Effect of the Structure of the Balance Sheet on the Performance of the Commercial Banks
Taking Listed Commercial Banks in China as Examples

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Abstract. Commercial banks play an important role in China's national financial system. However, in recent years, with the fast development of internet finance and diversification of financing method, traditional commercial banks have been confronted with many sources of shock. In this context, commercial banks are struggling making profit to survive. However, in the way they adjust, some are successful and some are not. At the same time, how to adjust the structure of its balance sheet is very important for the development of commercial banks. This research focuses on the relationship between the structure of the balance sheet and the performance of the commercial banks, using empirical analysis method. And the data comes from the annual reports of 42 listed commercial banks from 2011 to 2020.At last, the result shows that loan-deposit ratio is in negative correlation with the performance, inter-bank borrowing to inter-bank lending ratio is in positive correlation with the performance, and loan-asset ratio is in positive correlation with the performance. In addition, the increase on the proportion of trading financial assets can also lead to the improvement of the performance. By finding out the relation between the structure of the balance sheet and the performance, this research has indicated an effective way of the adjustment on the balance sheet aiming for a better performance, with sufficient evidence and objective analysis.

Keywords: commercial banks; balance sheet; structure; performance.

1. Introduction

1.1 Research Background and Motivation

Commercial banks are an essential and major part in a country's financial system. In the aspect of regulation, in 2010, with the introducing of Basel 3 rule, China Banking Regulatory Commission has put forward some new regulations to limit and manage the business of commercial banks. The Leverage management of commercial banks launched by the commission sets that the leverage ratio should not be more than 17 and core capital should take up at least 50% of total capital. Then in 2012, the commission launched the Commercial bank's capital management, which improved the regulation system of commercial banks and set some deadlines for the banks to meet the requirements of some relative regulations. By now, due to the enhancement of the regulation force, there have been more restrictions on the business and investing behavior of the commercial banks, which will certainly affect their profit ability and the overall performance. In the aspect of financing method, with the development of China's financial market and the improvement of financial opening, in recent years, there have been more alternatives for residents to do investment or to finance [1]. The situation of commercial banks, unlike what it used to be in the past, have been greatly influenced by other financial institutions like fund houses and security firms. The proportion of commercial banks' business is facing a distinct decrease nowadays. And with the rise of internet finance, the traditional commercial banks are caught in a more competitive environment compared with 5 years ago. In all, for the time being, commercial banks must improve and progress to adapt themselves to such competitive and challenging business environment, or their performance would be greatly affected and even suffer a great loss.

If the performance of commercial banks goes bad, the risk of insolvency will probably rise. When insolvency incidents occur more frequently among banks, the default risk will gradually spread to other parts of financial system, and may cause systematic financial risk. To avoid such tragedy,

commercial banks should start improving their management and strategies to attain better performance or just maintain it under such highly competitive business environment. This research focuses on the most important indicator of a commercial bank's business-balance sheet. By conducting empirical analysis on the ratios of some important items from assets and liabilities, this research has figured out the actual effect of the structure of the balance sheet on the performance of the bank. Thus, this research can be treated as a scientific reference for the commercial banks in their practice of managing their assets and liabilities in pursuance of better performance.

1.2 Literature Review

1.2.1 Research on Asset-debt Management

P.X.Feng(2008) paid attention to the adverse selection problem in the practice of asset-debt management. Based on the sight of the adverse selection problem, he pointed out that there was severe problem with term structure of asset and debt, which had negative effect on the performance. To solve the problem, he built a model combining many indicators including gap management, industry loan ratio and bond ratio to help making the decision on the asset-debt management of commercial banks [2]. Z.Nie(2014) started his research under the background of Interest Rate Liberalization, and for the current situation of asset-debt management in China he put forward 4 important goals in asset-debt management, then respectively gave suggestions on the optimization of the asset-debt structure from 5 aspects(asset, debt, intermediary business and risk management[3]. C.He(2020) held an opinion that the change in the way of economy development brought about the financial innovation of commercial banks including non-standardization business and inter-bank business. Such innovation in finance changed the structure of the balance sheet and attained good result. However, such adjustment also brought about some new financial risks, which should be noticed[4].

