

Has Interest Rate Liberalization Improved the Profitability of China's Banks?

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Abstract

In this study, we argue the relationship between interest rate liberalization and the profitability of banks in China. Using a novel dataset collected from Chinese commercial banks annual reports 2007–2019, this study shows that the improvement of interest rate liberalization has not affected the profitability of banks. We found that the increase in the degree of market competition leads to a decrease in the profit. However, in the early stage of interest rate liberalization, less competition pressure was not a big challenge, where the progress in marketization contributed to the profitability of banks. In addition, when banks were divided into three types, namely, joint-stock, city, and rural commercial banks, we found that the pressure from liberalization was concentrated on small and medium-sized commercial banks. Furthermore, as a response to market competition, non-interest income to diversify revenue sources has not contributed to improving the profitability of banks.

1. Introduction

Since the 1980s, many developing countries have conducted financial liberalization

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This paper is based on part of the data that was collected in Liu's M.A. thesis with new settings.

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reforms, and one of the key reforms is the reform of interest rate marketization. However, most of these financial liberalization reforms in developing countries have failed in systemic risks, such as the kind of Asian financial crisis. Despite its risks, financial liberalization reform is the only way for developing countries to promote the development of the financial industry and financial market through the improvement of price and competition mechanism. The key to assessing the success of reform is whether the liberalization reform has promoted the market competition and the management performance of financial institutions or not. Therefore, studies argued the relationship between interest rate liberalization and the profitability of banks.

As pioneer research focusing on financial liberalization, McKinnon (1973) pointed out the inefficiency in resource allocation through the behavior of government intervention on a financial system during the development period and submitted the theory of financial repression. Then, Shaw (1973) also argued the close relationship between the financial industry and economic development and proposed the theory of financial deepening. From their research, they both pointed out that the control of interest rates leads to financial repression. In addition, the marketization of the exchange rate and interest rate of commercial banks will promote economic development. Based on the research of McKinnon and Shaw, most studies focused on the relationship between interest rate liberalization and the profitability of commercial banks. They found that interest rate liberalization leads to the diversification of income structure.

Does the diversification of income structure improve the profitability of banks? The results vary because of the differences in samples and research methods. Eisemann (1976) noted that the expansion of non-interest income's business scope not only brings about the effect of diversification but also leads to an increase in the profitability of commercial banks. Considering the diversification of income structure as an evolution in the market, Baele et al. (2007) used panel data of European banks and studied the value of banks based on Tobin's Q theory. They found that the diversification of income structure can improve the stock price of banks. Moreover, banks are more relatively responsive to the changes in the financial market, and idiosyncratic risk can also be reduced.

However, some scholars obtained the opposite result. For instance, Stiroh and Rumble (2006) conducted a regression analysis using the data from commercial banks in the USA. They found that the increase of non-interest income has no significant relationship to the improvement of profitability or stability. On the contrary, focusing on non-interest income businesses leads to the deterioration of management. Then, Wei (2010) performed the regression analysis using data from 40 banks in China. He found a negative correlation between non-interest income and profitability. As the non-interest income business is at the early stage of market development, bringing a significant improvement to the profitability commercial banks is difficult. Zhang (2011) also studied the diversification of profit structure from the firm value perspective. He found that the increase of non-interest income cannot raise the value of banks because the high volatility of non-interest income has also disturbed the earnings structure. The non-interest income is highly correlated with interest spread income and is converted from margin income, weakening the ability to create value.

Mostly, however, the functionalization of the price mechanism is not a short term process. The studies obtained different results because of the different samples and stages in the liberalization reforms. To test the effectiveness of market-oriented reforms, they should conduct a long-term historical investigation. From the beginning of 1996, China's interest rate liberalization reform has experienced a long process but still on its way. Have the long-term reforms lead to a more efficient financial system in China? In this study, we argue the influence of the interest rate liberalization reform on bank's profitability by collecting data from 90 commercial banks in China. We also use different classification standards and divide these 90 banks into three groups to determine how differently they are affected. In addition, we divide the year from 2007 to 2019 into three periods to verify the different effects of interest rate liberalization in terms of historical and financial policy perspectives.

The remainder of the paper is organized as follows. Section 2 roughly describes the process of China's interest rate liberalization reform and its effect on bank operations and analyzes changes in the income structure of banks. Section 3 describes the data used in the empirical estimation. Section 4 firstly performs regression analysis on the

entire sample and adds dummy variables to perform regression again. Moreover, in this section, to analyze the difference among joint-stock, city, and rural commercial banks,¹⁾ we divided the samples into three categories regressed separately. We then divided the year from 2007 to 2019 into three periods to illustrate the differences in every period of China's interest rate liberalization reform. To test the robustness of the regression analysis's results, we change the explained variable return on assets (*ROA*) into return on equity (*ROE*) to run the robustness check. Finally, Section 5 concludes all the results and discusses policy implications.

