



Empirical Analysis of the Influence of competition on the profitability of Commercial Banks

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Abstract. China's interest rate liberalization reform largely intensified competition. In order to maintain profitability, many banks start to develop other businesses. However, there has been no research on whether competition is the primary factor that influences the profitability of commercial banks and whether this impact is universal. Therefore, we collected data on ROA, Asset-liability Ratio, Non-performing Loan Ratio, Interest Expense, Interbank deposit, and capital adequacy ratio of 585 listed banks, starting from 2011 to 2021 from WIND. The data used to conduct the research are winsorized to eliminate outliers at 5%. This paper constructed a fixed effects regression model. Also, this paper used GMM system dynamic for testing model endogeneity. To ensure model robustness, the model was tested by first changing the sampling period, and then repeating on interest income, and finally replacing deposit ratio with debt ratio. Finally, the following conclusions are drawn: (1) competition has a positive influence to the profitability of commercial banks. (2) the non-performing loan ratio has a greater influence regarding to the profitability of commercial banks. (3) the competition within in the region the bank is in has a greater influence regarding to the profitability of commercial banks.

Keywords: Profitability of Bank Operation, Competition, Commercial Bank.

1 Introduction

The rapidly intensifying competition among commercial banks has become a significant influencing factor of their operational dynamics and profitability. As commercial banking sectors across the globe become more saturated, the ramifications of this competition cannot be ignored. On the one hand, heightened competition has the potential to bolster the capabilities of commercial banks. This, in theory, should enhance their profit-generating potential, encouraging innovation and better customer service. On the contrary, there is a concern that escalating competition could result in increased investment by these institutions without a corresponding rise in the industry's overall profit pool. Such a scenario could lead to higher resource commitment by banks, while their profitability remains stagnant or even diminishes. Ascertaining whether factors that foster or inhibit bank profitability dominate in practice has thus emerged as a focal point in studies centered on commercial bank performance enhancement. This paper

aims to provide an empirical analysis to shed light on this pertinent issue, offering insights into the complex interplay between competition and profitability in the world of commercial banking.

2 Background and Literature Review

With the heightened integration of the global economy and the continuous development of the financial market, competition in the banking sector has intensified. To enhance their market share and profitability, major banks are constantly adopting innovative financial products, services, and strategies, striving for an edge in the market. The competition among banks is not only an inevitable outcome of the marketization of the banking industry but also plays a pivotal role in the robust and healthy development of the entire financial system.

China, being one of the world's largest economies, has seen its banking sector grow rapidly over the past decades, positioning itself as one of the most significant and influential banking markets globally. Against this backdrop, researching the competitive landscape of the Chinese banking sector and its impact on bank profitability is of paramount importance. Moreover, with China's economic transition and the deepening reforms in its financial market, the escalating competition in the banking sector presents both unprecedented challenges and opportunities for Chinese banks.

The competitive environment in the banking sector plays a critical role in propelling the marketization of banks. Marketization refers to the banking operations being more reliant on market forces rather than administrative interventions or other non-market mechanisms. In a highly competitive environment, banks are compelled to enhance their operational efficiency and optimize their products and services to meet the needs of their clients, thereby achieving profitability and growth. Hence, exploring the relationship between banking competition and profitability is vital for understanding the developmental trends and challenges faced by the Chinese banking sector.

3 Data and Measurement

In our analysis, we introduce profitability as the interpreted variable. Other variables such as Profit per capital, Non-performing Loan Ratio, Asset Liability Ratio, total capital, interest expense, inter-bank deposit, and capital adequacy ratio are introduced as explanatory variables. These variables mentioned above are available in table 1.

Table 1. Table of all variables used in basic analysis

Variable Name	Variable Type	Variable Symbol	Variable Meaning
PROFITABILITY	Explained Variable	EFFI(ROA)	Profit/capital
Competition	Core explanatory variable	COM	deposit /Total deposit

Asset Liability Ratio	Control Variable	ZF	Total Liabilities/Total Assets
Non-performing Loan Ratio		BL	Non-performing Loans/Total Assets
Total capital		ZZ	Ln(Total Assets)
Interest expense		PR	Ln(Interest Expense)
Interbank deposit		TY	Ln(Interbank Deposit)
Capital adequacy ratio		ZC	Core Capital /Risk-Weighted Assets

Variable source: The basic analysis of influences of competition on profitability of commercial banks are inspected and analyzed before these variables are designed in this paper.

