

# The Impact of Interest Rate Marketization on Commercial Banks's Income Structure-An Empirical Analysis of China's LPR Mechanism Reform based on DID Method

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**Abstract.** As the process of marketizing interest rates in China continues to advance, it becomes increasingly essential to evaluate the policy's impact on commercial banks' operations. The purpose of this article is to elucidate how China's commercial banks' revenue structure is affected by interest rate deregulation. By treating the reform of the Loan Prime Rate mechanism as a quasi-natural experiment and employing the difference-in-differences method, the goal is to elucidate the effects of the reform on commercial bank operations. Through empirical analysis using annual data from 2013 to 2022 for 42 listed commercial banks, the findings reveal that the LPR mechanism reform has had a negative impact on the net interest margin but a positive influence on the proportion of non-interest income. This indicates that the reform significantly contributes to the transformation of the income structure and profit model of Chinese commercial banks, highlighting the implications for ongoing interest rate marketization reforms. This study not only contributes to the academic discourse on interest rate marketization and banking operations but also offers pragmatic insights for policymakers and banking executives navigating the complexities of financial market reforms in China.

**Keywords:** Interest rate marketization, loan prime rate, difference-in-differences method.

## 1. Introduction

Since the 1990s, China has embarked on a long-term process of interest rate marketization, aiming to gradually establish a market-determined interest rate management system. Central to this endeavor is the reform of the lending base rate, which constitutes the core of the deregulation of interest rates. In 2013, the People's Bank of China (PBOC) formally introduced the Loan Prime Rate (LPR) to serve as a reference for commercial banks' loan pricing. However, the simultaneous existence of the LPR and the lending base rate has led to relatively low efficiency of interest rate transmission, resulting in persistently high financing costs for small and medium-sized enterprises [1]. To address these challenges, in August 2019, the PBOC took steps to improve its LPR quotation mechanism. The reformed LPR, now linked to the medium-term lending facility rate (MLF), has evolved into a market-based interest rate that accounts for the cost of funds, risk premiums, and other relevant factors [2]. While LPR reform has successfully promoted the optimal allocation of financial resources, it has also presented challenges to the development of China's banking industry. First, the shift from the traditional pricing method has diminished the deposit and loan spreads of commercial banks, thereby adversely affecting their short-term earnings [3]. Moreover, given that Chinese commercial banks have historically relied on a single source of income, many are currently reconfiguring their profit model to ensure their competitiveness [4]. As the third year of the LPR mechanism reform unfolds, it becomes increasingly crucial to explore the policy's impact on commercial bank operations. Such an examination holds significant guiding implications for China's ongoing efforts to further deepen marketization reform for interest rates.

China's interest rate marketization reform has garnered significant attention from scholars since its inception. In terms of theoretical analysis, Ba et al. analyzed the path of interest rate marketization in various countries and regions, including the United States, Japan, Germany and China. They concluded that the marketization of interest rates will lead to increased competition in the banking

industry and will prompt banks to explore new profitable growth [5]. Zeng and Wang analyzed the impact of the marketization of lending rates on the banking industry from short-, medium- and long-term perspectives. They argued that marketization of lending rates would initially impact banks' profits, followed by an increase in the difficulty of managing interest rate risk and credit risk, and ultimately reshape the risk appetite of commercial banks [6]. Yao and Ge analyzed the marketization of interest rates in China and the development status of banks' intermediate business. They concluded that the implementation of this reform has prompted banks to gradually change their development concepts, especially paying higher attention to intermediate business [7]. Shen et al. conducted empirical research utilizing data from 101 commercial banks in China between 2005 and 2015. They employed the dynamic panel system GMM approach to investigate the combined effects of interest rate liberalization and non-interest revenue on banks' net interest margins. The study demonstrated that the reform had a significant negative impact on commercial banks' interest income [8]. In summary, existing scholars have primarily explored the policy effects on commercial bank operations through theoretical research, with a scarcity of empirical research. Most empirical analyses have mainly focused on the policy's impact on the profitability and risk-taking level of commercial banks, while there is a lack of empirical testing of the policy's impact on the income structure of commercial banks.

This paper reviews existing literature to examine how interest rate marketization reform affects China's commercial banks' income structure. It uses the reform of the LPR mechanism as a quasi-natural experiment and applies the difference-in-differences (DID) method. The study's results aim to enrich the literature on interest rate marketization reform and the operations of commercial banks.