2. China's Interest Rate Liberalization Reform and Commercial Banks

As part of China's comprehensive reform and opening up in 1994, China's government decided to begin the reforms of interest rate liberalization and pointed out that the final goal of China's interest rate liberalization reform is to establish a complete market interest rate management system at the Chinese Communist Party (CCP) Central Committee in 1993. According to these policy goals, China started to expand the range of changes in market interest rate base on the central bank's benchmark interest rate. From then on, to promote the interest rate formation mechanism determined by the relationship between capital supply and demand in the market. Moreover, China started a long-term exploration of interest rate liberalization.

From 1996 to 2004, the interest rates of interbank lending, bond repurchase, treasury bond, and foreign currency loan markets were liberalized gradually. China then achieved the liberalization of the currency market, bond market, and foreign currency interest rates. In the meantime, the lower limit of the RMB deposit interest rate and the upper limit of loan interest rate have been completely canceled. Expanding the limit of deposit and loan interest rates means that China has made some achievements in the

1) According to China Banking and Insurance Regulatory Commission (CBIRC), we divided 90 banks into three types, (1) joint-stock commercial banks: registered capital of more than 1 billion yuan (12 banks in the sample), (2) city commercial banks: registered capital of more than 100 million yuan (58 banks in the sample), (3) rural commercial banks: registered capital of more than 50 million yuan (20 banks in the sample).

<http://www.cbirc.gov.cn/cn/view/pages/ItemDetail.html?docId=879929&itemId=927>, June 20, 2021.

liberalization of interest rates. In 2013, China made new progress in the liberalization of loan interest rates. That is, the liberalization of loan interest rates has been completed after the liberalization of the lower limit of loan interest rates. From 2014 to March 2015, the upper limit of deposit interest rates of financial institutions has been raised twice. Finally, completely liberalizing loan interest rates in October 2015 means the completion of the interest rate liberalization in deposits and loans.²⁾

Influenced by the interest rate liberalization, most of China's commercial banks have reduced interest spreads. Interest spread is the main source of a bank's income, so the reduction of the interest spread means a decrease in profits. Moreover, with the increase of market competition, the profits of banks will also decrease, as shown in the *ROA* and *ROE* charts (Figures 1 and 2). *ROA* and *ROE* have increased in the early stage because the pressure from liberalization was not great. However, since 2012, the entire sample shows a downward trend in *ROA* and *ROE*, indicating the decline of profitability. To make up for this, many banks expanded the amount of loan business in the short term and had a temporary effect. However, at the same time, more loans bring

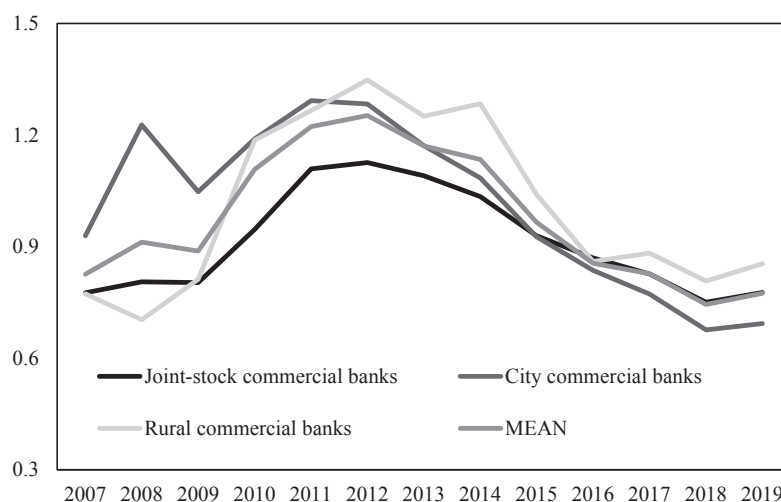


Figure 1. Changes of *ROA* (%)

Sources: calculated from collectible bank annual reports.

2) "The Supplement of 'Report on the Implementation of China's Monetary Policy', Orderly advance the reform of loan market interest rate", the people's bank of China (PBC).

<http://www.pbc.gov.cn/zhengcehuobisi/125207/125227/125960/126052/index.html>, June 20, 2021.

