2. THE INFLUENCE OF INCOME DIVERSIFICATION ON OPERATING STABILITY OF THE CHINESE COMMERCIAL BANKING INDUSTRY

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Abstract

This paper investigates the effects of diversified income structures on the risk of commercial banks in China. We selected 1111 samples of 101 different banks of China (including large and small banks) between 2006 and 2016. A two-step system Generalized Method of Moments is utilized, which does not need to know the exact distribution information of random error term to evaluate the diversified income of Chinese commercial banking industry's effect on risk. The final results show that the operating stability of the banking industry in China will decrease when the share of non-interest income or diversification level increase. This is quite different from previous studies in which researchers thought that a diversified strategy could reduce banking risks. The references for the policy makers are provided from intermediary business and financial supervision.

Keywords: income diversification, operating stability of bank, system generalized method of moments, non-interest income

JEL Classification: G21, E02.

1. Introduction

In recent years, the external operating environment of China's commercial banking industry has drastically changed. Intensified financial disintermediation, liberalization of interest rates, and development of online banking have reduced the profit margins of the traditional lending business in commercial banks. Under these pressures, Chinese commercial banks have implemented an income diversification strategy to increase the share of non-interest income. Many countries have implemented separate policies that supervise the commercial banking industry. However, its diversification has not always met the regulations, leading to risk concentration. Risk concentration can lead to lower operating stability when the bank's balance sheet deteriorates. Furthermore, it may potentially lead to a financial crisis, such as

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the global financial crisis of 2008.The crisis in 2008was led by the subprime crisis in the U.S.A. Commercial banks' non-interest income caused financial statements to deteriorate, resulting in exacerbation of the financial crisis. Compared to the traditional interest income activities, non-interest income activities have higher potential risks. Too much potential risk means increases in uncertainty in banks and decreases their operating stability.

Many previous studies have reported on the diversification of banks. Most of these studies focus on how banks' diversification strategies affect the risks of banks and the motivations for income diversification. Scholars prefer to collect data from developed countries rather than developing countries for research. However, as the largest developing country, China has become an indispensable part of the current economic environment. Thus, we analyzed the impact of the bank diversification strategy on the operating stability of Chinese commercial banks. This paper explores whether the diversification strategy of the Chinese commercial banking industry will affect banks' operating stability by analyzing non-interest income and the diversified structure from the income perspective. We utilize two stages System Generalized Method of Moments (GMM) model to reveal the influence of increasing non-interest income and a more diversified income structure on the operating stability of the Chinese commercial banking industry. Our expectation is that this paper will provide references for the banking industry in adopting a diversification strategy, improving decision making, and providing a new perspective.

In this paper, we select Chinese commercial banks whose total assets ranked in the top one hundred from 2014 to 2016. This sample contains all types of Chinese commercial banks and only excludes newly listed banks, which reduces the effects of outliers on the results. In addition, small size banks are not representative of the entire banking industry. We use data from those banks' balance sheet from 2006 to 2016. Based on the large size of the sample, the results show that, at the present stage, increases in non-interest income or changes in the structure of income reduce the operating stability of the banking industry. Due to the special situation and policies in China, this result is contrary to the results from most other countries.

2. Literature Review

Risk is an important factor that can affect operating stability of a commercial bank. Facing too much risk will reduce the operating stability of the banking industry. Thus, researchers discuss the causes of risks. Vazquez and Federico (2015) exploit a bank-level dataset from 2001-2009 to investigate the funding structures of banks. This dataset covers approximately 11000 banks in the U.S. and Europe. The results show that banks that have weaker structural liquidity and higher leverage have lower operating stability in financial crises. In the cross-section, the smaller domestic banks were more sensitive to the liquidity risk compared to the global banks, which are more likely to acquire solvency risk due to high leverage.