## 2. Methods

### 2.1. Data Source

Given that LPR was officially introduced into China's interest rate system in 2013 and the reform of the LPR mechanism occurred in 2019, the sample data selected for this paper are annual data from 2013 to 2022. The sample consists of 42 listed commercial banks within the banking industry, selected based on the industry classification standard of Shenyin Wanguo. The data is primarily sourced from the Wind database and the annual reports of each commercial bank. In addition, to avoid the influence of outliers, the data of each variable in the sample have been shrink-sized by 1% above and below.

### 2.2. Data Source

#### 2.2.1. Explained variables

This paper aims to analyze how the interest rate marketization reform affects the income structure of commercial banks, including their diverse income sources. Following existing literature, the study will independently assess the impact of the reform on the net interest income and net non-interest income of commercial banks. This approach seeks to understand the policy's influence on the transformation of commercial banks' income structure.

In terms of interest income, this paper draws on Lepetit et al. and Liu et al., where the level of net interest margin (NIM) is used as a proxy variable [9, 10]. The advantage of this indicator is that it provides a more comprehensive picture of the level of interest income of the bank. NIM is the ratio of net interest income to interest-earning assets. Where net interest income is the difference between total interest income and total interest expense.

As for non-interest income, drawing on Apergis and Shen et al. this paper selects the noninterest income ratio (NIIR) as a proxy variable [11]. NIIR is the proportion of net non-interest income to total revenue.

### 2.2.2. Core explanatory variables

Since the 2019 LPR formation mechanism reform, a "Time" dummy variable is used, set to 0 before 2019 and 1 from 2019 to 2022. LPR-offer banks, with stronger pricing power and stability, are expected to be more affected by the reform than non-offer banks. Following Zhang et al. (2020), a "Treat" dummy variable in this research designates non-offer banks as the experimental group (Treat=1) and offer banks as the control group (Treat=0) [12]. Additionally, an interaction term  $did = Treat \times Time$  is developed, crucial to the DID method. A significant coefficient in the interaction term would indicate the impact of the LPR formation mechanism reform on the experimental group.

### 2.2.3. Control variables

To control other factors that may affect the commercial banks' revenue structure, this paper includes the corresponding control variables in the model. Drawing on the research of Ding and other studies, this paper adds the cost-income ratio (CIR), non-performing loan ratio (NPLR), asset-liability ratio (DAR), the deposit and loan ratio (DLR), and the age of the bank (Age) as control variables [13].

## 2.3. Model Settings

The DID method is a commonly used causal inference technique in econometrics, often employed to assess the impact of policy reforms or project implementations on a particular variable. This approach compares changes over time between an experimental group and a control group, thus eliminating the influence of time-invariant individual characteristics and providing a more accurate estimation of the effects of policy reforms.

In order to analyze the impact of LPR reform on commercial banks, this paper constructs the following benchmark model by considering various factors:

$$NIIR_{it} = \beta_0 + \beta_1 did_{it} + \beta_2 Controls_{it} + \mu_t + \lambda_t + \varepsilon_{it} \quad (1)$$

$$NIM_{it} = \alpha_0 + \alpha_1 did_{it} + \alpha_2 Controls_{it} + \mu_t + \lambda_t + \varepsilon_{it} \quad (2)$$

$NIM_{it}$  and  $NIIR_{it}$  denote the level of net interest margin and the share of non-interest income of commercial bank  $i$  in period  $t$ , respectively.  $\alpha_1$  and  $\beta_1$  denote the differences in the policy effects of the LPR mechanism reform on commercial banks in the experimental and control groups, respectively.  $Controls_{it}$  are bank characteristics control variables.  $\mu_t$  and  $\lambda_t$  are individual fixed effects and time-fixed effects.

## 3. Results and Discussion

### 3.1. Model Settings

Table 1 displays the descriptive statistics for the factors discussed above. The findings indicate that the disparities in the NIM among the commercial banks in the sample are relatively modest, while the NIIR is comparatively large. Specifically, the minimum and maximum values for NIIR within the study period are 2.48% and 43.22% respectively, suggesting considerable divergence in the intermediary business development across individual banks over time. Furthermore, the table reveals substantial discrepancies in non-performing loan ratios, cost-income ratios, deposit and loan ratios, as well as the age of the commercial banks.