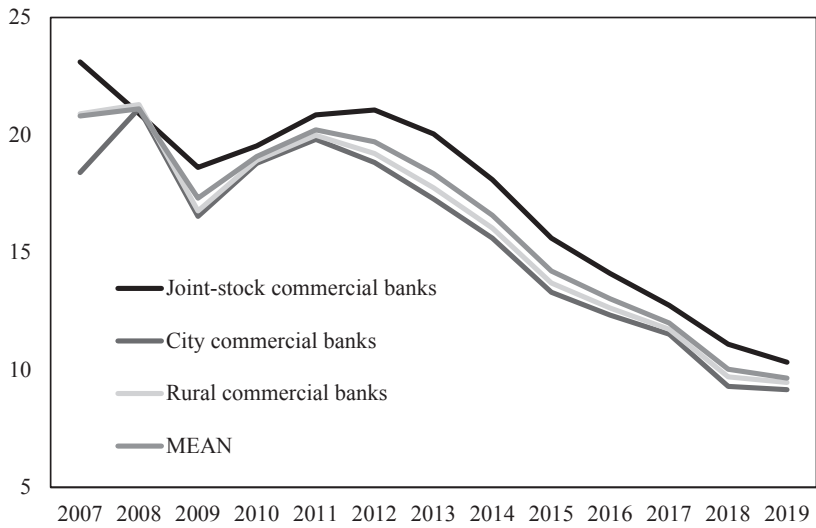


Figure 2. Changes of ROE (%)

Sources: calculated from collectible bank annual reports.

out more risks to the management of banks. As non-interest income is less affected by the change of interest rates, the diversification of income structure is helpful to reduce risks and improve the profitability of banks through some experiences from European and American banks. Thus, commercial banks in China increasingly tried to develop the non-interest income business positively.

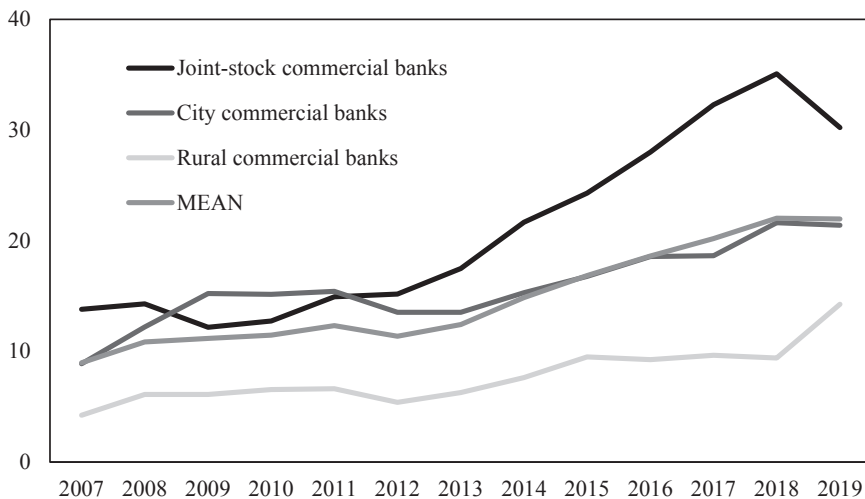


Figure 3. Changes in the proportion of non-interest income (%)

Sources: calculated from collectible bank annual reports.

Figure 3 shows that commercial banks in China are aware of the importance of non-interest income as a non-traditional income source. The ratio of non-interest income of commercial banks in 2019 has almost been doubled compared with that in 2007. Joint-stock, city, and rural commercial banks have a growing trend, and the growth of joint-stock commercial banks is the most evident (from 14% to more than 30%). The reason is that joint-stock commercial banks are more competitive and have more funds to support the development of non-interest income businesses compared with the other two types of banks. City and rural commercial banks are in a disadvantageous position in the market competition, so their business space is compressed. Furthermore, they can hardly obtain enough additional funds to develop non-interest businesses, particularly rural commercial banks, whose percentage of non-interest income is below average.

3. Data and Variables

The profitability of commercial banks is related to the income structure. Based on Sun and Lu (2019), we chose the variables after considering the factors that can affect the profitability of the bank. In this way, each factor affected by interest rate liberalization can be analyzed. The panel data are collected from the annual reports issued by each bank. In addition, the data consist of 90 banks in China for the period 2007–2019.

To measure the profitability of banks, we choose *ROA* as the explained variable. As an important factor affecting banks' profits, we chose net interest spread (*NIS*) as one of the explanatory variables. In this study, we mainly examine how the profitability of banks is influenced by liberalization's degree and non-interest income. Thus, we chose the marketization index (*MKT*)³⁾ and non-interest income ratio (*NIIR*) as the other two explanatory variables. The *MKT* is composed of five secondary indexes: (1) government-market relationship; (2) the level of non-state-owned economy's development; (3) the level of product markets' development; (4) the level of factor markets' development; (5) the level of market intermediary organization's development and legal environment.

3) It is an index calculated by Fan Gang to measure the level of marketization development in each region.

<https://www.ssap.com.cn/c/2019-03-28/1076146.shtml>, June 20, 2021.