In emerging economies, ownership and macroeconomic policy may also influence the operating stability of banks. Chen *et al.* (2017) use unbalanced bank level panel data from emerging economies during the period from 2000-2013. They discover that a bank may have lower operating stability if it has foreign ownership. Niu and Qiu (2013) analyze banks that have been listed for more than three years using risk-taking channel theory. They find that the policy of interest is negatively related to the market price of assets. To conclude, a lower interest level will increase banking risks. In other words, lower interest will make banks more stable. Saghi-Zedek (2016) discusses if banks controlled by certain categories of shareholders are more likely to benefit from their diversification strategy. Using data from

European commercial banks between 2002 and 2010, he measures banking risks using the Z-score and diversification level with the Herfindahl-Hirschman Index (HHI). The results show that the diversification strategy is associated with a higher default risk when banks do not have a controlling shareholder or simply have families and states as controlling shareholders. However, if banks have other institutions similar to them, they will be more stable.

The competition among banks has intensified due to economic development. As the benefit of traditional banking activities falls, there is currently a tendency for banks to diversify. However, is the diversification strategy suitable for banks? The following two views are noted by researchers. First, diversification may increase operating stability. Stiroh (2004) uses two types of data, bank-level data from 1984Q1 to 2004Q3 collected by Federal Deposit Insurance Corporation (FDIC) and data from banks' balance sheet from 1978 and 2000. After comparing these two types of data, they conclude that a decrease in the volatility of net interest income makes banks more stable. By contrast, diversification strategies increase the operating stability of banks. Chunhachinda and Li (2014) studied Asian listed banks. They believe that an increase in the ratio of non-interest income and total assets will increase market risk and asset risk, but the insolvency risk will decrease. Some researchers state that conclusions should be made for different situations, such as operating patterns and time periods. Köhler (2013) collects data from the balance sheet of German banks from 2002 to 2010. The result shows that the effect of non-interest income mainly depends on management patterns. For retail-oriented banks, non-interest income decreases operating stability. However, non-interest income will increase the operating stability of investment-oriented banks. Curi *et al.* (2015) study the business model for foreign banks based on a data set from the Luxembourg Central Bank (BCL) between 1995Q1 and 2009Q4. In their view, foreign banks should mainly focus on assets, funding, and income strategies during financial crises. At that period, diversification may lower technical efficiency. However, the results differ if the time parameter changes, such as the period prior to the financial crisis. Their second main result is that branches have more efficiency than subsidiaries both before and during a financial crisis. Nevertheless, as a form of an organization, subsidiaries are stronger than branches during financial crises. Thus, there is no suitable business model for all foreign banks. Managers need to utilize different methods according to different situations.

In some cases, researchers believe that diversification can have negative effects for various reasons. For non-interest income, De Young and Roland (2001) collect data from 472 U.S. commercial banks' balance sheets from 1988 to 1995. They calculate the total coefficient of leverage compared to the volatility of bank's income. The results show that non-interest income results in better bank performance. However, it also raises the uncertainty and volatility of banking income. Brunnermeier *et al.* (2012) use unbalanced penal data to analyze the relationship between bankruptcy risk and the volatility of income. They state that the Z-score will decline when there is an increase in non-interest income. In other words, diversification of banking income will decrease the operating stability of banks. William (2016) exploits data from Australian banks from 2002Q2 to 2014Q4. The results show that combining interest and non-interest income cannot generate any portfolio diversification benefit. Furthermore, non-interest income will also increase the Australian banks' systemic risk (tail risk). Schmid and Walter (2009), Acharya *et al.* (2006) and Laeven and Levine (2007) also support this argument.

As the basic business of banks, traditional banking activities are more mature than non-interest activities. Khan *et al.* (2017) use U.S. Bank Holding Company (BHC) quarterly data during 1986:Q4 to 2014:Q4 taken from Y-9C forms. The final data set includes 166,567 bank-quarters for 4749 BHCs. They use a panel regression with heteroskedasticity robust

standard errors to examine the relationship between risk and funding liquidity. The result shows that deposits can significantly reduce the Z-scores. In other words, banks will have instability if they face lower funding liquidity risk. Jonghe *et al*. (2015) think that expansion and venturing into non-traditional banking activities will reduce the systemic risk and benefit medium or large size banks. Forcing small banks to return to traditional banking activities is good, irrespective of the institutional setting. Sissy and Amidu (2017) also support this viewpoint. Their investigations cover data from African banks from 2002 to 2013as estimated by the Systems Generalized Method of Moments estimator (System GMM). They believe that diversification could increase profitability and could also increase the bankruptcy risk. Studies have also been performed in the area of risk management and banking regulations. Buston (2016) uses data from the Federal Reserve Y-9C reports. He finds that banks benefit from managing their risk via CDS since it will enhance their operating stability Liu *et al*. (2012) use the diversification level, performance and volatility on asset returns to analyze how to spread risks. They collect data from 19 Chinese commercial banks over a 10 year time period. The results show that higher diversification can avoid banking risk, but does not significantly affect performance.

