

# Does Interest Rate Liberalization Lead to The Narrowing of Commercial Banks' Interest Margins?

-- Empirical Evidence from Nearly A Decade in China

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**Abstract:** Based on the background of China's interest rate liberalization, this paper empirically investigates the impact of interest rate marketization on China's commercial banks' interest margins using a fixed effects model using panel data of 39 commercial banks in China for the last decade from 2013-2022. The results of the study indicate that interest rate liberalization significantly reduces the interest margins of Chinese commercial banks. In the long run, with the deepening of interest rate liberalization, the interest margins of commercial banks tend to narrow. At the end of the paper, suggestions are made in relation to the current situation of interest rate liberalization in China and the research results.

**Keywords:** Interest Margins, Interest Rate Liberalization, Commercial Bank.

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## 1. Introduction

Interest rate liberalization is the process of allowing the market's supply and demand to determine interest rates, in which no economic agent of the market can monopolize the determination of interest rates in a fully competitive market, but can only accept, as a recipient, the interest rates determined by the market as a whole. Interest rate liberalization gives commercial banks the autonomy to set interest rates, allowing for a more efficient allocation of resources to better stimulate economic and financial development [1,2], however, it may also increase the volatility of interest rates and the degree of price competition among banks, which in turn affects the level of commercial banks' interest margins.

The interest margin is the main source of income for commercial banks, which on the one hand reflects their own operating efficiency and profitability, and on the other hand reflects the financial environment in which banks operate and the social cost of financial intermediation [3], and is also an important macro prudential early warning indicator of financial stability [4], so the issue of spread has important theoretical and practical significance and has received much attention and extensive research from academia and industry.

China has been liberalizing interest rates for more than 30 years, and the reform of interest rate liberalization in China has entered deep water in the last decade. In July 2013, the Central Bank fully deregulated the interest rates on loans and bills discounting, and introduced interbank certificates of deposit in December 2013, and liberalized the floating ceiling of interest rates on time deposits in financial institutions in December 2015, while establishing and continuously improving the interest rate corridor mechanism between 2015 and 2018. What's more, Central Bank established a new mechanism for LPR transmission in 2019, and proposed the reform goal of achieving two tracks and one track, and continuously improved and implemented the reform work between 2019 and 2022. As can be seen, the process of interest rate liberalization reform in China has been deepening

in the last decade, and the degree of interest rate liberalization has been increasing.

There may be a close link between interest rate liberalization and commercial bank spreads, and this relationship has been repeatedly studied and discussed by scholars using data from the middle period of interest rate liberalization in China (from 2003 to 2013). So, as China's interest rate liberalization reform enters its late stage in the last decade, what impact will China's interest rate liberalization reform have on the spreads of China's commercial banks, and will this impact remain consistent with the way it was a decade ago? Moreover, is this impact consistent across different types of banks? The study of these issues can not only provide reference for commercial banks' decision making and operation, but also provide a realistic basis and data support for the central bank to further promote the interest rate market reform, which has important practical significance for further deepening the reform.

In view of this, this paper uses 39 Chinese commercial banks from 2013-2022 as a research sample to study the impact of interest rate liberalization on the interest margins of Chinese commercial banks and to analyze in depth the mechanism of its impact. Compared with existing studies, this paper has the following three possible innovations: First, most of the existing literature analyzes and discusses data from the middle period of China's interest rate liberalization (2003-2013), and many studies stop at the liberalization of the deposit interest rate ceiling, while this paper uses data from the last decade to analyze the impact of reform measures, including the establishment of the interest rate corridor mechanism and the establishment of the new mechanism for LPR transmission. Second, while traditional studies suggest an inverted U-shaped relationship between the degree of interest rate liberalization and bank spreads [5], this paper finds that data from the last ten years suggest that this relationship no longer holds. Third, this paper provides empirical evidence on the impact of interest rate liberalization reforms on bank spreads in China, which enriches the empirical research on the impact of interest rate liberalization reforms on bank spreads.

The rest of this paper is organized as follows: Section 2 is a literature review. Section 3 is the empirical design. Section 4 is the empirical results and analysis. Section 5 is the conclusion and policy recommendations of the paper.

## 2. Literature Review

### 2.1. Determinants of Bank's interest margin

The study of bank spread theory first originated from the market maker model proposed by Ho and Saunders (1981) [6], which regarded banks as risk averse traders and treated them as intermediaries between lenders and borrowers, and banks balanced loan demand and deposit supply by setting deposit and lending rates, and finally concluded that the spread of banks depended on factors such as the scale of bank transactions, the degree of risk aversion, the structure of the market, and the volatility of interest rates, etc. Many scholars have further deepened the spread determination model on this basis:

Allen (1988) [7] considers loan heterogeneity and argues that the cross-elasticity of demand among banks' diversified products narrows bank spreads. Angbazo (1997) [8], on the other hand, argues that bank spreads are also affected by credit risk and develops a spread determination model that includes credit risk. Maudos and Guevara (2004) [3] introduce operating costs and the degree of competition into the market maker model and find that bank spreads decrease with higher market concentration. Lin Jane-Raung et al. (2012) [9] selected commercial banks in eight Asian countries as a sample and found that when commercial banks have a higher degree of business diversification, the degree of interest rate risk on bank spreads is relatively small, indicating that when there are more types of businesses, banks have lower interest rate risk. Liya Liu et al. (2014) [10] further found that non-interest income and net interest margin are mutually negative substitutes in the Chinese commercial banking industry as a whole, and there are some differences among different types of banks. After that, Xiang Qiu (2015) [11] concludes that Chinese commercial banks' spreads narrow due to the increase in maturity mismatch risk. Considering macro policy and economic effects, Binghai Xin et al. (2015) [12] concluded that macroeconomic uncertainty has a significant positive effect on bank spreads. Some scholars also point out that the level of internationalization, on the other hand, changes the cost and revenue of banks' operations, which in turn affects bank spreads, and that increasing the level of internationalization increases bank spreads [13].