Brouke (1989) and Athanasoglou et al. (2006) proved that the higher efficiency of cost leads to higher profits. Therefore, we choose the cost-to-income ratio (*CIR*) as a control variable. Banks with good capital send a good signal to the financial markets to show the safety of their funds. Brouke (1989) conducted a study in 12 European countries and found that capital adequacy ratio (*CAR*) has a positive and fairly significant correlation with bank profits. Hence, we chose *CAR* as the second control variable. Athanasoglou et al. (2008) found a significantly positive correlation between credit risk and profitability. To measure the credit risk of a bank, we choose the non-performing loan ratio (*NPLR*) as another control variable. Abreu and Mendes (2000) found a significantly positive correlation between asset composition and profitability; therefore, we chose loan-deposit ratio (*LDR*) as a control variable. Finally, we chose the logarithm of the asset of banks (*LNAS*) because based on Berger et al. (1987), asset shows a significant negative correlation with profits. According to the bank types (*Type*), different periods of interest rate liberalization (*Period*), the provinces where the banks are located (*Region*), and 13 years (*Year*), we add four sets of dummy variables (Table 1).

Table 1. Variable list

Variable type	Code	Variable name	Description
Explained variable	<i>ROA</i>	Return on assets	$\text{Net Profit} \div \text{total asset} \times 100$
Explanatory variable	<i>NIS</i>	Net Interest Spread	$(\text{Interest Income} - \text{Interest expense}) \div \text{total asset} \times 100$
	<i>NIIR</i>	Non-Interest Income ratio	$\text{Non-Interest Income} \div \text{Ordinary income} \times 100$
	<i>MKT</i>	marketization index	Index to measure the degree of marketization
Control variable	<i>CIR</i>	Expense ratio	$\text{Ordinary expenses} \div \text{Ordinary income} \times 100$
	<i>CAR</i>	Capital adequacy ratio	$\text{Owned capital} \div \text{risk-weighted assets} \times 100$
	<i>NPLR</i>	Non-performing loan ratio	$\text{Loan provision rate} \div \text{Provision coverage} \times 100$
	<i>LDR</i>	loan-deposit ratio	$\text{Total loans} \div \text{total deposits} \times 100$
	<i>LNAS</i>	Capital amount	$\text{Ln}(\text{total capital})$
dummy variables	<i>Type</i>	Bank types	3 types
	<i>Period</i>	different periods of interest rate liberalization	3 periods
	<i>Region FE</i>	Provinces that banks are located	30 provinces
	<i>Year FE</i>	2007-2019	13 years

From Table 2, we can find that 90 commercial banks in China have an average of 1.00% *ROA*, which indicates that the entire banking industry is earning profits. *NIS* has been declining because of the following: the restraint of interest rate liberalization policy in these years, the average value is decreased to 2.68%, and improvements of management mode such as diversification of income structure are needed. *NIIR* shows an average of 17.53%. However, a considerable discrepancy between the maximum value of 87.83% and the minimum value of -5.34% still exists because different banks show different intentions of developing non-interest income businesses. The *MKT* has an average of 7.48, indicating that the nationwide marketization is being progressed steadily. The *CIR* has an average of 33.07%, and approximately 12% up to the standard of "below 45%" still exists. Hence, commercial banks in China have an excellent *CIR*. Particularly according to the data compiled by the magazine "The Banker" published in 2019, China Construction Bank and Industrial Bank ranked first and third in the worldwide *CIR* ranking.⁴⁾ Concerning the *NPLR*, the average of 1.65% is at a low level, but a significant discrepancy from the maximum value exists. Hence, we can know that many banks are facing credit risk. *LDR* has a maximum of 97.93%, indicating that some banks rely too much on the loan business. Finally, regarding the assets of banks, it's also confirmed that there are no evident difference in the whole sample.

Table 2. Descriptive statistics

Variables	N	Mean	S.D.	Min	Max
<i>ROA</i>	1,170	1.00	0.35	-0.58	3.00
<i>ROE</i>	1,170	15.89	6.09	-8.13	45.85
<i>NIS</i>	1,170	2.68	0.63	0.64	6.50
<i>NIIR</i>	1,170	17.53	8.83	-5.34	87.83
<i>MKT</i>	1,170	7.48	1.69	2.33	10.00
<i>CIR</i>	1,170	33.07	5.28	15.67	80.54
<i>CAR</i>	1,170	13.00	2.45	-4.82	38.09
<i>NPLR</i>	1,170	1.65	1.64	0.02	28.44
<i>LDR</i>	1,170	64.77	8.92	0.68	97.93
<i>LNAS</i>	1,170	25.78	1.45	21.23	29.63

4) From the top 1000 world banks ranking 2019, The Banker.

<https://www.thebankerdatabase.com/index.cfm/search/ranking>, June 20, 2021.