3. Variables and Models

3.1 Selected Variables

3.1.1 Bank Operating Stability Measurement

If banks are exposed to too much risk, their operating stability will decline. The low operating stability of the bank may lead to bankruptcy. Therefore, we measure the operating stability according to bankruptcy risks (Z-value). After studying previous research, we split the Z value into two parts, as was done by Bai *et al.* (2016) and Stiroh (2004).

$$Z = Z1 + Z2 = \frac{ROA+E/A}{SDROA}, Z1 = \frac{ROA}{SDROA}, Z2 = \frac{E/A}{SDROA}. \quad (1)$$

In equation (1), Z1 measures the portfolio risk of Chinese commercial banks and Z2 measures the financial leverage risk of Chinese commercial banks. Z1 and Z2 are splits of the original Z-score, so the meaning is the same as the original Z-score. As Z1 and Z2 increase, the Z value will also increase and the bankruptcy risks will be smaller. ROA is the Chinese commercial banks' returns on assets. SDROA is the standard deviation of returns on assets. E and A are the equity and assets of a commercial bank, respectively.

3.1.2 Measurement of Diversification in Income Structure

This paper will measure the diversification of the commercial banking industry's income structure from two perspectives. First, we use non-interest income as a percentage of total income (SHNON) to measure the diversification level. DeYoung and Rice (2004) and Stiroh (2006) also use this measurement for the diversification level.

Second, we use the income diversification index (DIV) that is based on the Herfindahl-Hirschman Index (HHI) to measure the structural changes of commercial banks' income.

$$DIV = 1 - (SHNET^2 + SHNON^2) \quad (2)$$

In equation (2), the mean of SHNET is net interest income as a percentage of total income. SHNON denotes non-interest income as a proportion of total income. In general, the value of income diversification index (DIV) should be between 0 and 0.5. When the income of commercial banks completely comes from net interest income or non-interest income, the DIV is equal to 0, which means that the banks are not diversified. When commercial banks'

net interest income and non-interest income each account for half of the total income, the DIV is 0.5. Therefore, a greater DIV indicates a more diversified income for commercial banks. In particular, when the banks' interest income or non-interest income decreases, the DIV may be less than zero.

3.1.3 Control Variables

In commercial banks, we have to consider changes in the operating environment since many of these environmental factors also have impacts on the operating stability of the banking industry. To more accurately measure the impact of the diversification of the commercial banking industry on their operating stability, it is essential to reduce the impact of these factors on risk. A commercial bank's share of loans to total assets corresponds to the traditional business activity level. A higher proportion of equity to total assets leads to more operating stability. The growth rate of assets and returns on assets reflect the operating status and profitability of a bank. These four factors are enough to describe the characteristics of a bank.

For the reasons above, we select the following control variables: ratio of loans to total assets (LOANS), ratio of equity to total assets (EQUITY), growth rate of bank's assets (GROWTH) and returns on assets (ROA). The details are shown in Table 1. The correlations of variables are shown in Table 2.

Table 1

Details and Definitions of Variables

Variables	Variable symbol	Definitions
Dependent variables	Z	Bankruptcy risk of commercial banks
	Z1	Split value of Z-score; portfolio risk of commercial banks
	Z2	Split value of Z-score; financial leverage risk of commercial banks
Independent variables	SHNON	Ratio of non-interest income to total income
	DIV	Income diversification index: $\mathrm{DIV} = 1 - (\mathrm{SHNET}^2 + \mathrm{SHNON}^2)$
Control variables	LOANS	Ratio of loans to total assets
	EQUITY	Ratio of equity to total assets
	GROWTH	Growth rate of bank's assets
	ROA	Returns on assets

Table 2

Correlation Coefficients of the Variables

	SHNON	DIV	LOANS	EQUITY	GROWTH	ROA
SHNON	1.0000					
DIV	/	1.0000				
LOANS	-0.1310	--0.0887	1.0000			
EQUITY	0.0056	-0.0108	0.0141	1.0000		
GROWTH	-0.0150	--0.0311	-0.2459	0.1111	1.0000	
ROA	-0.1234	--0.1326	0.1725	0.2311	-0.0663	1.0000

Table 2 reports the correlation coefficients of the variables used in this study. We do not find the variables used as independent variables to be highly correlated (The maximum correlation coefficient is less than 0.25). This indicates that multicollinearity is not a major issue in our empirical analyses.