### 2.2. Interest rate liberalization and interest margin of bank

There has been much academic discussion about the impact of interest rate liberalization on bank spreads, but there is still no consensus. Sarr (2000) [14] argues that increased interest rate liberalization increases competition among banks, which increases bank deposit rates and reduces bank spreads, and Saunders and Schumacher (2000) [15] find that macro financial policies reduce bank spreads while reducing interest rate volatility under interest rate liberalization based on data from the United States and Europe. Some scholars also argue that interest rate liberalization does not necessarily lead to a decrease in commercial bank spreads, and that spreads may even increase with deeper interest rate liberalization [16,17]. Kumar (2017) [18] states that although interest rate liberalization leads to an environment of low interest rates,

the increase in the size of credit and the optimization of the deposit and lending structure will eventually increase the interest income of commercial banks.

Taking China's interest rate liberalization reform as the background, many Chinese scholars have given corresponding analyses. Many studies have concluded that the competitive effect resulting from interest rate liberalization significantly narrowed bank spreads [19,20,21]. Particularly, Lifu Fu and Jian Wei (2014) [22] point out that interest rate liberalization reduced commercial banks' net spreads by 29.31% relative to a reasonable level and that, relative to national banks local banks were hit harder. Some scholars also hold the opposite view, Shusong Ba et al. (2012) [23] argues that although bank spreads will narrow in the short term, and they will show a stable or widening trend in the long term. Using evolutionary game analysis, Shuqing Huang and Lulu Sun (2014) [24] point out that interest rate liberalization reform will lead to a gradual adjustment of banking business and eventually expand banks' spread income. In contrast, Peng et al. (2016) [5] point out that the two show an inverted U-shaped relationship, with spreads showing a trend of increasing and then decreasing.

With reference to the above literature, we will make comprehensive refinements to the existing interest rate determination model by combining the latest data of the last decade in China, and examine the determinants of commercial bank spreads during the gradual progress of interest rate liberalization and the impact of the degree of interest rate marketization on commercial banks' interest margins in China with empirical analysis.

## 3. Research Design

### 3.1. Study sample and data sources

We select 39 commercial banks in China (including 5 large state-owned commercial banks, 10 joint-stock banks, 17 urban commercial banks and 7 rural commercial banks) as an empirical sample to study the impact of interest rate marketization on the spreads of commercial banks in China. Macro data are obtained from the National Bureau of Statistics of China, and bank micro data are obtained from the CSMAR database. For missing and apparently anomalous data, we consult a large number of bank annual reports for additions and corrections, and finally obtain balanced panel data for 39 commercial banks from 2013-2022.

### 3.2. Variable selection

#### 3.2.1. Dependent variable

The dependent variable in this paper is commercial bank's interest margin. In traditional theoretical studies, banks are often regarded as financial intermediaries who only take deposits and issue loans, but with modern financial innovation and the continuous diversification and complexity of bank functions, such simple abstraction has deviated from the actual phenomenon. Interest-bearing assets of modern commercial banks not only refer to loans, but also include bond investments, interest on reserves, interbank deposits, etc. Interest-bearing liabilities not only refer to deposits, but also include interbank lending, bond financing, etc. These factors should obviously be taken into account as well. In modern bank management, net interest margin (NIM) is a recognized indicator to measure the level of bank spreads, and is also an important data required to be disclosed in banks' annual reports, which makes the integrity and rigor of the indicator

data guaranteed. In most previous studies, NIM is also often selected as the dependent variable. Therefore, in this paper we choose NIM as the dependent variable.

### 3.2.2. Independent variable

The core independent variable of this paper is the degree of interest rate liberalization, and the interest rate liberalization index IRL is chosen to represent the degree of interest rate liberalization. Referring to the existing literature, Shujun Wang and Jiangan Peng (2014) [25] systematically measure

the process of interest rate liberalization. They divided the interest rate market into four primary indicators: deposit and loan rates, money market rates, bond market rates and yield of financial product, and established secondary indicators under the four primary indicators and assigned weights to each indicator to measure the comprehensive index of interest rate liberalization in China, and the specific indicators and weights are shown in Table 1. In this paper, we take the year 2013 as the starting point to reconstruct the interest rate market index for China from 2013 to 2022.

**Table 1.** Indicators of interest rate liberalization

IRL Index	Primary indicators	Weight	Secondary indicators	Weight
	IRL Index	deposit and loan rates	0.6140	RMB loan rate
RMB deposit rate				0.4375
Foreign currency loan rate				0.0625
Foreign currency deposit rate				0.0625
money market rates		0.1847	Inter-bank lending rate	0.7500
			Bill discount interest rate	0.2500
bond market rates		0.1074	Bond Issue Interest Rate	0.6000
			Bond repurchase rate	0.2000
			Bond transaction interest rate	0.2000
yield of financial product		0.0939	Yield of bank financial products	0.5370
			Yield of Money Fund	0.2047
			Yield of Trust Product	0.2583

Ultimately, the interest rate liberalization index is calculated as:

$$IRL = \sum q_i * (\sum w_i * p_i) \quad (1)$$

Where  $q_i$  is the respective weight of the primary indicators,  $w_i$  is the specific value of each secondary indicator, and  $p_i$  is the respective weight of the secondary indicators.