1.2.2 Research on the performance of Commercial Banks

X.lin(2013) used financial ratio analysis to analyze the factors affecting the performance of the commercial banks. In her research, ROA and ROE are the indicators of the performance of the banks. The research's model proved that cost-to-income ratio, earnings per stock share and non-interest income have significant effect on ROA, while loan-to-deposit ratio and non-performed loan ratio have significant effect on ROE[5]. H.Yang(2019) selected the year 2011 as the point out of his research. The research explained that in 2011, with the launching of the new regulations on commercial banks, leverage ratio were strictly limited and supervised. And a limited leverage ratio led to the decrease of loans and total asset, eventually aroused a strike on the performance of the commercial banks. Although the performance became worse, the safety level increased [6]. Z.Y.Sun(2022) analyzed the influence of internet finance on the performance of the commercial banks. For the asset, he believed that with the prosperity of internet finance, the income from asset will decrease due to the decrease in the proportion of loans. For the debt, his analysis pointed out that the intensified business competition and the decrease in the proportion of demand deposits will increase the banks' cost of debt. Besides, the decrease in the service charge and commission will furthermore reduce the profit of the commercial banks[7]. Current research has already clarified some relationship between the structure of the balance sheet and the performance. Their discoveries and conclusions have offered a meaningful reference for the theory foundation of this research. However, there are still some aspects that existing research has not dabbled in. For example, few studies simultaneously focus on multiple big items of assets and debts and compare each of their influence on the performance. Besides, most of the current research ignores the effect of the trading financial assets, which has already been a big part in assets. In order to add a significant supplement to current research, this research selects loans, assets, inter-bank business and trading financial assets as research objects, which add up to a quite large proportion of a commercial bank's balance sheet. Meanwhile, considering the structural relationship between these objects, this research uses item ratios to substitute for items to study the effect of ratios(or structure) on the performance.

1.3 Research Contents and Framework

Based on these studies, these research analyses the effect of the structure of the balance sheet on the performance of the commercial banks both theoretically and empirically, and get some result on how the ratio of items from asset and debt affect the performance. Then based on the result, some suggestions are given to adjust and optimize the structure of the balance sheet to attain better performance. The framework of this article is arranged as below: the first part is introduction, then the second part is theory and empirical analysis. The third part is the result and discussion based on the theory and empirical analysis, and the last part is conclusion.

2. Methodology

2.1 Theoretical Mechanism Research

2.1.1 Dependent Variable

Return on book asset(ROA), ROA is an indicator that describes the bank's overall profit. ROA is a term with two variables, one of which is net profit , and the other is asset, and it is defined as asset divided by net profit. On the other hand, ROE is also an indicator that evaluates a bank's capability of gaining profit, defined as net profit over equity. In comparison to ROE, ROA is a better indicator due to the own characteristic of commercial banks, that is, substantial liabilities. Deposits, borrowings and some payable, altogether make up the liabilities that reach far beyond the amount of the equities for most of the commercial banks. Since equity is only a small portion in the whole asset of a bank, it is more meaningful to use ROA to evaluate the performance of a bank rather than ROE.

2.1.2 Explanatory Variables

Loan-to-deposit ratio(LDR), Loan and deposit are two major service for a commercial bank, the amount of which could generally excess those of the other subjects in a balance sheet. Hence, the value of them are critical for the net interest earned by a bank, with the indicator NIM(net interest margin) to assess it. On the one hand, more loans could generate more interest earnings. On the other hand, under the background of interest rate liberalization, after the cancellation of loan-to deposit ratio, banks will expand the scale of loans, which will more need for loan fund and lead to the increase in cost of fund. Then banks have to absorb the deposits under higher rate [8]. And a rise in deposit interest rate will affect the NIM. Referring to the income statement of a bank, interest income plays an important role in the profit, while net profit is the numerator of ROA. In other words, the loan-to-deposit ratio can significantly affect the performance of a commercial bank. This article defines: LDR is equal to the ratio of loan to deposit.

The proportion of inter-bank borrowing and inter-bank lending(BLR): the scale of inter-bank businesses are expanding fiercely in recent years. As X.Chen(2016) mentioned, inter-banks business has two aspects of significance. On the one hand, commercial banks could get more interest income as well as some intermediary income through inter-bank business. On the other hand, inter-bank business will relieve the pressure from supervising, that is, the short in loan fund can be relieved by inter-bank borrowing[9].Thus inter-bank business is a rising term in the balance sheet definitely affecting the overall profit .This paper defines BLR as equal to interbank borrowing to interbank lending ratio.