3.2 The Models

The Generalized Method of Moments includes both the difference Generalized Method of Moments and system Generalized Method of Moments. The difference Generalized Method of Moments cannot make good use of limited information and is prone to the problem of weak instruments. Thus, in this paper, we use the two stage System Generalized Method of Moments model (Sys-GMM) and dynamic panel data to reveal the influence of income diversification on the operating stability of the Chinese commercial banking industry. As discussed by Roodman (2009), the System Generalized Method of Moments (Sys-GMM) has the following two points. First, the Generalized Method of Moments does not need to know the exact distribution information of the random error term. It allows the random error term to be heteroskedasticity and sequence-correlated. Therefore, the regressor estimate by the Generalized Method of Moments is more effective than other regression methods. Second, the Generalized Method of Moments uses instrumental variables to solve the endogeneity problem between the independent variable and dependent variable. These two advantages make the Generalized Method of Moments with dynamic panel data widely used in the empirical analysis of the operating stability of the commercial banking industry.

To obtain more accurate results, we discuss the influence of the ratio of non-interest income to total income and the income diversification index on the bank's operating stability. The base models are as follows:

$$Y_{i,t} = \beta_0 + \beta_1 Y_{i,t-1} + \beta_2 SHNON_{i,t} + \sum_{m=1}^{M} \gamma_m X_{i,t}^m + \varepsilon_{i,t}. \quad (3)$$

$$Y_{i,t} = \beta_0 + \beta_1 Y_{i,t-1} + \beta_2 DIV_{i,t} + \sum_{m=1}^{M} \gamma_m X_{i,t}^m + \varepsilon_{i,t}. \quad (4)$$

In these two models, $Y_{i,t}$ is the measure of the operating stability of the commercial bank. It can be the dependent variable Z, Z1, or Z2. $Y_{i,t-1}$ are the first-order lag dependent variables. In equation (3), SHNON is the ratio of non-interest income to total income. In equation (4), DIV is the income diversification index. $X_{i,t}^m$ are the control variables, including LOANS, Equity, and GROWTH. $\varepsilon_{i,t}$ is the individual heterogeneity and random error. The lower scripts i and t represent the data of individual bank i at time t. $\beta_0, \beta_1, \beta_2,$ and γ_m are the coefficients of the models.

Base on equations (3) and (4), we construct 6 models as follows:

$$Z_{i,t} = \beta_0 + \beta_1 Z_{i,t-1} + \beta_2 SHNON_{i,t} + \gamma_1 LOANS_{i,t} + \gamma_2 GROWTH_{i,t} + \gamma_3 EQUITY_{i,t} + \gamma_4 ROA_{i,t} + \varepsilon_{i,t}. \quad (5)$$

$$Z_{i,t} = \beta_0 + \beta_1 Z_{i,t-1} + \beta_2 DIV_{i,t} + \gamma_1 LOANS_{i,t} + \gamma_2 GROWTH_{i,t} + \gamma_3 EQUITY_{i,t} + \gamma_4 ROA_{i,t} + \varepsilon_{i,t}. \quad (6)$$

$$Z1_{i,t} = \beta_0 + \beta_1 Z1_{i,t-1} + \beta_2 SHNON_{i,t} + \gamma_1 LOANS_{i,t} + \gamma_2 GROWTH_{i,t} + \gamma_3 EQUITY_{i,t} + \gamma_4 ROA_{i,t} + \varepsilon_{i,t}. \quad (7)$$

$$Z1_{i,t} = \beta_0 + \beta_1 Z1_{i,t-1} + \beta_2 DIV_{i,t} + \gamma_1 LOANS_{i,t} + \gamma_2 GROWTH_{i,t} + \gamma_3 EQUITY_{i,t} + \gamma_4 ROA_{i,t} + \varepsilon_{i,t}. \quad (8)$$