### 3.2.3. Control variables

With reference to existing studies, we select control variables based on bank level and macroeconomic level, respectively. Risk aversion, operating cost, operating scale, intermediate business income, and market concentration are selected as bank level control variables, and M2 growth rate, and GDP growth rate are selected as macro control variables. The calculation method and literature basis of each variable are shown in Table 2.

**Table 2.** Description of variables

Variables	Symbol	Measurement	Previous studies
Interest margin	NIM	Net interest income / Average interest-earning assets	Peng et al.(2016) [5]
Degree of IRL	IRL	Interest Rate Liberalization Index	Wang & Peng(2014) [25]
Risk aversion	ETA	Owner's Equity / Total Assets	Nguyen(2012) [26]
Operating Costs	COST	Operating Costs / Total Assets	Maudos & Solis(2009) [27]
Loan Size	LNLO	Ln(Total Loans)	Maudos & Solis(2009) [27]
Intermediate business income	NII	Handling fee and commission income / Operating income	Leptit et al.(2008) [28]
Market concentration	HHI	Sum of the squares of each bank's assets/total assets of similar banks	Han & Wang (2017) [29]
Macroeconomic conditions	M2	M2 growth rate	Gerlach et al.(2005) [30]
	GDP	GDP growth rate	Omankhanlen et al.(2021) [31]

### 3.3. Empirical model

Combined with the previous analysis, we develop an empirical model of the determinants of spreads of Chinese commercial banks as follows:

$$NIM_{it} = \alpha_i + \beta_1 IRL_t + \beta_2 ETA_{it} + \beta_3 COST_{it} + \beta_4 LNLO_{it} + \beta_5 NII_{it} + \beta_6 HII_{it} + \beta_7 M2_t + \beta_8 GDP_t + \varepsilon_{it} \quad (2)$$

Where,  $i=1,2,\dots,n$  represent the number of the bank respectively, and  $t$  stands for the time span.  $\alpha_i, \beta_i$  stand for the

model parameters to be estimated.  $\varepsilon_{it}$  is the random disturbance.

## 4. Empirical Results and Analysis

### 4.1. Descriptive statistics of the main variables

Table 3 shows the results of descriptive statistics of the variables used in the empirical evidence. From the results, it

can be seen that the average net interest margin (NIM) of Chinese commercial banks is 2.45, with a minimum value of 1.25 and a maximum value of 5.60, which indicates that the NIM varies greatly among banks, and among years. By bank type, rural commercial banks have the highest average NIM of 3.21, which is much higher than the industry average; large state-owned banks have the lowest average NIM of 2.17.

**Table 3.** Descriptive statistics of variables

	Variables	Mean	Std	Min	Max	observations
<b>Full sample</b>	NIM	2.45	0.6580	1.25	5.60	390
	IRL	0.86	0.1059	0.69	1.00	390
	ETA	7.57	1.5452	2.53	13.86	390
	COST	1.22	0.5427	0.20	3.30	390
	LNLO	13.02	2.0620	8.66	16.93	390
	NII	14.12	8.8642	1.73	37.64	390
	HHI	0.189	0.1364	0.099	0.488	390
	M2	10.62	1.9919	8.10	13.59	390
	GDP	6.22	1.9223	2.20	8.40	390
<b>Large state-owned banks</b>	NIM	2.17	0.3521	1.48	2.92	50
	ETA	7.92	0.7410	5.80	9.30	50
	COST	1.13	0.4032	0.26	1.81	50
	LNLO	16.14	0.4966	14.98	16.93	50
	NII	19.19	2.9077	13.18	24.37	50
	HHI	0.218	0.0010	0.217	0.220	50
<b>Joint-stock banks</b>	NIM	2.32	0.3248	1.52	3.27	100
	ETA	6.85	1.2982	2.53	9.41	100
	COST	1.27	0.5338	0.20	2.68	100
	LNLO	14.61	0.6660	12.27	15.76	100
	NII	23.17	7.8138	7.56	37.64	100
	HHI	0.118	0.0015	0.116	0.120	100
<b>Rural Commercial Bank</b>	NIM	3.21	0.8914	1.96	5.60	70
	ETA	9.48	1.5571	6.74	13.86	70
	COST	1.41	0.7599	0.24	3.30	70
	LNLO	10.55	1.2678	8.66	13.31	70
	NII	4.34	2.6137	1.73	14.77	70
	HHI	0.469	0.0118	0.445	0.488	70
<b>City Commercial Bank</b>	NIM	2.30	0.5270	1.25	4.05	170
	ETA	7.10	1.1379	4.78	10.33	170
	COST	1.14	0.4500	0.31	2.53	170
	LNLO	12.18	1.0861	10.09	14.37	170
	NII	11.33	6.0287	2.27	28.37	170
	HHI	0.106	0.0057	0.099	0.116	170

Figure 1 reflects the trend of the average net interest margin of different types of banks over time, and Figure 2 reflects the

trend of the interest rate market index.

From the trend of the average net interest margin, the net

interest margin of all four types of banks generally shows a gradual decline in volatility, with a rapid decline between 2013 and 2017, a rebounding rise between 2017 and 2018,

and a gradual and slow decline after 2018, with rural commercial banks showing the most drastic fluctuations and large state-owned banks being relatively the most stable.