4. Empirical Analyses

Based on the model constructed by Sun and Lu (2019), this study constructed the following model by considering the availability of data from the Commercial Banks of China and incorporating the *MKT*:

$$ROA_{i,t} = \beta_0 + \beta_1 NIS_{i,t} + \beta_2 NIIR_{i,t} + \beta_3 MKT_{i,t} + \beta_4 CIR_{i,t} + \beta_5 CAR_{i,t} + \beta_6 NPLR_{i,t} + \beta_7 LDR_{i,t} + \beta_8 LNAS_{i,t} + \beta_9 Dummies + \varepsilon_{i,t}$$

where i is the bank, $i = 1, 2, 3, 4, \dots, 90$; t is time, $t = 2007, 2008, 2009, \dots, 2019$; $ROA_{i,t}$ is a number that indicates the profitability of bank i in year t . As the result of Hausman test is $Prob > \chi^2 = 0.000 < 0.1$, so we chose fixed effects model to run the regression analysis.

4.1 Basic regression results

The result from Table 3 shows that *NIS* and *CAR* have a positive correlation with profitability (*ROA*) at the 1% significance level. Interest spread also remains the most important source of income. In addition, *CAR* represents the ability of commercial banks to respond to risks, and a higher *CAR* leads to higher profits. *NIIR* has a negative correlation with *ROA* but has no significant correlation. The reason is that banks in China still rely on the traditional source of income, and the influence of new sources, such as non-interest income, is fairly limited. The *MKT* has a negative correlation with *ROA* at the 1% significance level. For the entire sample, the progress of marketization leads to the reduction of profit. The *CIR* has a negative correlation with *ROA* at the 1% significance level, showing that a higher *CIR* leads to less profits. The *NPLR* has a negative correlation with *ROA* at the 5% significance level. As expected, considerable credit risks lead to a decrease in profit. The *LNAS* has a negative correlation with *ROA* at the 5% significance level. From this result, the expansion of bank assets size is a waste of resources and will reduce the management efficiency of banks. Therefore, the size of assets has a negative correlation with *ROA*. Unlike the expected result, the *LDR* has a negative correlation with *ROA* at the 5% significance level. The reason is that, although banks increase loans to earn more profits, liquidity, and credit risks will also increase simultaneously, which will lead to a decrease in profits.

Table 3. Basic regression results

VARIABLES	(1) <i>ROA</i>	(2) <i>ROA</i>	(3) <i>ROA</i>	(4) <i>ROA</i>
<i>NIS</i>	0.132*** (4.40)	0.123*** (4.49)	0.149*** (9.13)	0.122*** (7.74)
<i>NIIR</i>	-0.002 (-1.23)	-0.001 (-0.84)	0.000 (0.31)	0.002* (1.85)
<i>NKT</i>	-0.078*** (-3.24)	-0.074*** (-3.32)	-0.097*** (-7.25)	-0.030 (-1.24)
<i>CIR</i>		-0.016*** (-3.40)	-0.015*** (-7.64)	-0.014*** (-7.57)
<i>CAR</i>		0.022*** (3.38)	0.022*** (5.53)	0.020*** (5.37)
<i>NPLR</i>		-0.032** (-2.22)	-0.041*** (-7.33)	-0.027*** (-4.93)
<i>LDR</i>		-0.005** (-2.22)	-0.003*** (-2.66)	-0.001 (-1.01)
<i>LNAS</i>		-0.051* (-1.94)	-0.021** (-2.35)	-0.015* (-1.81)
Constant	1.262*** (6.57)	3.168*** (4.55)	2.317*** (8.55)	1.562*** (4.85)
<i>Year FE</i>	-	-	-	YES
<i>Region FE</i>	-	-	YES	YES
Observations	1,170	1,170	1,170	1,170
Adjusted r2	0.114	0.254	0.307	0.386

Note: *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively; regressions with a standard robust errors selection and *t* value is in parenthesis.

After the *Region* dummies were added, we found that, for the entire sample, the *MKT* still has a negative correlation with *ROA* at the 1% significance level. However, after the addition of *Region* and *Year* dummies, variable *MKT* has no significant correlation with *ROA* anymore. This result indicates that *Region* dummies will significantly affect the influence from the marketization to the profitability of commercial banks. *Year* dummies may weaken the influence of marketization on profitability.