**Table 1.** Descriptive Statistics for Variables

Variable	N	Mean	SD	Min	Max
NIIR	420	20.34	9.909	2.483	43.22
NIM	420	2.347	0.500	1.250	4.464
NPLR	420	1.347	0.386	0.640	2.410
CIR	420	30.66	5.682	21.44	57.88
DAR	420	92.72	1.138	90.29	95.57
LDR	420	73.84	14.48	38.97	110.1
Age	420	20.42	7.696	3	36

### 3.2. Benchmark Regression Results

To determine whether to use a fixed effects model or a random effects model in the benchmark model, the first step was to run the Hausman test. The test findings show that the null hypothesis is rejected, indicating that a fixed effects model would be a better fit. After that, the impact of the LPR change on the NIIR and NIM of commercial banks was examined using the DID model. The following table 2 displays the results of the regression:

**Table 2.** Benchmark Regression Results

VARIABLES	NIIR		NIM	
	Model 1	Model 2	Model 1	Model 2
did	6.426*** (1.152)	3.824* (2.257)	-0.366*** (0.060)	-0.143* (0.079)
Constant	18.443*** (1.372)	-85.358 (73.365)	2.455*** (0.062)	10.621** (4.405)
Observations	420	420	420	420
R-squared		0.445		0.638
Number of id	42	42	42	42
Controls	NO	YES	NO	YES
Bank FE	NO	YES	NO	YES
Year FE	NO	YES	NO	YES

Robust standard errors in parentheses \*\*\* p<0.01, \*\* p<0.05, \* p<0.1

First for the NIIR, according to the regression results of Model 2, the interaction term  $did_{it}$  is significantly positive. This indicates that the LPR mechanism reform significantly increases the NIIR of the experimental group banks relative to the control group banks. For the level of NIM, according to the regression results of Model 1, the interaction term  $did_{it}$  is significantly negative. It indicates that relative to the quoting banks, the level of NIM of the non-quoting banks significantly decreases after being hit by the LPR mechanism reform. The regression findings initially indicate that the LPR mechanism reform facilitates a transformation in the income structure of commercial banks, characterized by an increase in the NIIR and a contraction of NIM.

Presently, China's commercial bank deposit interest rates continue to reference the statutory interest rate, with no immediate plans for market-oriented reform in the deposit pricing mechanism. Concurrently, the LPR has exhibited a downward trend since its inception, contributing to a narrowing of commercial bank spreads. Non-quoted banks are disproportionately affected by the diminishing deposit and loan spreads, leading to a decline in the profitability of traditional deposit and loan operations. Consequently, commercial banks face an urgent need for transformation and expansion, actively seeking to augment non-interest income businesses to offset the diminishing profitability of traditional operations. Furthermore, the reform is expected to enhance marketization and intensify competition among commercial banks. This competitive environment compels commercial banks to diversify their income sources, thereby fostering the development of their intermediary business.

### 3.3. Robustness Tests

#### 3.3.1. Parallel trend test

This study employs a DID method to assess the influence of LPR reform on the income structure of commercial banks. The validity of this method hinges on the presence of a shared trend between the control group and the experimental group before the policy implementation. Specifically, this common trend implies the absence of a substantial disparity in the trajectory of NIIR and NIM between quoting and non-quoting banks before the LPR reform, or that any disparity is statistically insignificant. To investigate this, the study constructs a series of dummy variables representing the temporal proximity to the introduction of the LPR quoting mechanism.  $Before_i$  refers to the time dummy variable for period  $i$  from the sample starting point to the introduction of the LPR quoting mechanism. Current refers to the current period of the LPR reform. And  $After_i$  is the time dummy variable for the time distance from period  $i$  after the LPR reform. The focus here lies in assessing the significance of the dummy variables before the policy implementation, thereby conducting the parallel trend test.