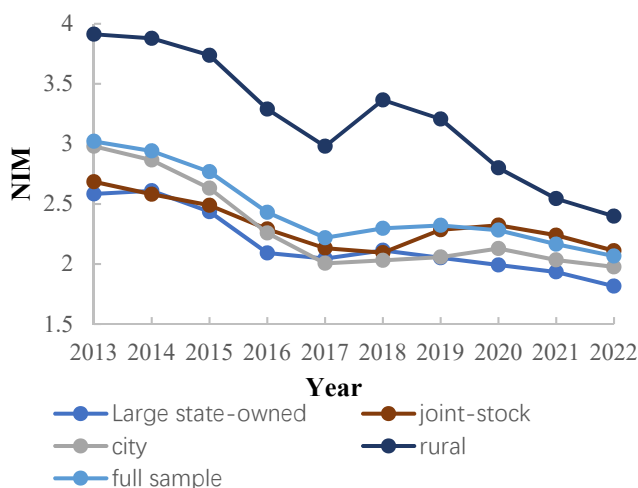


Figure 1. Trends in net interest margin over time

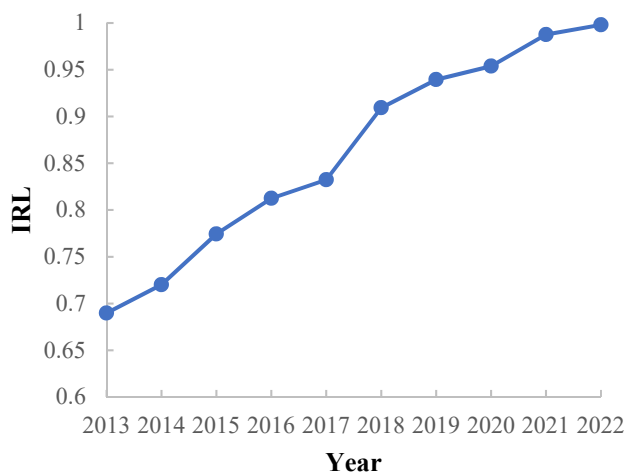


Figure 2. Trends in interest rate liberalization over time

In the ten years from 2013 to 2022, along with the liberalization of the upper limit of loan interest rates, the establishment of the interest rate corridor, the introduction of the new LPR mechanism, and the promotion of the two tracks of interest rates into one, the interest rate liberalization index (IRL) increased from a minimum value of 0.69 to a maximum value of 1.00, indicating that the degree of interest rate marketization in China has been deepening in the past ten years, and by 2022, the interest rate market reform process has entered deep water and the degree of interest rate liberalization has reached a high level.

Among the control variables, the degree of risk aversion (ETA) varies widely across different types of banks, with rural commercial banks having a significantly higher degree of risk appetite and fewer risk control measures, resulting in higher mean and maximum values of ETA than other types of banks, while urban commercial banks with government background have lower values of ETA, perhaps because local governments value risk control more than earnings and thus reject riskier projects and asset allocation decisions. The variability of operating costs (COST) is not significant among

the various types of banks, with rural commercial banks having slightly higher values in terms of mean values and the rest of the types of banks having very similar values. Loan size (LNLO) is closely related to the overall asset size of banks, and generally banks with large asset size have relatively larger loan size, so it is natural to find that large state-owned banks have the largest loan size with an average value of 16.14, while rural commercial banks have the smallest loan size with an average value of only 10.55. The mean value of intermediate business income ratio (NII) for the whole sample is 14.12, reflecting the reality that the development of intermediate business of Chinese commercial banks is relatively backward compared with that of developed countries; and there is also a large gap between different types of banks, with the share of intermediate business income of joint-stock banks reaching 23.17, which is significantly higher than that of other types of banks, followed by large state-owned banks with 19.19, and Rural commercial banks have less intermediate business development, with a share of only 4.34. In terms of market concentration (HII), the degree of monopoly is stronger among rural commercial banks, while the degree of competition is stronger among urban

commercial banks. Overall, the nature exhibited by all variables is consistent with normal expectations and financial theory, and no statistical results that clearly contradict financial theory are observed.

## 4.2. Empirical regression results and analysis

### 4.2.1. Full sample regression results and analysis

Since the data we use is panel data, we need to consider whether there is individual effect before regression, we first determine whether there is individual effect in the model by F-test, the F-value obtained by the test is 18.23 and the p-value is 0.0000, indicating that there is significant individual effect in the model, that is, the fixed-effects model is better

than pooled regression model, so the fixed-effects model is used for regression analysis. To analyze the rationality of introducing macro control variables outside the model, we test the introduced variables accordingly. Column 1 contains only the variables in the above theoretical model, while column 2 adds two variables, GDP growth rate (GDP) and M2 growth rate (M2). In addition, R-squared of the regression equation improved from 0.8689 to 0.8716 after the introduction of the variables, and the adjusted R-squared improved from 0.8522 to 0.8544 after adding the variables. The reliability of the model is improved, which indicates that GDP growth rate and M2 growth rate are indispensable in explaining banks' net interest margin.