4.2 Regression results after adding interaction

At this part, we added an interaction, which consists of *NIIR* and *MKT*, so that we can analyze the relationship between non-interest income (affected by the progress of interest rate liberalization) and the profitability of banks. Table 4 shows the result, where the interaction has a negative correlation with *ROA* at the 5% significance level. From this result, we can say that commercial banks are affected by interest rate

Table 4. Results after adding interaction

VARIABLES	(1) ROA	(2) ROA	(3) ROA
<i>NIS</i>	0.161*** (9.82)	0.153*** (9.21)	0.124*** (7.75)
<i>NIIR</i>	0.012** (2.27)	0.007 (1.28)	0.006 (1.16)
<i>MKT</i>	0.019 (1.63)	-0.083*** (-4.72)	-0.022 (-0.82)
<i>CIR</i>	-0.015*** (-8.22)	-0.015*** (-7.65)	-0.014*** (-7.58)
<i>CAR</i>	0.019*** (4.90)	0.022*** (5.47)	0.020*** (5.33)
<i>NPLR</i>	-0.040*** (-6.96)	-0.041*** (-7.35)	-0.027*** (-4.94)
<i>LDR</i>	-0.002** (-2.01)	-0.003*** (-2.66)	-0.001 (-1.01)
<i>LNAS</i>	-0.019** (-2.54)	-0.020** (-2.25)	-0.015* (-1.74)
<i>c.NIIR#c.MKT</i>	-0.001** (-2.41)	-0.001 (-1.25)	-0.000 (-0.79)
Constant	1.329*** (4.97)	2.170*** (7.34)	1.474*** (4.33)
<i>Year FE</i>	-	-	YES
<i>Region FE</i>	-	YES	YES
Observations	1,170	1,170	1,170
Adjusted r2	0.231	0.307	0.386

Note: *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively; regressions with a standard robust errors selection and *t* value is in parenthesis.

liberalization, and they strengthen non-interest income businesses to diversify income structure. However, the promotion effect of non-interest income on profits was woken by the progress of interest rate liberalization. After the addition of *Year* and *Region* dummies, the interaction *c.NIIR#c.MKT* has no significant correlation with *ROA* anymore.

4.3 Regression results of different periods

According to whether any important changes exist or not, we divided 13 years into three periods. In 2010, with the listing of Agricultural Bank of China, the business restructuring and shareholding system reforms in China's commercial banks have made great achievements. In July 2013, the float of loan rate was canceled by the central bank, indicating that the loan rate was completely liberalized. Thus, we can divide 2007-2019

into three periods: (1) *Period 1*, 2007–2009, (2) *Period 2*, 2010–2012, and (3) *Period 3*, 2013–2019. After that, we added three interactions into the regression. From the result, we can find that the interaction consists of *Period 1*, and *MKT* has a negative correlation with *ROA* at the 1% significance level. We can say that from 2007 to 2009, banks had no enough time to fully understand the interest rate liberalization, so the progress of liberalization led to the decrease of banks' profits. The interaction consists of *Period 2*, and *MKT* has a positive correlation with *ROA* at the 1% significance level. This result shows that, from 2010 to 2012, after shareholding system reform has made important achievements, the competitiveness of commercial banks has increased. Therefore, the progress of liberalization led to the increase of profits of banks. The last interaction consists of *Period 3*, and *MKT* has a negative correlation with *ROA*

Table 5. Results of different periods

VARIABLES	(1) <i>ROA</i>	(2) <i>ROA</i>	(3) <i>ROA</i>
<i>NIS</i>	0.122*** (4.47)	0.116*** (4.20)	0.117*** (4.21)
<i>NIIR</i>	-0.001 (-0.62)	-0.001 (-0.39)	-0.001 (-0.62)
<i>MKT</i>	-0.117*** (-4.43)	-0.051** (-2.41)	0.008 (0.26)
<i>CIR</i>	-0.015*** (-3.26)	-0.015*** (-3.41)	-0.015*** (-3.55)
<i>CAR</i>	0.020*** (3.21)	0.019*** (3.00)	0.021*** (3.17)
<i>NPLR</i>	-0.028** (-2.00)	-0.027** (-2.00)	-0.031** (-2.21)
<i>LDR</i>	-0.004* (-1.88)	-0.005** (-2.06)	-0.005** (-2.40)
<i>LNAS</i>	-0.065** (-2.35)	-0.056** (-2.13)	-0.042* (-1.69)
<i>c.MKT#c.Period 1</i>	-0.019*** (-3.41)		
<i>c.MKT#c.Period 2</i>		0.019*** (6.33)	
<i>c.MKT#c.Period 3</i>			-0.018*** (-3.75)
Constant	3.827*** (5.19)	3.085*** (4.49)	2.440*** (3.76)
Observations	1,170	1,170	1,170
Adjusted r2	0.268	0.284	0.269

Note: *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively; regressions with a standard robust errors selection and *t* value is in parenthesis.

at the 1% significance level. We can say that after 2013, the progress of liberalization led to the decrease of banks' profits. The reason is that the loan rate was completely liberalized, commercial banks set a lower loan rate to increase their profit, and then, the interest spread was narrowed. Moreover, the expansion of loan transactions is always accompanied by the increase of liquidity and credit risks. Therefore, the progress of liberalization led to the decrease of banks' profits during this period.