$$Z2_{i,t} = \beta_0 + \beta_1 Z2_{i,t-1} + \beta_2 SHNON_{i,t} + \gamma_1 LOANS_{i,t} + \gamma_2 GROWTH_{i,t} + \gamma_3 EQUITY_{i,t} + \gamma_4 ROA_{i,t} + \varepsilon_{i,t}. \quad (9)$$

$$Z2_{i,t} = \beta_0 + \beta_1 Z2_{i,t-1} + \beta_2 DIV_{i,t} + \gamma_1 LOANS_{i,t} + \gamma_2 GROWTH_{i,t} + \gamma_3 EQUITY_{i,t} + \gamma_4 ROA_{i,t} + \varepsilon_{i,t}. \quad (10)$$

Equations (5) and (6) describe the influence of the ratio of non-interest income to total income and the income diversification index on the bankruptcy risk. Equations (7) and (8) describe the influence of the ratio of non-interest income to total income and the income diversification index on portfolio risk. Equations (9) and (10) describe the influence of the ratio of non-interest income to total income and the income diversification index on the financial leverage risk of commercial banks.

4. Data Analysis

4.1 Data Selection

We select Chinese commercial banks with total assets that ranked in the top one hundred in 2014 and 2016, giving us a total of 101 banks as a sample. (One of the banks was replaced by another in 2016.) Then, we use their balance sheet data from 2006 to 2016 as our raw data. To avoid the impact of the financial crisis and financial cycles, we use the three-year moving average of raw data to be our dataset. After moving the average, there are 1111 observations in total. The data comes from the Wind database and the annual balance sheet of commercial banks. The sample banks consist of large, medium and small banks, including 5 large banks, 14 medium banks, and 82 small banks.

4.2 Descriptive Statistics of Data

Through statistical analysis of the sample data, the following can be concluded. First, with respect to the operating stability of commercial banks, the mean bankruptcy risk of Chinese commercial banks (Z) is 34.8165, standard deviation is 26.1609, Maximum value is 240.9845, and minimum value is -6.8196, which means that there is a large difference in the level of risk between commercial banks in China. Some commercial banks have excellent operating stability, while others are less stable. In terms of portfolio risk (Z1), the differences among commercial banks are small. However, if the financial leverage risk (Z2) is concerned, there are obvious differences.

Second, in the diversification of commercial banks, the mean of the non-interest income ratio (SHNON) is 0.1741. Although it is higher than that of previous years, the overall level is still low. Next, the mean of income diversification index (DIV) is 0.2522, standard deviation is 0.1222, Maximum value is 0.4975, and minimum value is -0.0747, which shows that the diversification of the income structure of commercial banks in China has yet to be improved and that there is a difference among commercial banks. The statistical characteristics of the control variables are shown in Table 3.

Table 3

Descriptive Statistics of Data

Variables	SHNON	DIV	LOANS	Growth	Equity	ROA	Z	Z1	Z2
Mean	.1741	.2522	.4500	.3019	.0661	.0101	34.8165	4.2847	28.3587
Max	.7148	.4975	.6399	2.6773	0.1810	.0423	240.9845	15.9231	152.9449
Min	-.0359	-.0747	.1734	-.0727	-.0267	-.0035	-6.8196	-.5491	-9.0601
Std. Dev.	.1155	.1222	.0958	.2198	.0193	.0038	26.1609	2.5496	17.7389

5. Results

5.1 The Effect of Non-interest Income on Bank Operating Stability

Table 4 reports the results of the effect of non-interest income on commercial bank operating stability (Z1, Z2, and Z). In term of portfolio risk, the following can be concluded. The ratio of