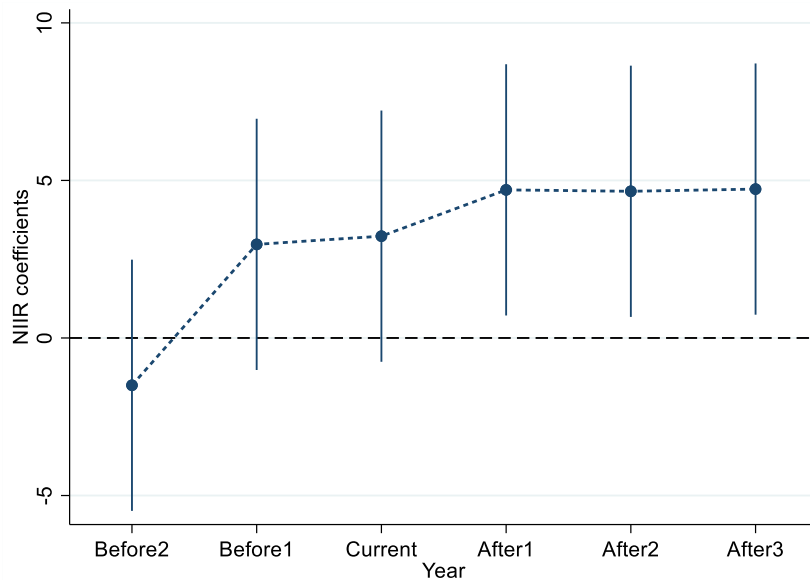


Figure 1. Parallel Trend Test for NIIR

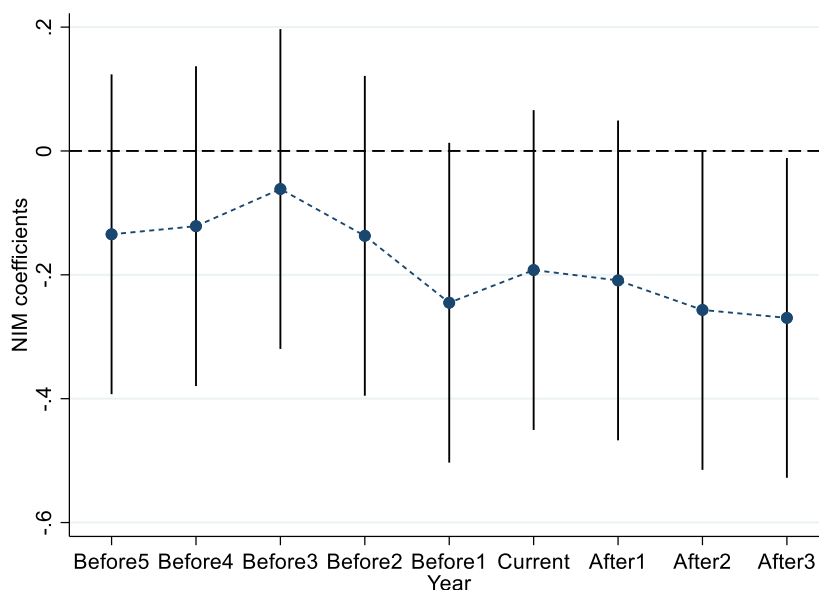


Figure 2. Parallel Trend Test for NIM

The results, depicted in Figure 1 and Figure 2, reveal that the coefficients of  $Before_i \times Treat$  are statistically insignificant in both models. This insignificance suggests a shared developmental trend in each business aspect of banks within both the control and experimental groups before the introduction of the LPR quoting mechanism. Furthermore, the non-significance of  $Current \times Treat$  indicates a lagged effect of the LPR reform on commercial banks. Consequently, the original model satisfies the parallel trend assumption of the DID model.

### 3.3.2. Placebo tests

To assess the robustness of the aforementioned findings against potential omitted variables and random factors, this study implements a two-level randomized experiment at the bank level during the reform period. This involves the random selection of commercial banks and the random generation of the time of reform. Subsequently, regressions are conducted based on the specifications outlined in column (3) of Table 1. The reliability of the conclusions is then evaluated by gauging the likelihood of obtaining the estimated coefficients of the baseline regression from the simulated experiment.

To bolster the validity of the placebo test, the aforementioned process is repeated 500 times. Subsequently, the distribution of the estimated coefficients on the "did" coefficient is plotted. This step aims to examine whether the income structure of commercial banks is influenced by factors other than those associated with the LPR reform policy. If the distribution of the estimated "did" coefficient under the randomization process approximates 0 and conforms to a normal distribution, it indicates that the model adequately accounts for significant influences. In other words, the effects observed in the benchmark analysis are genuinely attributable to the policies under scrutiny in this paper.