4.4 Regression results of different types of banks

To analyze the difference among the three types of banks after the diversification of income structure, we added three interactions into the regression. From the result, we can find that when the interaction consists of *Type 1*, *NIIR* has a positive

Table 6. Results of different types of banks

VARIABLES	(1) <i>ROA</i>	(2) <i>ROA</i>	(3) <i>ROA</i>
<i>NIS</i>	0.124*** (4.59)	0.124*** (4.57)	0.123*** (4.50)
<i>NIIR</i>	-0.002 (-1.36)	0.002 (1.02)	-0.001 (-0.72)
<i>MKT</i>	-0.077*** (-3.41)	-0.076*** (-3.37)	-0.076*** (-3.39)
<i>CIR</i>	-0.015*** (-3.16)	-0.015*** (-3.18)	-0.016*** (-3.40)
<i>CAR</i>	0.022*** (3.35)	0.022*** (3.36)	0.022*** (3.36)
<i>NPLR</i>	-0.033** (-2.26)	-0.033** (-2.25)	-0.032** (-2.23)
<i>LDR</i>	-0.005** (-2.24)	-0.005** (-2.24)	-0.005** (-2.20)
<i>LNAS</i>	-0.051* (-1.95)	-0.051* (-1.95)	-0.051* (-1.93)
<i>c.NIIR#c.Type 1</i>	0.005** (2.58)		
<i>c.NIIR#c.Type 2</i>		-0.004** (-2.16)	
<i>c.NIIR#c.Type 3</i>			-0.017*** (-5.49)
Constant	3.171*** (4.55)	3.153*** (4.52)	3.238*** (4.63)
Observations	1,170	1,170	1,170
Adjusted r2	0.256	0.256	0.296

Note: *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively; regressions with a standard robust errors selection and *t* value is in parenthesis.

correlation with ROA at the 5% significance level. With the progress of liberalization, the non-interest income of *Type 1* (joint-stock commercial banks) increased the profit of banks. Then, when the interaction consists of *Type 2*, *NIIR* has a negative correlation with *ROA* at the 5% significance level. Moreover, when the interaction consists of *Type 1*, *NIIR* has a negative correlation with *ROA* at the 1% significance level. This result shows that the non-interest income of *Type 2* (city commercial banks) and *Type 3* (rural commercial banks) led to the decrease of profit. As city and rural commercial banks have a narrow market compared with joint-stock commercial banks, the income of non-interest cannot increase profit.

4.5 Robustness check

From the results of the robustness check in Table 7, we can find that the figures of the explanatory variables, that is, *NIS*, *NIIR*, and *MKT*, have changed. However, their

Table 7. Results of robustness check

VARIABLES	(1) <i>ROE</i>	(1) <i>ROE</i>	(2) <i>ROE</i>	(3) <i>ROE</i>
<i>NIS</i>	1.916*** (3.73)	1.695*** (3.64)	1.954*** (7.35)	1.237*** (5.17)
<i>NIIR</i>	-0.015 (-0.76)	-0.037 (-1.62)	0.009 (0.48)	0.025 (1.53)
<i>MKT</i>	-3.671*** (-9.92)	-3.367*** (-9.17)	-3.954*** (-18.06)	-0.126 (-0.34)
<i>CIR</i>		-0.200*** (-3.71)	-0.155*** (-5.01)	-0.124*** (-4.55)
<i>CAR</i>		-0.149* (-1.69)	-0.152** (-2.37)	-0.138** (-2.40)
<i>NPLR</i>		-0.629*** (-4.27)	-0.707*** (-7.75)	-0.563*** (-6.80)
<i>LDR</i>		-0.083*** (-2.80)	-0.053*** (-2.79)	-0.026 (-1.50)
<i>LNAS</i>		-1.042** (-2.33)	-0.002 (-0.01)	0.404*** (3.11)
Constant		78.203*** (6.65)	51.812*** (11.73)	11.136** (2.28)
<i>Year FE</i>	-	-	-	YES
<i>Region FE</i>	-	-	YES	YES
Observations	1,170	1,170	1,170	1,170
Adjusted r2	0.306	0.382	0.382	0.526

Note: *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively; regressions with a standard robust errors selection and *t* value is in parenthesis.

correlation with ROA has no difference from the basic regression results. Therefore, the regression results are robust.

5. Conclusion

Using a novel dataset collected from commercial bank annual reports, we analyzed the influence of interest rate liberalization on the profitability of commercial banks in China. We found that for the entire sample, the growth of *MKT*, which is considered the dummy of market competition, will reduce the profitability of commercial banks. With the increasing market competition, most commercial banks proposed diversification in the income structure. The *NIIR* has greatly improved these years. However, the interest spread is still the main source of bank income. From the regression results, we found that non-interest income has no evident relationship with the profitability of banks. The reason is that the development of the non-interest income business of China's commercial banks is still at the primary stage and focused on the larger joint-stock commercial banks. This development can hardly influence the profitability of banks through the economy of scale.