The proportion of Trading financial asset and total asset(TFAAR): Trading financial asset is what a bank holds and sells someday to get capital income. Compared with bonds or some other fixed-income investments, trading financial asset is more risky with more uncertainty in future income. Taking stock for example, stock price fluctuates wildly in an accounting period, and dividends are unstable depending on the performance of the enterprises. So the higher the proportion of the trading financial asset, the more uncertain of the profit gained for a bank. However, high risk generally indicates high probability of high income, so it is hard to judge whether a bank should raise the ratio of trading financial asset or reduce it. By studying the effect of this variable, we can answer the

question based on the data from the recent ten years that whether a bank should increase the portion of the trading financial asset. This paper defines TFAAR as equal to trading financial asset to total asset ratio.

The proportion of loans and asset(LAR): Loan is one of the main businesses of a commercial bank. In China, The interest rate of loans is a market rate determined by supply and demand of the cash and fluctuates around the rate given by the central bank. Of course, loans are risky assets. NPL, short for non-performing loans, is a term describing the loans that cannot be paid. NPL not only returns nothing, but also lead to the loss of the asset. With the expanding of the scale of the loans, there may be more NPL within them, which may decrease net income. This article defines LAR as equal to loan to total asset radio.

2.1.3 Control Variables

Since the task of this study is to find out the effect of the structure of the balance sheet on the performance of the banks, it is necessary to add other influential variables to the model to strengthen the explanation of the independent variables. Non-performed loan ratio(NPLR): As is mentioned above, NPL reflects the quality and safety of loans, and the ratio of NPL(NPLR), differs from bank to bank. The standard of credit evaluation, the effectiveness of financial management, the creditworthiness of the target customer group and many other factors can both influence the ratio of NPL. This article defines NPLR as equal to NPL to total loan.

Net profit margin(NPM): NPM is an indicator describing the proportion of net profit and total profit. In the pursuance of the maximization of profit and minimization of cost, this variable reflects the operating and management ability of a bank. Furthermore, the investing ability of the financial managers and the conscious of risk management of a bank will greatly affect this variable. This article defines NPM as equal to net profit to total profit ratio.

2.2 Empirical Research

2.2.1 Data Source

The research has selected a panel data of 42 listed commercial banks with a year range(2011,2020) from wind database. Since the original data has different units and orders of magnitude, normalization has been done to it to convert the original data into non-dimensional form. The formula for normalization is:(x-average of x)/stand error of x. In the formula, x represents the cross section data of the panel.

2.2.2 Descriptive Statistics

In this paper, the eigenvalues of the variables are solved, and the results are shown in Table 1.

Table 1. Descriptive Statistics

Variables	N	Mean	Sd.	Min	Max
NPM	420	81.29	6.632	53.58	128.8
LDR	420	69.73	13.49	26.43	116.0
ROA	420	1.008	0.252	0.438	1.780
BLR	420	7,260	79,542	0	1.497e+06
NPLR	420	1.277	0.627	0	9.560
TFRRA	420	5.491	11.74	0.00832	90.73
LAR	420	47.22	8.734	18.56	64.36
Number of Bank		42	42	42	42

The mean, standard error, minimum and maximum values of the variables are given from Table 1. All analyses below have rounded the statistics to two decimal places for ease of presentation. The dependent variable ROA ranges from 0.44% to 1.78% with a mean of 1.01% and a standard error of 0.25%. From the eigenvalues of LDR, it can be seen that the ratio of loans to deposits ranges from 26.43% to 115.99%, with an average of 69.73% and a standard error of 13.49%. The BLR ranges from

0 to 1496964% with a mean of 7259.60% and a standard error of 79542.1%. TFAAR, its mean is 5.49% and its stance error is 11.74%, ranging from 0.01% to 90.73%. LAR, the ratio of loans to total assets, ranges from 18.56% to 64.36%, with an average of 47.22% and a standard error of 8.73%. The mean value of the control variable NPM was 81.29%, the standard error was 6.63%, and the range was from 53.58% to 128.79%. The variable NPLR ranges from 0 to 9.56% with a mean of 1.28% and a standard error of 0.63%.