4 Empirical Results

4.1 Empirical Model equation

This paper also takes into account the variance and the impact of individual samples, as well as year effect. Based on these consideration and on the global regression model, this paper adopted a fixed effect regression model. The equation of the model is described:

$$ROA_{it} = \beta_0 + \beta_1 COM_{it} + \sum_j v_j controls_{jit} + m_i + \lambda_t + \mu_{it} \tag{1}$$

Where β_0 corresponds to intercept, β_1 corresponds to the coefficient of competition, controls is the Control Variable listed above. m_i corresponds to individual effect, λ_t corresponds to time effect, and μ_{it} represents random interference.

This paper used stata to help analyze the statistical variables and obtained statistics of the 3687 sampled banks during the period 2011 to 2021. The analytical outcome are shown in Table 2 below.

Table 2. Descriptive statistics of the empirical analysis of the influence of competition on the profitability of commercial banks

Variable Name	Sample Size	Mean	St.dev	Min	Max
ROE	3687	0.9281	0.4852	-1.7554	7.2213
COM	3687	0.6667	1.0259	0.0278	3.7007
ZF	3687	92.2527	2.1690	60.6374	101.3128
BL	3687	1.9524	0.9400	0.83	3.83
ZZ	3687	24.6939	1.7040	21.1233	31.1913
PR	3687	20.7738	1.7871	16.7553	26.8793
TY	3687	19.4260	4.5615	-1.6094	28.6179
ZC	3687	13.6928	2.0157	10.73	18.56

The descriptive statistics shows that there is no odd value. The distribution is relatively concentrated for each variable. There may exist unavoidable internal relations that break the inter-independence of these variables. Based on that, we need a deeper analysis on these variables.

4.2 Basic Regression Model

This paper will proceed with empirical regression, constructing the regression model and implementing specific steps for model regression and detection. Firstly, we choose from the mixed cross-section model and the individual fixed effect model according to the ratio of likelihood in the panel data. If we see significant divergence between individual samples and time in each section in the panel data, then we should choose the individual fixed effect model. Otherwise, we choose the other. We accept the null hypothesis if we see the p-value of F and LR are greater than 0.1[1]. If not, we determine the mixed cross-section model is not a good fit.

Secondly, the Hausman test is employed to decide which model the panel data should be modeled as from the two models mentioned above[2]. The starting hypothesis is that if the intercept term has no relationship with profitability, then we should adopt the random effect model. We determine relationship by looking at the p-value. If the p-value is less than 0.05, we adopt the individual fixed effect model. Otherwise, we select the individual random effect model.

Following these procedures, this paper furthermore adds the regression analysis of the mixed cross-sectional model, with the outcome posted in Table 3. This paper also conducts regression analysis for individual fixed effect model and the individual random effect model based on mixed cross-sectional analysis.

Table 3. Regression Results

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
COM	0.0554** (0.0233)	0.0574** (0.0229)	0.0759*** (0.0214)	0.0473** (0.0228)	0.0444* (0.0227)	0.0420* (0.0229)	0.0600*** (0.0228)
ZF		-0.0426*** (0.0036)	-0.034*** (0.0034)	-0.0395*** (0.0036)	-0.0375*** (0.0037)	-0.0375*** (0.0037)	-0.0203*** (0.0042)
BL			-0.0735*** (0.0034)	-0.0721*** (0.0034)	-0.0713*** (0.0034)	-0.0712*** (0.0034)	-0.0674*** (0.0034)
ZZ				0.1286*** (0.0362)	0.2913*** (0.7659)	0.2963*** (0.0488)	0.2655*** (0.0484)
PR					-0.1433*** (0.0284)	-0.1422*** (0.0284)	-0.1329*** (0.0281)
TY						-0.0022 (0.0027)	-0.0018 (0.0027)
ZC							0.03358*** (0.0040)
C	1.3641***	5.3011***	4.7030***	2.0776**	0.8386	0.7391	-0.7945

	(0.0256)	(0.3376)	(0.3164)	(0.8047)	(0.8382)	(0.8471)	(0.8581)
Adj.R ²	0.3700	0.3967	0.4745	0.4766	0.4809	0.4810	0.4920
F-statistic	165.03	169.32	214.53	200.86	190.66	178.77	176.00
Prob(F-stat)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
N	3687	3687	3687	3687	3687	3687	3687
Bank control	Y	Y	Y	Y	Y	Y	Y
Year contro	Y	Y	Y	Y	Y	Y	Y

Note: The number in the parentheses represents the standard error. The number asterisks show different significance level. Three means 1%; two means 5%; and 1 means 10%.