non-interest income (SHNON) is negatively related to the portfolio risk measurement index (Z1), and the coefficient is -0.3338. The z-value is -6.78, which is significant at the 1% level. In control variables, the ratio of loans to total assets (LOANS) is positively related to the portfolio risk measurement index (Z1). The coefficient is 1.211, which is significant at the 1% level. The growth rate of assets (Growth) is positively related to the portfolio risk measurement index (Z1). The coefficient is 1.1491, which is significant at the1% level. The ratio of equity to total assets (Equity) is negatively related to the portfolio risk measurement index (Z1). The coefficient is -8.2951, which is significant at the 1% level. The returns on assets (ROA) are negatively related to the portfolio risk measurement index (Z1). The coefficient is -14.0521, which is significant at the 1% level. In addition to the constant item, all variables are significant at the 1% level, indicating that the 6 independent variables in the model have significant effects on the portfolio risks of commercial banks. The p-value for the Arellano-Bond test for AR (1) in first differences is 0.077 and for the Arellano-Bond test for AR (2) in first differences is 0.158. In the Hansen test of over-identifying restrictions, the p-value is 0.101.

For the financial leverage risk, the test shows that ratio of non-interest income (SHNON) is negatively related to the financial leverage risk measurement index (Z2). The coefficient is -2.4918 and the z-value is -8.05, which is significant at the 1% level. With respect to control variables, the ratio of loans to total assets (LOANS) is positively related to the financial leverage risk measurement index (Z2). Its coefficient is 2.6378 and is significant at the 1% level. The growth rate of assets (Growth) is negatively related to the financial leverage measurement index (Z2). Its coefficient is -4.1679, which is significant at the 1% level. The ratio of equity to total assets (Equity) is negatively related to the financial leverage measurement index (Z2). The coefficient is -82.4928, which is significant at the 1% level. Finally, the returns on assets (ROA) are positively related to the financial leverage risk measurement index (Z2). The coefficient is 92.12, which is significant at the 1% level. All variables are significant at the 1% level, indicating that the 6 independent variables in the model have significant effects on the financial leverage risk of commercial banks. The p-value for the Arellano-Bond test for AR (1) in first differences is 0.037 and for the Arellano-Bond test for AR (2) in first differences is 0.133. In the Hansen test of over-identifying restrictions, p-value is 0.175.

Then, with respect to the bankruptcy risk, the test shows that the ratio of non-interest income (SHNON) is negatively related to the bankruptcy risk measurement index (Z). The coefficient is -3.2783 and z-value is -9.67, which is significant at the 1% level. In the control variables, the ratio of loans to total assets (LOANS) is positively related to the bankruptcy risk measurement index (Z). The coefficient is 4.5733, which is significant at the 1% level. The growth rate of assets (Growth) is negatively related to the bankruptcy measurement index (Z). The coefficient is -2.6443, which is significant at the1% level. The ratio of equity to total assets (Equity) is negatively related to the bankruptcy measurement index (Z). The coefficient is -90.6468, which is significant at the 1% level. Finally, the return on assets (ROA) is positively related to the bankruptcy risk measurement index (Z). The coefficient is 100.5094, which is significant at the 1% level. All variables are significant at the 1% level, indicating that the 6 independent variables in the model have significant effects on the bankruptcy risks of commercial banks. The p-value for the Arellano-Bond test for AR (1) in first differences is 0.097 and for the Arellano-Bond test for AR (2) in first differences is 0.201. In the Hansen test of over-identifying restrictions, the p-value is 0.143.

Table 4

Results of the Effect of Non-interest Income on Commercial Bank Operating Stability

Variables	Z1	Z2	Z
Y.L1	.9778***	.9517***	.9511***
C	-.0017	6.8632***	6.3596***
SHNON	-.3338***	-2.4918***	-3.2783***
LOANS	1.211***	2.6378***	4.5733***
Growth	1.1491***	-4.1679***	-2.6443***
Equity	-8.2951***	-82.4928***	-90.6468***
ROA	-14.0521***	92.1200***	100.5094***

Note: *, **, and *** represent "significant" at significance levels of 10%, 5% and 1%, respectively.

The results of the test show that the regression coefficients of the ratio of non-interest income to total income are -0.3338, -2.4918 and -3.2783, respectively, and that they are negatively related to portfolio risk, financial leverage risk and bankruptcy risk. This result is contrary to previous studies. In previous studies, the scholars believe that diversification could reduce the risk of banks. However, our results show that operating stability of the banking industry will decrease when non-interest income increases.