2.2.3 Multi-co-linearity Test

Since the variables chosen in this research are ratios of some items in assets and liabilities of a balance sheet, they are in great risk of being highly connected with each other. The correlation between explanatory variables could ruin the accuracy and correctness of the regression. In this case, before regression, it is critical to figure out whether the explanatory variables are strongly connected. Here by using VIF(variance inflation factor), the connection between the variables can be measured. The following shows the VIF value of the explanatory variables:

Table 2. VIF of Variables

Variables	VIF	1/VIF
LAR	2.0	0.500497
LDR	1.93	0.517278
TFAAR	1.05	0.948326
BLR	1.01	0.986650
Mean VIF	1.50	

The table 2 shows that all the VIF values are no more than 2, far less than the threshold 10, so it is believed that there is no multi-co-linearity among the explanatory variables.

2.2.4 Model Selection

There are three major kinds of model for model, and they are the fixed-effect model, the random-effect model and the mixed regression model. So now there's a problem that which model should be chosen. Considering the requirements of the hypothesis of the random-effect model are higher than those of the fixed-effect model and the mixed regression model. However, only few situations can meet such requirements, thus the topic now becomes the comparison between the fixed-effect model and the mixed regression model. By introducing LSDV method, these two models can be clearly compared .The following table shows the result of LSDV method.

Table 3. The Result of LSDV Method

0	Coef.	Variables	Coef.	Variables	Coef.
ldr	-.011***	13.Bank	0.067***	29.Bank	-0.084**
blr	0.000***	14.Bank	-0.089	30.Bank	-0.148**
tfaar	0.002*	15.Bank	-.196***	31.Bank	-0.470***
npm	-.014***	16.Bank	-.355***	32.Bank	-0.250***
lar	0.018***	17.Bank	-0.051	33.Bank	-0.154***
2.Bank	-.247***	18.Bank	-0.031	34.Bank	-0.119**
3.Bank	-.195***	19.Bank	-.106***	35.Bank	0.234***
4.Bank	-.205***	20.Bank	0.013	36.Bank	-0.634***
5.Bank	-.198***	21.Bank	-.374***	37.Bank	0.035
6.Bank	-.505***	22.Bank	-.230***	38.Bank	-0.095**
7.Bank	0.111***	23.Bank	0.016	39.Bank	-0.167***
8.Bank	-.292***	24.Bank	-.222***	40.Bank	-0.313***
9.Bank	-.085***	25.Bank	-0.101	41.Bank	-0.296***
10.Bank	-.336***	26.Bank	-.279***	42.Bank	-0.344***
11.Bank	-0.047	27.Bank	-.248***	Constant	2.255***
12.Bank	-.453***	28.Bank	-0.010	R-squared	0.658

Notes: Robust t-statistics in parentheses. *** p<0.01, ** p<0.05, * p<0.1

As the table demonstrates, quite a lot of the individual dummy variables are significant under the significance level of 5%, so the null hypothesis that the coefficients of all individual dummy variables equals 0 can be confidently rejected. Hence individual fixed effect is considered to exist, and the fixed-effect model should be used. To be more specific, the most suitable model for this case should be the individual fixed-effect model. The form is shown below:

$$ROA_{it} = \lambda_i + \beta_1 LDR_{it} + \beta_2 BLR_{it} + \beta_3 TFAAR_{it} + \beta_4 LAR_{it}$$

$$+ \beta_5 NPM_{it} + \beta_6 NPLR_{it} + u_{it} \tag{1}$$

In this model, i=1,2,3,...,N, representing all the individuals observed. While t=1,2,3,...,T, representing all the T times. ROA_{it} , ldr_{it} , BLR_{it} , $TFAAR_{it}$, LAR_{it} , NPM_{it} and $NPLR_{it}$ respectively represent the observed value at time t of each variable. β_n (n=1,2,3,4,5,6) represents the parameter to be estimated for each independent variable. λ_i represents intercept term and u_{it} represents random error of this model.

3. Results and Discussion

3.1 Estimation Results

Use the model above to do multiple regressions to estimate the parameters. The empirical method for this model is fixed-effects regression for panel data with all the individuals clustered. By using clustering robust standard error regression, the effect of sequence self-correlation and heteroskedasticity are illuminated and the result will be relatively more robust. After regression, the result is as shown below:

Table 4. The Result of Regression

Variables	Coef.
ldr	-0.493***
blr	0.082***
tfaar	0.106**
lar	0.555***
nplr	-0.232*
npm	-0.346***
Constant	0.001***
Observations	420
Number of Bank	42
Within R-squared	0.509
Company FE	YES