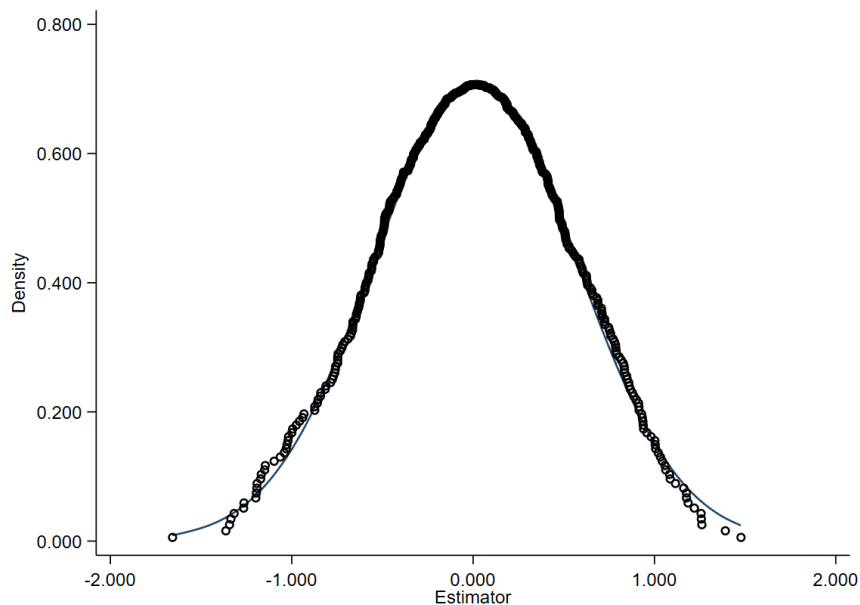
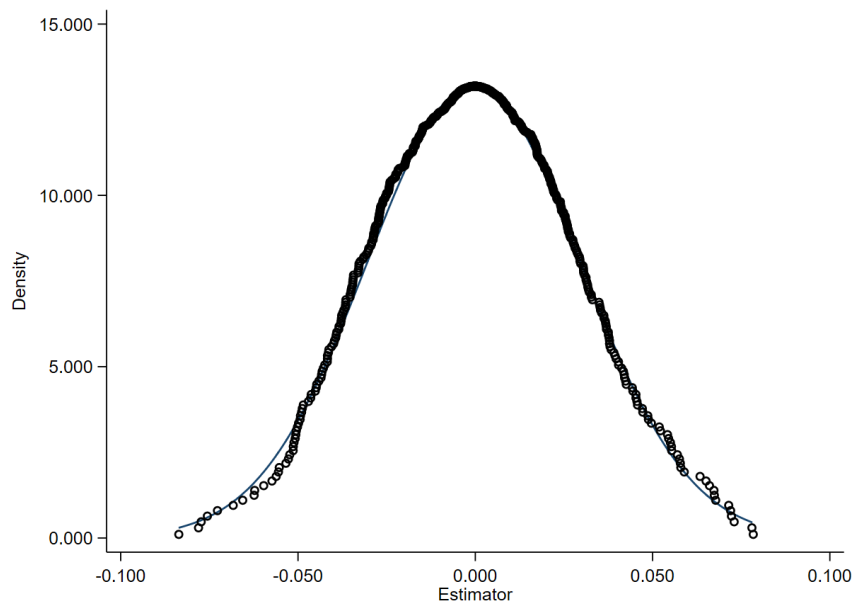


Figure 3. Placebo Tests for NIIR



**Figure 4.** Placebo Tests for NIM

The distribution of the estimated coefficients, as depicted in Figure 3 and Figure 4, reveals that the estimated coefficients of the spurious *did* term are centered around 0. This suggests the absence of substantial omission issues in the modeling, thereby affirming the robustness of the core conclusions.

#### 4. Conclusion

This study uses the DID model to empirically analyze the effects of the LPR mechanism reform on the percentage of non-interest revenue and net interest margin of commercial banks. It is based on the annual data of 42 listed commercial banks in China from 2013 to 2022. Examining how the interest rate liberalization change has affected the way commercial banks organize their income is the main goal. The empirical study shows that although the LPR method reform significantly increases the percentage of non-interest income, it significantly decreases the net interest margin of Chinese commercial banks. Thus, it can be concluded that the marketization of interest rates reform has played an essential part in changing the operations model and revenue structure of Chinese commercial banks.

In light of the aforementioned findings, several recommendations are proposed. For commercial banks, it is advisable to proactively address the impact of the interest rate marketization reform by diversifying income sources and expanding financial services to reduce reliance on traditional business. Concurrently, commercial banks should bolster risk management, optimize asset allocation, and develop flexible strategies to adapt to the evolving market environment, ensuring the resilience of their profit models. As for policymakers and financial regulators, supporting financial innovation and providing additional development space and policy support for commercial banks is essential to foster the diversified development of the financial industry. Furthermore, regulatory policies should be enhanced to strengthen the supervision of commercial banks' risk management, and support for technological innovation should be provided to promote the development of financial technology and enhance the service efficiency and competitiveness of commercial banks.

This study has certain limitations that warrant consideration. Firstly, the reform of the LPR mechanism was implemented in 2019, and the study period covers only four years post-implementation. Given the difficulty in obtaining quarterly financial data for most commercial banks, the research sample is limited to the annual data of 42 listed commercial banks. There is ample room for expanding the sample data. Additionally, Chinese commercial banks exhibit diverse banking natures and varying development characteristics. The impact of policy shocks may differ across different types of commercial banks, suggesting that future research could focus on the heterogeneous effects of policies on various types of commercial banks.

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