We believe that this result is due to the following reasons. First, at the present stage, the bank's non-interest income activities are at an early stage and the bank has limited control over them. Second, increasing the proportion of non-interest income activities will reduce the bank's concern about its main business. Third, the increase of non-interest income increases the volatility of income, thus increasing the bank's bankruptcy risk. In addition, the non-interest income activities are at an early stage and lack government supervision. Due to these reasons, an increase in non-interest income will lead to a decrease in the operating stability of the commercial banking industry.

5.2 The Effect of the Income Structure Diversification on Bank Operating Stability

Table 5 shows the results of the effects of a diversified income structure on commercial bank operating stability (Z1, Z2, and Z). In terms of portfolio risk, we can see that the income diversification index (DIV) is negatively related to the portfolio risk measurement index (Z1). The coefficient is -0.2251 and z-value is -3.51, which is significant at the 1% level. In control variables, the ratio of loans to total assets (LOANS) is positively related to the portfolio risk measurement index (Z1). The coefficient is 1.2467, which is significant at the 1% level. The growth rate of assets (Growth) is positively related to the portfolio risk measurement index (Z1). The coefficient is 1.1726, which is significant at the 1% level. The ratio of equity to total assets (Equity) is negatively related to the portfolio risk measurement index (Z1). The coefficient is -8.3194, which is significant at the 1% level. Finally, the returns on assets (ROA) are negatively related to the portfolio risk measurement index (Z1). The coefficient is -13.9877, which is significant at the 1% level. In addition to the constant item, all variables are significant at the 1% level, indicating that the 6 independent variables in the model have significant effects on the portfolio risks of commercial banks. The p-value for the Arellano-Bond test for AR (1) in first differences is 0.084 and for the Arellano-Bond test for AR (2) in first differences is 0.161. In the Hansen test of over-identifying restrictions, p-value is 0.105. For the financial leverage risk, the test shows that the income diversification index (DIV) is negatively related to the financial leverage risk measurement index (Z2). The coefficient is -1.8312 and z-value is -5.75, which is significant at the 1% level. In the control variables, the

ratio of loans to total assets (LOANS) is positively related to the financial leverage risk measurement index (Z2). The coefficient is 2.8065, which is significant at the 1% level. The growth rate of assets (Growth) is negatively related to the financial leverage measurement index (Z2). The coefficient is -4.3864, which is significant at the 1% level. The ratio of equity to total assets (Equity) is negatively related to the financial leverage measurement index (Z2). The coefficient is -81.7994, which is significant at the 1% level. Finally, the return on assets (ROA) is positively related to the financial leverage risk measurement index (Z2). The coefficient is 91.0688, which is significant at the 1% level. All variables are significant at the 1% level, indicating that the 6 independent variables in the model have significant effects on the financial leverage risks of commercial banks. The p-value for the Arellano-Bond test for AR (1) in first differences is 0.037 and for the Arellano-Bond test for AR (2) in first differences is 0.132. In the Hansen test of over-identifying restrictions, p-value is 0.163.

For the last case, the bankruptcy risk, the test shows that the income diversification index (DIV) is negatively related to the bankruptcy risk measurement index (Z). The coefficient is -2.3677 and z-value is -5.53, which is significant at the 1% level. In the control variables, the ratio of loans to total assets (LOANS) is positively related to the bankruptcy risk measurement index (Z). The coefficient is 5.1578, which is significant at the 1% level. The growth rate of assets (Growth) is negatively related to the bankruptcy measurement index (Z). The coefficient is -2.9440, which is significant at the 1% level. The ratio of equity to total assets (Equity) is negatively related to the bankruptcy measurement index (Z). The coefficient is -89.6449, which is significant at the 1% level. Finally, the returns on assets (ROA) are positively related to the bankruptcy risk measurement index (Z). The coefficient is 91.9204, which is significant at the 1% level. All of the variables are significant at the 1% level, indicating that the 6 independent variables in the model have significant effects on the bankruptcy risks of commercial banks. The p-value for the Arellano-Bond test for AR (1) in first differences is 0.097, and for the Arellano-Bond test for AR (2) in first differences is 0.199. In the Hansen test of over-identifying restrictions, p-value is 0.179.