**Table 4.** Results of Linear Regression Analysis

	(1)		(2)	
	coefficient	t-value	coefficient	t-value
<b>_cons</b>	-4.6805*** (1.1901)	-3.93	-4.9511*** (1.1938)	4.15
<b>IRL</b>	-3.5886*** (0.3191)	-11.25	-3.0342*** (0.3885)	7.81
<b>ETA</b>	0.0611*** (0.0188)	3.26	0.0636*** (0.0187)	3.41
<b>COST</b>	0.0594 (0.0389)	1.53	0.0600 (0.0387)	1.55
<b>LNLO</b>	0.4315*** (0.0793)	5.44	0.3763*** (0.0813)	4.63
<b>NII</b>	-0.0258*** (0.0040)	-6.39	-0.0211*** (0.0044)	4.85
<b>HHI</b>	23.5280*** (2.9880)	7.87	24.2365*** (2.9843)	8.12
<b>M2</b>			0.0260*** (0.0100)	2.61
<b>GDP</b>			0.0026 (0.0088)	0.30
<b>R<sup>2</sup></b>	0.8689		0.8716	
<b>adj. R<sup>2</sup></b>	0.8522		0.8544	
<b>F-value</b>	51.9577		50.6373	
<b>p-value</b>	0.0000		0.0000	

*Note:* Standard errors are in the parentheses. \*\*\*, \*\*, \* refer to significant at 1%, 5%, and 10% significance levels respectively.

Observing the data of column 2 in Table 4, the most noteworthy is the coefficient of interest rate liberalization index. The coefficient of the degree of interest rate marketization is -3.0342 and is significant at the 1% level, indicating that the liberalization of interest rates in China has had a significant negative impact on commercial banks' interest margins. This shows that in the process of interest rate liberalization in the last decade, the available spreads have not shortened due to the liberalization of deposit rate pricing and the improvement of the LPR quotation mechanism, which led to the intensification of the competition among commercial banks inappropriately. In a study of commercial banks from 2003-2014 by Jiangang Peng [5], the squared term of the interest rate liberalization index,  $IRL^2$ , was added in the model and pointed out that bank interest margins are not linearly related to the degree of interest rate liberalization, but rather in an inverted U-shape. We likewise attempted a regression with the inclusion of  $IRL^2$  and found that both IRL and  $IRL^2$  are insignificant at 10%, with p-values of 0.1093 and 0.4123, respectively.

This result is due to the fact that Peng [5] ultimately concludes that the inverted U-shaped relationship is based on

the gradual model of "loans before deposits" that was followed during the interest rate liberalization reform in China from 2003 to 2013, which gave commercial banks the opportunity to price their loans autonomously. So commercial banks obtained excess spreads above the benchmark spreads by increasing their lending rates, which led to an inverted U-shaped relationship in which bank spreads rose and then fell. However, during the period 2013-2022 studied in this paper, the liberalization of lending rates has been completed, and commercial banks can no longer obtain spreads in the competitive market by raising lending rates as a result of the reform, while the liberalized deposit rates will lead to a narrowing of bank spreads in the fierce competition, so the negative linear relationship obtained in this paper is consistent with the theoretical results and is an innovation and continuation of the previous results.

In addition, all independent variables except for operating costs and GDP growth rate have a significant effect on bank spreads. Among them, the coefficient of risk aversion (ETA) is 0.0636 and is significant at the 1% level, which indicates that commercial banks, out of risk aversion preference, require greater compensation for greater risks, higher loan

pricing and consequently higher spreads, and the empirical results are consistent with the theory. The coefficient of scale of operations (LNLO) is 0.3763 and significant at the 1% level, indicating that the larger the loan size, the greater the potential loss faced, and therefore the higher interest margin is needed as compensation, which is consistent with the theoretical results. The coefficient of intermediate business income (NII) is negatively correlated with the spread, with a coefficient of -0.0211 and significant at the 1% level, indicating that the more intermediate business a bank has, the more diversified it is, the wider the source of income, the lower the need for spread, and the interest margin will be relatively lower. The degree of market concentration (HHI) is positively related to interest margins with a coefficient of 24.2365, which is significant at the 1% level, implying that the stronger the concentration of the market, the stronger the bargaining power in the market, which is more conducive to higher interest margins, in line with theoretical expectations.

In Peng's study [5], the coefficient of money supply is positive but insignificant, which is not consistent with theoretical expectations, and the explanation is that China's interest rate formation mechanism is still not liberalized enough and the interest rate liberalization reform needs to be strengthened, while the coefficient of money supply growth (M2) in this study is 0.0260 and significant at the 1% level, which indicates that the degree of interest rate marketization

in China has been greatly improved compared with that of 10 years ago, and the interest rate formation mechanism has been liberalized and perfected, resulting in the final research results in line with theoretical expectations.

Finally, the coefficients of two variables, operating cost and GDP growth rate, are positive but insignificant. The non-significant coefficient of cost of operations (COST) shows that larger operating costs do not necessarily lead to higher interest margins to compensate for expenses, and interest rates are not significantly affected by operating expenses. The insignificant coefficient of GDP growth rate implies that an increase in GDP growth rate does not have a significant impact on spreads, which is not consistent with theoretical expectations, probably because GDP growth rate has been gradually slowing down in the last decade due to a number of factors and has been subject to great fluctuations due to the epidemic, resulting in its failure to have a significant impact.

#### 4.2.2. Heterogeneity analysis

To further justify the results obtained from the full-sample analysis and to explore the impact of interest rate marketization on different types of banks, we conducted a grouped regression study on four types of banks, including large state-owned banks, joint-stock banks, urban commercial banks, and rural commercial banks, and Table 5 presents the regression results for each of the four types of banks.