After adding interaction consisting of *NIIR* and *MKT*, we found that with the progress of marketization, non-interest income can hardly increase the profit of banks. Then, after adding interaction consisting of period and *MKT*, we found the following: (1) during the first period 2007–2009, banks cannot fully understand the interest rate liberalization reform, so the progress of liberalization led to the decrease of the profit of banks. (2) During the second period 2010–2012, after having important achievements in shareholding system reforms, the pressure from liberalization was not so much like nowadays. Thus, the progress of liberalization led to the increase of the profits of banks. (3) During the last period 2013–2019, the loan rate was completely liberalized, narrowing interest spread. Moreover, commercial banks face more liquidity and credit risks than before. Hence, the progress of liberalization led to the decrease of the profits of banks. After adding the interaction consisting of Type dummies and *NIIR* into the regression, we found that with the progress of liberalization, diversification of income structure of joint-stock commercial banks increased their profit. However, the diversification of

income structure decreased the profit of city and rural commercial banks.

From the above results, we can hardly believe that the progress of liberalization can increase the profit of banks. In addition, the diversification of income structure is only helpful for joint-stock commercial banks to improve their profitability. However, we cannot say that any economic policy or reformations will always bring about good results, particularly in the short term. In addition, traditional banking industries face more challenges increased by the harsh business environment. This case keeps low interest rates and allows the development of non-bank financial institutions and IT industries. Under these circumstances, although the diversification of income structure may always involve risks, relying on traditional income resources, such as interest spread, will bring much more liquidity and credit risks. Therefore, Chinese commercial banks should utilize the benefits of interest rate liberalization more effectively and reduce these risks by improving their operating capacity.

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Appendix. List of commercial bank annual reports survey

Joint-stock Commercial Banks				
China Merchants Bank	China Zhesang Bank	Hua Xia Bank	Ping An Bank	Industrial Bank
China Citic Bank	China Bohai Bank	China Minsheng Banking Corp	Shanghai Pudong Development Bank	China Guangfa Bank
China Everbright Bank	Hengfeng Bank			
City Commercial Banks				
Bank of Ningbo	Bank of Chongqing	Bank of Quanzhou	Bank of Lanzhou	Bank of Kunlun
Bank of Nanchang	Bank of Hebei	Datong Bank	Bank of Qinghai	Bank of Jiangsu
Bank of Rizhao	Bank of Shaoxing	Harbin Bank	Xiamen Bank	Bank of Wenzhou
Bank of Jinzhou	Panzhuhua City Commercial Bank	Hankou Bank	Fushun Bank	Bank of Qingdao
Bank of Jiujiang	Guangxi Beibu Gulf Bank	Bank of Huzhou	Bank of Yingkou	Bank of Luoyang
Guilin Bank	Bank of Dalian	Huishang Bank	Bank of Jilin	Bank of Tianjin
Bank of Chengdu	Great Wall West China Bank	Bank of Jining	Zhejiang Mintai Commercial Bank	Weihai City Commercial Bank
Bank of Guiyang	Haixia Bank of Fujian	Zhejiang Tailong Commercial Bank	Qilu Bank	Bank of Nanjing
Bank of Xi'an	Fudian Bank	Bank of Guangzhou	Bank of Dongying	Chongqing Three Gorges Bank
Bank of Liuzhou	Bank of Hangzhou	Zhejiang Chouzhou Commercial Bank	Bank of Taian	Bank of Beijing
Bank of Jiaxing	Bank of Inner Mongolia	Bank of Xinxiang	Huarong Xiangjiang Bank	Bank of DongGuan
Laishang Bank	Bank of Ningxia	Bank of Weifang		
Rural Commercial Banks				
Chizhou Jiuhua Rural Commercial Bank	Jiangsu Xinghua Rural Commercial Bank	Jiangsu Hai'an Rural Commercial Bank	Tongling Wanjiang Rural Commercial Bank	Rural Commercial Bank of Zhangjiagang
Anhui Shitai Rural Commercial Bank	Jiangsu Jiangyan Rural Commercial Bank	Jiangsu Gaochun Rural Commercial Bank	Beijing Rural Commercial Bank	Wuxi Rural Commercial Bank
Xiaoshan Rural Commercial Bank	Guangzhou Rural Commercial Bank	Fuyang Rural Commercial Bank	Shanghai Rural Commercial Bank	Tongling Rural Commercial Bank
Zhejiang Yuhuan Rural Commercial Bank	Zhuhai Rural Commercial Bank	Qingdao Rural Commercial Bank	Hangzhou United Bank	Wenling Rural Commercial Bank