Our models discovered three categories:

First, the category of conducive variables. This contains competition, total capital, and capital adequacy ratio. Among those, total capital has the most significant influence.

Second, the category of variables with negative impact. This contains Non-performing loan ratio, Asset Liability Ratio, and Profit expenses. Among those, Profit expenses has the most significant influence.

Third, the category of variables that have little impact on commercial banks' profitability. This includes only one variable, Interbank deposit. The reason may be that Interbank deposit is just asset of the bank, so it doesn't have special influence.

4.3 Heterogeneity

Heterogeneity refers to the quality or state of being diverse, varied, or composed of different elements. It is whether the explanatory power of the explanatory variables on the explained variables in the sub-samples show different patterns and whether explanatory power differs significantly in each sub-category. Banks are categorized into different types according to different economic property to analyze heterogeneity[3].

One: Heterogeneity analysis according to the competition ratio

According to the traits of competition, banks are classified into rural commercial bank, Nation-Owned Banks with national shareholding banks, and regional banks. Fixed effect regression is applied on these banks separately. Results are shown in Table 4.

Two: Heterogeneity analysis according to higher or lower non-performing liability ratio. Fixed effect regression is applied on these banks separately. The outcomes are shown in Table 4.

Table 4. Heterogeneity Regression

	Model 8 (Rural commercial banks)	Model 9 (Nation-Owned Banks with national shareholding banks)	Model 10 (regional banks)	Model 11 (low non-performing loan ratio)	Model12 (high non-performing loan ratio)
COM	-0.0412 (0.0490)	-0.0217 (0.0322)	0.1230*** (0.0312)	0.0742*** (0.0220)	-0.0737 (0.0751)
ZF	-0.0917*** (0.0069)	-0.0159 (0.0171)	0.0117** (0.0055)	-0.0063 (0.0048)	-0.0586*** (0.0077)
BL	-0.0625*** (0.0069)	-0.0142*** (0.0066)	-0.1218*** (0.0110)	-0.1317*** (0.0213)	-0.0485*** (0.0041)
ZZ	0.6121*** (0.0690)	0.4548*** (0.1469)	-0.0202 (0.0705)	-0.0046 (0.0526)	0.4940*** (0.0969)
PR	-0.2604*** (0.0413)	-0.2076** (0.1043)	0.0693* (0.0401)	0.0387 (0.0310)	-0.3913*** (0.0572)
TY	0.0007 (0.0029)	-0.0365** (0.0279)	-0.0184*** (0.0066)	0.0007 (0.0037)	0.0006 (0.0039)
ZC	0.0080 (0.0051)	0.0390*** (0.0120)	0.0391*** (0.0071)	0.0254*** (0.0048)	0.0157** (0.0069)
C	0.7444 (1.2312)	-4.6515*** (2.6254)	-0.8209 (1.2779)	1.0154 (0.9438)	2.8093 (1.7785)
Adj.R ²	0.5032	0.7444	0.5885	0.4746	0.4199
F-statistic	113.99	27.76	82.10	77.89	56.39
Prob(F-stat)	0.0000	0.0000	0.0000	0.0000	0.0000
N	2383	197	1107	1856	1831
Bank control	Y	Y	Y	Y	Y
Year control	Y	Y	Y	Y	Y

As can be seen from the regression results in Table 4, only the profitability of regional banks are affected by competition. It may result from the relative smaller scale of regional banks, thus customer base is not solid. For national owned banks and shareholding commercial banks, as well as rural commercial banks, they are not affected by competition. This is possibly because the government has funding to national owned banks and rural commercial banks.

Another category of models suggest that the profitability of banks with high non-performing ratio is not affected by competition, probably because that these banks are already developed and take a high risk and high return route. This can also explain why shareholding commercial banks are not affected by competition.

Also, if a bank's profitability is affected by competition, the magnitude is big. That means competition has influence on regional banks. However, the influence is conducive, due to a positive coefficient.

4.4 Robustness analysis

Robustness is a measure of stability of the impact of the core explanatory variable on the explained variable. If the regression result is robust and the regression coefficient doesn't vary significantly in the robustness analysis, it is agreed that the model is constructed objectively, reliably, not depending on false assumptions[4]. Various approaches can be employed to assess model robustness. One method involves selecting a similar alternative to the core explanatory variable for analysis. We observe if the explanatory power remains. If the core explanatory variable exhibits minimal change in the coefficient or impact on the explained variable, we consider the model robust. Another technique involves manipulating the sample size, either increasing or decreasing it, to observe the core explanatory variable's impact on the explained variable. If the coefficient remain stable, the model is deemed robust.