Table 5

Results of the Effects of Non-interest Income on Commercial Bank Operating Stability

Variables	Z1	Z2	Z
Y.L1	.9782***	.9520***	.9520***
C	-.0259	6.8347***	6.1924***
DIV	-.2251***	-1.8312***	-2.3677***
LOANS	1.2467***	2.8065***	5.1578***
Growth	1.1726***	-4.3864***	-2.9440***
Equity	-8.3194***	-81.7994***	-89.6449***
ROA	-13.9877***	91.06875***	91.9204***

Note: *, **, and *** represent “significant” at significance levels of 10%, 5% and 1%, respectively.

After the test, we can conclude that an increase in the income diversification index (DIV) will lead to increased risks. In other words, a diversified income structure will worsen the operating stability of banks. Our conclusions may seem inconsistent with the modern portfolio theory (MPT). However, in practice, there are many uncontrollable factors. Thus, the hypothesis of modern portfolio theory (MPT) cannot be fulfilled due to irrational managers, an inefficient market, or other factors. Therefore, we believe that in the case of limited control of the new business, changing the income structure of commercial banks will increase the volatility of asset returns and eventually lower bank operating stability.

6. Robustness Tests

To verify the reliability of the above empirical results, we use a two stage least squares instrumental variable (IV) method for robustness testing. In addition to the change in the significance of some variables, the main conclusions are consistent with the previous results, demonstrating that the important conclusions of the empirical analyses are still valid. The results of the robustness test of model 3 are shown in table 6.

Table 6

Robustness Test for Model 3

Variables	Z1	Z2	Z
Y.L1	.9977***	.9005***	.8666***
C	3.0394	.8195	-5.4445
SHNON	-9.3852*	-64.8784	-103.8399*
LOANS	2.3155	51.8215**	72.8432**
Growth	-.6388	-28.4203**	-36.7814***
Equity	-17.7505*	68.1866	207.0161
ROA	-97.7805**	-504.0272	-632.194

Note: *, **, and *** represent "significant" at significance levels of 10%, 5% and 1%, respectively.

Table 7 shows the results of the robustness test for Model 4.

Table 7

Robustness Test for Model 4

Variables	Z1	Z2	Z
Y.L1	.9810***	.9799***	.9663***
C	.0534	5.1984***	5.1780***
DIV	-.1660	-1.1699	-1.6603
LOANS	1.1564***	2.7217	4.3846**
Growth	.6183***	-2.3089	-1.3899
Equity	-6.2696***	-83.1579***	-89.4587***
ROA	-17.9099***	105.4217**	109.4185**

Note: *, **, and *** represent "significant" at significance levels of 10%, 5% and 1%, respectively.

7. Conclusions

In this paper, through an extensive literature review, we relate to many previous studies on the diversification of banks. Most of them focus on how banks' diversification strategies affect banking risks and the motivations for diversification. Scholars prefer to collect data from developed countries rather than developing countries for research. Thus, this study reveals the influence of income diversification on the operating stability of the Chinese Commercial Banking industry. We hope that this paper can provide references for the banking industry in diversification strategies, decision making, and providing new perspectives.

We select the Chinese commercial banks with total assets ranked in the top one hundred in 2014 to 2016.This provided a total sample of 101 banks. (One of the banks was replaced by another in 2016.). This sample contains all types of commercial banks in China and it only excluded newly listed banks, reducing the effects of outliers on the results. In addition, small size banks are not representative of the entire banking industry. There are 1111 total sets of data. We use the ratio of non-interest income to total income (SHNON) and diversification

income index (DIV) as the independent variables for the two models. The control variables include the ratio of loans to total assets (LOANS), ratio of equity to total assets (EQUITY), growth of a bank's assets (GROWTH) and returns on assets (ROA). We explored the impact on the operating stability of Chinese commercial banks from the two perspectives of non-interest income and income structure based on the two stage system Generalized Method of Moments (Sys-GMM). Then, robustness tests are carried out to ensure the reliability of the results.

The results show that an increase in the non-interest income or changes in the structure of income will reduce the operating stability of the banking industry. From a practical point of view, since the implementation of the diversification strategy in China's commercial banking industry is not older than 10 years, the diversification strategy is still in a developing stage, which causes the external environment and business operations to lack operating stability. From the perspective of theoretical research, the time dimension is shorter. Therefore, if it is placed in the long term, there are certain practical reference limitations that require further improvement and testing.

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