**Table 5.** Regression results for different types of banks

	(1)		(2)		(3)		(4)	
	coefficient	t-value	coefficient	t-value	coefficient	t-value	coefficient	t-value
<b>_cons</b>	5.2407 (4.6434)	1.13	11.1917** (4.6712)	2.40	-5.9802** (2.9866)	-2.00	-9.9689** (4.4879)	-2.22
<b>IRL</b>	0.6662 (0.6737)	0.99	-2.3579*** (0.8196)	-2.88	-2.4719*** (0.9280)	-2.66	-3.1848*** (1.1634)	-2.74
<b>ETA</b>	0.1097*** (0.0416)	2.64	0.0542 (0.0458)	1.18	0.0555* (0.0303)	1.84	0.0191 (0.0435)	0.44
<b>COST</b>	0.0886 (0.0655)	1.35	-0.0198 (0.0540)	-0.37	0.1138 (0.0775)	1.47	0.0427 (0.0966)	0.44
<b>LNLO</b>	-1.3460*** (0.2144)	-6.37	-0.0043 (0.1524)	-0.03	0.4804*** (0.1448)	3.32	0.3257 (0.2394)	1.36
<b>NII</b>	-0.0404*** (0.0074)	-5.43	-0.0206*** (0.0044)	-4.72	-0.0330*** (0.0080)	-4.10	0.0226 (0.0300)	0.76
<b>HHI</b>	81.5830*** (17.6266)	4.63	-59.8368* (34.7954)	-1.72	37.3922** (17.3713)	2.15	25.4759*** (6.4834)	3.93
<b>M2</b>	-0.0029 (0.0096)	-0.30	0.0302* (0.0177)	1.70	0.0365** (0.0169)	2.16	0.0342 (0.0409)	0.84
<b>GDP</b>	0.0174** (0.0078)	2.25	0.0111 (0.0125)	0.89	0.0086 (0.0136)	0.63	-0.0267 (0.0313)	-0.85
<b>R<sup>2</sup></b>	0.9634		0.8716		0.8030		0.8662	
<b>adj. R<sup>2</sup></b>	0.9516		0.8544		0.7704		0.8321	
<b>F-value</b>	81.2640		50.6373		24.6317		25.4257	
<b>p-value</b>	0.0000		0.0000		0.0000		0.0000	

Note: Standard errors are in the parentheses. \*\*\*, \*\*, \* refer to significant at 1%, 5%, and 10% significance levels respectively.

In Table 5, (1), (2), (3), and (4) represent the regression results for large state-owned banks, joint-stock banks and urban commercial banks, and rural commercial banks, respectively.

In the regression results for large state-owned banks, the coefficient of the interest rate liberalization index does not pass the significance test, indicating that there is no significant negative linear relationship between the degree of

interest rate liberalization and the interest margin of large state-owned banks. It is also noted that the coefficients of the degree of risk aversion (ETA), scale of operations (LNLO), intermediate business income (NII), and degree of market concentration (HHI) are significant, which indicates that large state-owned banks tend to have policy advantages and economies of scale due to their special political status and market monopoly in China. In addition, its lending business mainly serves large state-owned enterprises, and its interest

rate pricing is relatively low and stable, which is less affected by interest rate liberalization. What's more, large state-owned banks have significant advantages in intermediate business income, and with the unwarranted advance of the interest rate liberalization, the proportion of their intermediate business income increases unwarrantedly, reducing their reliance on spread income, and completing the adjustment of their income composition and preferences in the process of interest rate liberalization, and eventually these changes significantly explain the changes in bank interest margins.

For joint-stock banks, urban commercial banks and rural commercial banks, the coefficient of the interest rate liberalization index is negative and significant at the 1% level, indicating that the interest margins of these banks show a significant negative relationship with the degree of interest rate liberalization. Among them, the coefficient of the interest rate liberalization index of rural commercial banks is -2.74, and its absolute value is the largest among the four types of banks, which shows that the interest rate liberalization has the greatest impact on rural commercial banks.

For these three types of banks, the performance on the control variables is different. It is noteworthy that the coefficients of intermediate business income for both joint-stock banks and urban commercial banks are significantly

negative, which indicates that with the advancement of interest rate market reform, these two types of banks are also expanding their intermediate business income to reduce their reliance on spread income, and joint-stock banks are more obvious in this regard. In contrast, the coefficient of rural commercial banks is not significant, because rural commercial banks are able to engage in few intermediate businesses themselves and are hardly chosen by customers. Compared with large state-owned banks, other banks lack the advantages of scale and policy, which makes them more serious in the narrowing of interest margins in a competitive market environment and more sensitive and susceptible to the response to interest rate liberalization.

### 4.3. Robustness tests

In order to ensure the robustness of the above analysis results, we perform robustness tests in several ways.

#### 4.3.1. Using different models in regression

In the previous we used a fixed-effects model to regress the panel data, and there are also many scholars who use pooled models or random-effects models for regression, and we can test the robustness of the regression results of the fixed-effects model through these two regressions, and the results of the regressions are shown in the table 6.

