looking consumption changes are significantly positively correlated with the Shibor rate, MLF rate and SLF rate, while current

Table 8. Forward-looking estimation of the decomposed economic growth.

Variables	Repo_rate	Shibor_overnight	MLF_rate	SLF_rate
gap_CPI_YoY_back	0.199***	0.179***	0.390***	0.874***
	(5.60)	(4.37)	(11.34)	(7.84)
investchange_back	−0.0304*	−0.0406**	−0.0509***	−0.192***
	(−2.34)	(−2.71)	(−5.55)	(−6.40)
consumptionchange_back	0.00307	0.0267	0.0414***	0.123***
	(0.26)	(1.94)	(5.86)	(5.00)
exportchange_back	0.0147***	0.0145***	0.00867***	0.0411***
	(4.46)	(3.81)	(3.77)	(5.49)
gap_PPI_YoY_back	−0.00952	0.0509*	0.0299***	0.00704
	(−0.52)	(2.40)	(3.44)	(0.22)
Realestate_price	0.00749	−0.00458	0.00280	0.0558***
	(1.83)	(−0.97)	(0.78)	(5.56)
USGDP_YoY	0.0780**	0.0779**	0.0541***	0.119**
	(3.10)	(2.68)	(5.02)	(2.95)
SHCompositeindex	−0.000818***	−0.000877***	0.0000707	−0.000455*
	(−7.79)	(−7.24)	(0.68)	(−2.26)
Constant	4.743***	4.992***	2.989***	3.743***
	(11.57)	(10.55)	(8.68)	(4.82)
Observations	171	171	102	135

statistics in parentheses.
*$p < 0.05$, **$p < 0.01$, ***$p < 0.001$.

consumption changes are only significantly positively correlated with the MLF rate. This suggests that PBC considers the impact of monetary policy on future consumption more than current consumption, and once again verifies the medium-to-long-term nature of consumption.

6. Conclusion

Following the twenty-first century, scholars have initiated research on Taylor rule, conducting empirical analyses utilizing data from the Chinese market. However, the majority of prior studies have predominantly emphasized the application of foreign quantitative methodologies, while neglecting the potential differences between China's monetary policy environment and those of other countries. This study extends the standard linear Taylor rule and incorporates forward-looking elements. The findings indicate that the PBC effectively takes the Taylor rule into account but integrates distinct Chinese characteristics, particularly by employing different monetary policy instruments at various stages to manage diverse liquidity issues. The PBC's current emphasis on developing structural monetary policies represents a further extension of this approach.

The benchmark regression results indicate that the CPI gap and the GDP gap are significantly positively correlated with the interest rate indicator, while the Shanghai Composite Index is significantly negatively correlated with a very small coefficient. This suggests that the PBC's monetary policy essentially adheres to the Taylor rule, primarily targeting the CPI gap and output gap, but also pays attention to the stock market conditions. The CPI gap, investment changes and export changes are significantly positively correlated with the interest rate indicator. This suggests that PBC may opt for interest rate cuts to stimulate investment, thereby leveraging further momentum for economic growth. When export growth, which represents the fundamental state of China's economy, slows down, the PBC resorts to interest rate cuts to devalue the RMB,

thereby enhancing China's export competitiveness. The results regarding the reserve rate cuts and interest rate adjustments indicate that these actions are significantly positively correlated with the CPI gap, GDP gap and PPI gap. This once again confirms that the PBC's monetary policy is essentially in line with the Taylor rule. The significant negative correlation with U.S. GDP also suggests that the PBC tends to consider the Federal Reserve's monetary policy stance. The forward-looking regressions based on CPI, PPI, GDP indicators, as well as changes in investment, consumption and exports yield results that are essentially consistent with the benchmark regressions. This indicates that the monetary policy of PBC is forward-looking in nature. Additionally, the significant positive correlation with forward-looking consumption suggests that the PBC places greater emphasis on future consumption rather than current consumption levels.

Based on China's political fundamentals and significant exogenous shocks, we divided the period from January 1998 to April 2025 into four distinct economic phases and conducted grouped regressions. The significant positive correlation between the interest rate indicator and the CPI and GDP indicators during the 1998–2007 and 2018–2025 periods, as well as the insignificance during the 2008–2017 period, illustrates the process of PBC's monetary policy adhering to the Taylor rule – adjusting – returning to the Taylor rule. Prior to the subprime mortgage crisis, during a period of relative global economic stability, PBC essentially adhered to the Taylor rule. However, from 2011 to 2017, under the policy emphasis by President Xi Jinping on guarding against systemic financial risks, demanding that finance serves the real economy and strengthening the PBC's macroprudential management, China, decided to abandon the indiscriminate use of expansive monetary tools. After 2018, in response to exogenous demand shocks, such as the Sino-US trade dispute and the COVID-19 pandemic, the PBC returned to a monetary policy framework that is more in line with the Taylor rule. In the grouped regression results for the reserve rate and interest rate tools over the periods of 1998–2012 and 2013–2025, the significant correlation between the ultra-long-term liquidity tool reserve requirement ratio and the GDP indicator in the first phase, and its insignificance in the second phase, along with the insignificance of the interest rate tool in the first phase and its significance in the second phase, indicate that PBC has shifted its focus from quantity-based monetary policy instruments to price-based policy instruments.

In summary, this work employs various time periods, models and computational techniques to examine the Chinese adaptation of the Taylor rule and reveals that the PBC's monetary policy takes Taylor rule as an important consideration while promoting the transformation and upgrading of monetary tools frame. The conclusions drawn from this analysis are compelling and can be applied to a broader context. However, this paper does have certain limitations: China's financial market structure differs significantly from that of other countries, leading to substantial differences in the effectiveness of policy transmission compared to foreign ones. The PBC also fully absorbs feedback from learning effects to optimise and adjust its policy tools. Therefore, further in-depth discussions using structural models based on the dynamic changes in China's micro-financial markets are needed.

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