In this study, we reduced the sampling period to reduce the number of samples. Regression processing is conducted, and an evaluation is performed to determine the robustness of the model.

Reducing sampling period: We reduced the sampling period. It is now 9 years from 2012 to 2021 instead of the original data of 10 years from 2011 to 2021. With this new sampling period, robust regression results was obtained and the results are shown in Table 5.

(1)Replacement of deposit ratio by liability ratio: We changed the core explanatory variables and we replaced deposit ratio by liability ratio. Other variables remain unchanged. With this replaced variable, robust regression results was obtained and the results are listed in Table 5.

Table 5. Robustness Regression

	Baseline model	Robustness Analysis 1	Robustness Analysis 2
COM	0.0600*** (0.0228)	0.0471** (1.5716)	0.0551*** (0.0142)
ZF	-0.0203*** (0.0042)	-0.0105** (0.0043)	-0.0206*** (0.0041)
BL	-0.0674*** (0.0034)	-0.0659*** (0.0032)	-0.0815*** (0.0041)
ZZ	0.2655*** (0.0484)	0.3057*** (0.0484)	0.3123*** (0.0467)
PR	-0.1329*** (0.0281)	-0.1553*** (0.0282)	-0.1290*** (0.0283)
TY	-0.0018 (0.0027)	-0.0023 (0.0026)	-0.0041 (0.0026)
ZC	0.03358***	0.0371***	0.0277***

	(0.0040)	(0.0040)	(0.0041)
C	-0.7945 (0.8581)	-2.2419*** (0.8630)	-1.7967** (0.8394)
Adj.R ²	0.4920	0.2133	0.2228
F-statistic	176.00	190.88	179.31
Prob(F-stat)	0.0000	0.0000	0.0000
N	3687	3530	3620
Bank control	Y	Y	Y
Year control	Y	Y	Y

4.5 Endogeneity analysis: GMM system dynamic method

Endogeneity refers to the correlation between the independent variable and unexplained error in the dependent variable. This can be analyzed with dynamic panel models. This paper adopts the GMM system method proposed by Arellano and Boverover[5].

Table 6. GMM system dynamic

	Baseline model	GMM System
COM	0.0600*** (0.0228)	0.0681*** (0.0207)
L.EFFI		0.3546*** (0.0147)
ZF	-0.0203*** (0.0042)	0.0005 (0.0041)
BL	-0.0674*** (0.0034)	-0.0831*** (0.0043)
ZZ	0.2655*** (0.0484)	0.1382*** (0.0464)
PR	-0.1329*** (0.0281)	-0.1764*** (0.0278)
TY	-0.0018 (0.0027)	-0.0050* (0.0027)
ZC	0.03358*** (0.0040)	0.0219*** (0.0037)
C	-0.7945 (0.8581)	0.9784 (0.8079)
Adj.R ²	0.4920	0.6436
F-statistic	176.00	255.88
Prob(F-stat)	0.0000	0.0000
N	3687	2966
Bank control	Y	Y
Year control	Y	Y

According to Table 6, the robustness model is highly consistent with the baseline model, which means robustness of the models. All models agree on the factor that influences the profitability of commercial banks. This means the results in Table 6 is valid.

Also, after the GMM system dynamic method, as shown in Table 6, It is seen that the values are also highly consistent, especially for the core explanatory variable. Also, both models agree that competition has influence on the commercial banks' profitability. That means the model doesn't suffer endogeneity issues.

5 Conclusions

We examined the empirical impact of competition on the profitability of commercial banks. The analysis was conducted using the ROA, deposit ratio, asset liability ratio, non-performing loan ratio, total capital, interest expense, inter-bank deposit, and capital adequacy ratio of 584 listed banks from 2011 to 2021. The paper concludes that competition will have a great beneficial influence on the profitability of regional banks, or on banks that have low non-performing loan ratio.

Findings

Overall, there are three main findings. First, this paper found that competition has a beneficial influence to the profitability of commercial banks. Second, the non-performing loan ratio has a considerable influence on the profitability of commercial banks. Third, competition within in the region the bank is in has an influence on the profitability of such banks.

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