Table 6. Regression results of different models

	pooled model		random-effects model	
	coefficient	t-value	coefficient	t-value
<b>_cons</b>	2.7386*** (0.5305)	5.16	3.2663*** (0.4308)	7.58
<b>IRL</b>	-1.6855*** (0.3951)	-4.27	-2.6112*** (0.2732)	-9.56
<b>ETA</b>	0.1007*** (0.0192)	5.25	0.1052*** (0.0171)	6.15
<b>COST</b>	0.2921*** (0.0520)	5.62	0.1063*** (0.0379)	2.81
<b>LNLO</b>	-0.0308* (0.0165)	-1.86	0.0200 (0.0277)	0.72
<b>NII</b>	-0.0146*** (0.0039)	-3.78	-0.0246*** (0.0040)	-6.20
<b>HHI</b>	0.9810*** (0.2136)	4.59	1.3635*** (0.4122)	3.31
<b>M2</b>	0.0417*** (0.0152)	2.74	0.0283*** (0.0097)	2.93
<b>GDP</b>	0.0039 (0.0144)	0.27	0.0063 (0.0087)	0.72
<b>R<sup>2</sup></b>	0.6125		0.8716	0.6114
<b>adj. R<sup>2</sup></b>	0.6043		0.8544	0.6032
<b>F-value</b>	75.2687		50.6373	74.9287
<b>p-value</b>	0.0000		0.0000	0.0000

Note: Standard errors are in the parentheses. \*\*\*, \*\*, \* refer to significant at 1%, 5%, and 10% significance levels respectively.

From the regression results, we can see that the index of interest rate liberalization is -1.6855 and -2.6112 and significant at the 1% level, respectively, regardless of the model used, while the other control variables are significant at the 1% level and consistent with the coefficients obtained from the fixed effects model, except for LNLO and GDP. This further confirms the reliability of the results obtained from the previous study that bank interest margins are linearly and negatively correlated with interest rate liberalization, and robustness and rigor are ensured.

#### 4.3.2. Change the proxy variable selection

To further ensure the reliability of the above analysis results, we change the proxies for robustness testing. When choosing macro control variables, many scholars choose CPI growth rate as the control variable, so we use CPI growth rate instead of GDP growth rate for the regression, and the regression results obtained are shown in the table below, the coefficient of interest rate liberalization index is -2.8010, and it passes the significance test at 1% level, thus, the empirical results of this paper have strong robustness and reliability.



**Table 7.** Results of robustness tests

	coefficient	t-value
_cons	-4.6104*** (1.1846)	-3.89
IRL	-2.8010*** (0.3893)	-7.20
ETA	0.0605*** (0.0186)	3.26
COST	0.0683* (0.0385)	1.77
LNLO	0.3468*** (0.0820)	4.23
NII	-0.0182*** (0.0045)	-4.00
HHI	23.4475*** (2.9865)	7.85
M2	0.0346*** (0.0102)	3.38
CPI	-0.0559** (0.0264)	-2.11
R <sup>2</sup>	0.8733	
adj. R <sup>2</sup>	0.8563	
F-value	51.3785	
p-value	0.0000	

Note: Standard errors are in the parentheses. \*\*\*, \*\*, \* refer to significant at 1%, 5%, and 10% significance levels respectively.

## 5. Conclusion

The following results can be obtained from the research of this paper:

(1) The impact of interest rate liberalization on the interest margin income of Chinese commercial banks is significant, but it no longer presents the inverted U-shaped relationship as in the existing extensive literature, but a clear negative relationship, and the interest margins will keep shrinking as the degree of interest rate liberalization deepens.

(2) There are some differences in the effects of interest rate liberalization on different types of banks, with significant negative effects on the spreads of joint-stock banks, rural commercial banks, and urban commercial banks, and the largest effects on rural commercial banks, while the effects on large state-owned banks are insignificant.

(3) Factors such as risk aversion, loan size, intermediate business income, degree of market concentration and macroeconomic changes also have an impact on commercial bank spreads.

Based on the results of the research, the following recommendations are made:

(1) Interest rate liberalization has reduced interest margins of commercial banks in China and intensified the intensity of market competition. Some banks may invest their loans in riskier areas to make up for the loss of lower spreads in order to obtain higher profits. In response, commercial banks need to improve their risk management capabilities, while the regulatory authorities need to further strengthen their supervision of commercial banks.

(2) In the long run, interest rate liberalization has reduced interest margins, and data show that China has been in a phase of declining spreads for the past decade. Banks should move away from reliance on interest margins to develop diversified businesses, especially intermediate businesses, to improve

comprehensive income, mitigate the negative impact of declining interest margins, and find new profit opportunities.

(3) The government and the central bank need to recognize the heterogeneity of the impact of interest rate liberalization reform on different types of commercial banks, and in the process of further promoting interest rate liberalization reform, they should apply differentiated policies in order to help commercial banks complete financial innovation and promote the development of the real economy.

## References

- [1] R. I. Mckinnon, Money and Capital in Economic Development[M]. Washington D. C: Brookings Institution Press, 1973:115-128.
- [2] S. Edwards, Financial deepening in economic development[M]. Oxford:Oxford University Press, 1973:260.
- [3] J. Maudos and J. F. D. Guevara. "Factors Explaining the Interest Margins in the Banking Sectors of the European Union", Journal of Banking and Finance, 2004, 28(9) : 2259-2281.
- [4] A. Birchwood, M. Brei, and D. M. Noel, Interest Margins and Bank Regulation in Central America and the Caribbean, Journal of Banking and Finance, 2017, Vol.85, 56-68.
- [5] Jiangang Peng, Shujun Wang, and Tianyu Guan, "Does Interest Rate Liberalization Narrow Interest Margins of Commercial Bank? Empirical Evidence Based on Chinese Banking Industry", Journal of Financial Research (in Chinese), 2016, 43(7) : 48-63.
- [6] T. S. Ho, and A. Saunders, The Determinants of Bank Interest Margins: Theory and Empirical Evidence, Journal of Financial and Quantitative Analysis, 1981, Vol.16, 581-600.
- [7] L. Allen, "The Determinants of Bank Interest Margins: A Note". Journal of Financial and Quantitative Analysis, 1988, 23(2) : 231-235.
- [8] L. Angbazo, "Commercial Bank Net Interest Margins, Default Risk, Interest rate Risk and Off-balance Sheet Banking". Journal of Banking and Finance, 1997, 21(1) : 55-87.