Notes: Robust t-statistics in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Since it is the fixed-effect model, within r-sq is the critical indicator to assess the fitting effect. From the regression table, the within r-sq equals 0.509, which means the fitting effect of this model is relatively good. Not shown on the table, the p value for F statistic of this model equals 0, strongly rejecting the null hypothesis that

$$\beta_1 = \beta_2 = ... = \beta_n = 0 \tag{2}$$

which means this model is quite significant. Then check the significance for each coefficient. As is shown on the table, the coefficients for core explanatory variables, including LDR, BLR, TFAAR and LAR, are all significant under significance level 0.05. For the controlled variables, the coefficient

of NPLR is significant under significance level 0.1 and the coefficient of NPM is significant under significance level 0.01.In all, the regression result has indicated that all the coefficients are significant.

3.2 Discussion

From the result of the empirical research, the effect of the structure of the balance sheet on the performance of the commercial banks becomes clear. In general, LDR has negative effect on ROA, while BLR, TFAAR and LAR has positive effect on ROA. More specifically, the coefficient of LDR is approximately -0.49, which means that if LDR rises by 1, ROA will decrease by 0.49.The coefficient of BLR is approximately 0.08, which means if BLR rises by 1, ROA will rise by 0.08.The coefficient of TFAAR is approximately 0.11, which means if TFAAR rises by 1, ROA will rise by 0.11.And the coefficient of LAR is 0.55, which means if LAR rises by 1, ROA will rise by 0.55.Among all the explanatory variables, LAR have the biggest effect on ROA, and LDR comes second with an opposite effect.This is because the scale of loan is a two-sided problem. If loan-to asset ratio is too low, interest income will considerably reduce, which may ruin the performance.As Y.Fu(2020) has proved, the increase of loan ratio can improve the bank's performance, because more loans would generate more interest and the cash absorbed by the bank would be more effectively utilized, avoiding the waste of assets.[10]While if loan-to- deposit ratio becomes too high, the expanded loan scale will arouse a rise in the ratio of non-performed loans, especially in recent years, which may ruin the performance.Besides, as is mentioned previously, the rise in cost of loan fund has already been a reality over these years, which may reduce NIM and ruin the performance.[11]As for the controlled variables of NPM and NPLR, both of them are significant with a negative coefficient, which means that the introduce of these variables makes sense academically.

4. Conclusion

In recent years, on the one hand, with the launch of more regulations on commercial banks and intensified force of supervision, there have more limitation on commercial banks business operation. On the other hand, a more developed financial market and the occurrence of internet finance have altogether intensified the competition in current business environment. It is the very moment to help the commercial banks to maintain and improve their performance. Since the balance sheet conveys much important information about the asset and debt structure of a bank, to realize this goal, a research on the balance sheet of the commercial banks should be conducted. In this research, empirical analysis and theory analysis are combined. By studying the data from the annual report of many commercial banks in China, the result comes out. That is, the higher the loan-to-deposit ratio, the lower the ROA. The interbank lending ratio, the trading financial asset ratio and the asset-liability ratio are all positively correlated with ROA. When the three are relatively increased, they will all lead to an increase in ROA. Therefore, for the financial managers of the commercial banks, they should pay some attention to the result of this research and adjust the structure of the balance sheet of their banks. More specifically, they should reduce the loan-to-deposit ratio, while simultaneously raise the loan-to-asset ratio. That is, commercial banks should carefully control the amount of loans and deposits to maximize the performance.[] The trading financial assets should have more proportion in total asset, which indicates that non-interest income should be attached more importance to nowadays. As for inter-bank businesses, commercial banks should manage to raise the inter-bank borrowing to inter-bank lending ratio if possible, because the coefficient of this ratio is relatively small due to its two-sided effect and merely a small change would not generate an obvious improvement in ROA, but it is still a significant variable and should not be ignored. Of course this research is far from perfect, because although many important items in the balance sheet have been taken into account, there are still some influential items ignored. How the ratios of the ignored items affect the performance is not studied, but they may have some effect on the creating of the benefit. Therefore, the ratios of other items like cash ratio, ratios of different kinds of loans should be studied, to give an all-around explanation of the mechanism of how exactly the structure of the balance sheet affects the performance of commercial banks in the future

study. Besides, the study could be more detailed and specified. For example, there are many categories of loans, and the structure of loans do have empirical effect on the performance, but it is not specified in this research.

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