- [9] Lin Jane-Raung, Chung Huimin, Hsieh Ming-Hsiang, and Wu Soushan, The Determinants of Interest Margins and Their Effect on Bank Diversification: Evidence from Asian Banks. *Journal of Financial Stability*, 2012, Vol. 8, No. 2: 1-11.
- [10] Liya Liu, Minghui Li, Sha Sun, and Jinqiang Yang, The relationship between Net Interest Margin and Non-interest Income for Chinese banks. *Economic Research Journal (in Chinese)*, 2014, (7) : 110-124.
- [11] Xiang Qiu, Maturity Mismatch and Bank Interest Margin. *Journal of Financial Research (in Chinese)*, 2015, 419(5) : 83-100.
- [12] Binghai Xin, Jiang Tao, and Xiaoyun Zhang, The Impact of Macroeconomic Uncertainty on Net Interest Margin. *Journal of Yunnan Finance and Trade Institute (in Chinese)*, 2015, (5) : 111-123.
- [13] C. M. Buch, C. T. Koch, and M. Koetter, Should I Stay or Should I Go? Bank Productivity and Internationalization Decisions. *Journal of Banking and Finance*, 2014, Vol. 42, No. 1:266-282.
- [14] A. Sarr, "Financial Liberalization, Bank Market Structure and Financial Deepening - An Interest Margin Analysis". IMF Working Papers, 2000, 00-38.
- [15] A. Saunders and L. Schumacher, "The determinants of bank interest rate margins: an international study". *Journal of International Money and Finance*, 2000, 19(6) : 813-832.
- [16] E. Chirwa and M. Mlachila, "Financial Reforms and Interest Rate Spreads in the Commercial Banking System in Malawi". IMF Working Papers, 2004, 51(1) : 96-122.
- [17] G. López –Espinosa, A. Moreno, and F. P. D. Gracia, "Banks Net Interest Margin in the 2000s: -A Macro Accounting international perspective". *Journal of International Money and Finance*, 2011, 30(6) : 1214-1233.
- [18] D. Kumar, The Impact of Interest Rate Marketization on China's Commercial Banks and Its Tactics. *Journal of Mathematical Finance*, 2017, 6 (5) : 921-929.
- [19] Working Group on Interest Rate liberalization Reform of the CBRC, Research on Interest Rate liberalization Reform and Commercial Bank Transformation. *Financial Regulation Research (in Chinese)*, 2012, (11) : 1-12.
- [20] Guangyuan Xing, Zongxian Feng, and Aolin Leng, The Impact of Deregulation of Loan Interest Rates on Commercial Bank Profitability. *Journal of Xi'an Jiaotong University (Social Sciences) (in Chinese)*, 2014, (6) : 51-57.
- [21] Chuang shen, Shengmin Zhao, and Ying Li, Interest Rate Liberalization, Non-interest Income and Net Interest Margin of Banks—The Different Influence Paths of Classified Non-interest Income. *Statistical Research (in Chinese)*, 2020, (5) : 68-81.
- [22] Lifu Fu and Jian Wei, Government Regulation, Interest Rate Liberalization and Net Interest Margin. *Collected Essays on Finance and Economics (in Chinese)*, 2014, (7) :90-97.
- [23] Shusong Ba, Zhongwei Hua, and Yuanqian Zhu, International comparison of interest rate liberalization: path, performance and market structure. *Journal of Central China Normal University (Humanities and Social Sciences) (in Chinese)*, 2012, Vol.51,(5) :33-46.
- [24] Shuqing Huang and Lulu Sun, Dynamic Choice of Commercial Banks' Pricing Strategies in the Process of Deposit Rate Liberalization. *Shanghai Finance (in Chinese)*, 2014, (5) :34-39.
- [25] Shujun Wang and Jiangang Peng, The Studies on the Measurement and Performance of China's Interest Rate Liberalization: Empirical Analysis Based on the Bank Credit Channel. *Financial Economics Research (in Chinese)*, 2014, Vol.29, (6) :75-85.
- [26] J. Nguyen, "The Relationship Between Net Interest Margin and Noninterest Income Using a Sysyem Estimation Approach". *Journal of Banking and Finance*, 2012, 36(9) , 2429-2437.
- [27] J. Maudos and L. Solís, The Determinants of Net Interest Income in the Mexican Banking System: An Integrated Model. *Journal of Banking and Finance*, 2009, Vol.33, 1920-1931.
- [28] L. Lepetit, E. Nys, P. Rous, and A. Tarazi, Bank Income Structure and Risk: An Empirical Analysis of European Banks. *Journal of Banking and Finance*, 2008, Vol.32, 1452-1467.
- [29] Zhenguo Han and Yajun Wang, Factors Affecting Commercial Bank Spreads Under Interest Rate Liberalization. *Journal of Capital University of Economics and Business (in Chinese)*, 2017, Vol.19, (1) : 18-24.
- [30] S. Gerlach, W. Peng, and C. Shu, Macroeconomic conditions and banking performance in Hong Kong SAR: A panel data study. *BIS Papers*, 2005, 22(2), 481–497.
- [31] A. E. Omankhanlen, N. Ilori, A. A. Isibor, and L. U. Okoye, Monetary policies and the achievement of bank profit objectives. *Journal of Central Banking Theory and Practice*, 2021, 2(1), 201-220.