HOW DOES RISK MANAGEMENT AFFECT FINANCIAL PERFORMANCE? EVIDENCE FROM CHINESE LISTED COMMERCIAL BANKS

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Abstract

An increasing number of commercial banks in China began to pay attention to comprehensive risk management after the global financial crisis. With the accelerated pace at which China's commercial banks are expanding abroad, establishing a comprehensive risk management system appropriate for the international financial market has become a critical hurdle for these banks' further development. This paper explores the impact of risk management on the financial performance of listed banks in China, comparing state-owned banks and non-state-owned banks, by establishing multiple linear regression analysis models. The results reveal a significant impact on the financial performance of state-owned commercial banks, such as on insolvency risk index, loan-to-deposit ratio, nonperforming loan ratio, and bank size. Insolvency risk index and bank size are found to positively impact state-owned commercial banks' financial performance. For non-state-owned banks, capital adequacy ratio, nonperforming loan ratio, and bank size have significantly impact financial performance, with bank size positively influencing financial performance.

Keywords: Commercial Bank, China, Risk Management, Financial Performance

1. INTRODUCTION

The subprime mortgage crisis emerged publicly in September 2008 and rapidly developed into global financial turmoil. Although the financial crisis stemmed from housing loan derivatives, its effects were mostly concentrated in the banking sector. During the crisis, as investment banks declared bankruptcy and were then merged and acquired, a serious credit crisis emerged in the banking sector, leading to the collapse of the U.S. real estate market and seriously impacting the global economy.

The credit risk currently affecting the profitability of Chinese commercial banks is manifested in two ways. First, credit concentration is overly high. The proportion of medium- and long-term loans among total loans is growing, the investment direction of credit funds is overly concentrated, and the investment industry overlap rate is increasing. Industry or regional cyclical declining will lead to a large number of credit funds that cannot be recycled, thus seriously limiting bank profitability. Second, the period allocation of Chinese commercial banks' deposits and loans

appears unreasonable. This brings substantial potential risk to the operations of these banks, for which deposits tend to be active and loan terms longer. Credit risk leads to increased market risk and exacerbates the impact on operational risk. Therefore, the establishment and improvement of a comprehensive risk management system are necessary for the survival and development of China's commercial banks.

Establishing and implementing a comprehensive risk management system would improve the ability of China's banking sector to respond to the current economic globalization and the challenges brought by the opening up of financial markets. With the continual liberalization of China's financial markets, foreign banks have entered the Chinese market, bringing numerous challenges to the country's domestic commercial banks. The competitive advantages of foreign banks – such being more standardized, competitive, and experienced as well as having a high level of product technology and a strong sense of risk control – greatly weaken the competitiveness of Chinese commercial banks. To compete with foreign banks during the process of accelerating economic globalization, China's commercial banks will need to improve their risk management systems according to financial market changes, refine their crisis-response capacity, enhance their risk resistance, and strengthen their own competitive advantages. In addition, China's listed banks have established more than 1,000 overseas branches and, as the country's economy flourishes further, more banks will go abroad and compete for international market share with their foreign counterparts. This will require Chinese commercial banks to comply with the requirements of foreign regulatory agencies and to improve their own risk management to better respond to the various opportunities and challenges abroad. As a result, risk management capability has become among the most basic expectations and judgment criteria of regulatory authorities and market participants when assessing banks. Therefore, this paper empirically analyses the influence of capital adequacy ratio (CAR), insolvency risk index (IR), loan and deposit ratio (LDR), loan loss reserve (LLR), and nonperforming loan ratio (NPL), and size of a bank on the financial performance of banks.

The remainder of this paper is as follows. Section 2 reviews the literature on the effect of various risk variables on banks' financial performance. Section 3 elaborates on the methodology, empirical models, and variables of our empirical research. Section 4 reports our empirical results and discusses the implications. Finally, Section 5 concludes our research, identifies the limitations of our paper and suggests the direction of future studies.

2. LITERATURE REVIEW

The hard lessons of the financial crisis helped promote risk regulatory requirements in the global banking sector. Scholars have since started researching and discussing the practical significance of risk control indicators for the banking sectors of various countries. This section reviews the literature on the relationship of bank financial performance with CAR, IR, LDR, LLR, NPL, and bank size (SIZE),

thus providing a theoretical basis for the current research.

2.1. Impact of CAR on financial performance

Previous research presents inconsistent results regarding the impact of capital adequacy on financial performance. Repullo (2004) suggests that CAR regulation could limit bank investment in high-risk activities when no restriction exists for banks to invest in capital markets. Regulating CAR facilitates improving operating performance by reducing the probability of losses from investing in risky activities. Pasiouras and Kosmidou (2007) find that the profitability of bank sectors in 15 countries from 1995 to 2001 was strongly related to CAR. They determine that a higher core CAR is linked to better financial performance, implying that CAR, especially core CAR, has a positive impact on bank performance. Pasiouras (2008) validates that the three major-pillar regulatory requirements of Basel II were positive for bank performance based on the data of 615 listed banks in 74 countries from 2000 to 2004 and that improving minimum capital requirements, increasing supervision, and emphasizing market discipline could effectively improve bank operating efficiency. Ji (2011) confirms the positive impact of CAR on bank performance through empirical analysis of data from 10 Chinese listed banks from 2006 to 2010. Xu and Chen (2012) study the relationship between CAR and commercial bank risk-taking and determine that a higher CAR is associated with a lower proportion of risk assets and a lower risk of bankruptcy. High CAR reflects the cautiousness of a bank's portfolio. By analysing the panel data of 36 Chinese banks, Jiang and Zhao (2012) find that CAR positively affects bank profitability. Increased CAR is associated not only with reduced risk for banks but also continual improvements in their profitability. Duan and Yang (2013) analyse the data of 41 commercial banks in China from 2003 to 2011 and conclude that CAR is positively correlated with the yield of both listed non-listed banks. The impact is greater on non-listed banks than listed banks. Pan (2013) establishes a multiple regression model that indicates that Chinese commercial banks' CAR positively impacts and facilitates profitability. Therefore, banks should continue to strengthen their capital management in order to improve profitability. Zhong (2014) proposes a regression model to identify the factors influencing the core CAR of commercial banks, concluding that stricter capital regulatory requirements significant affect the expansion of bank assets. Accordingly, banks should focus on asset restructuring and reduce their proportion of high-risk credit assets.

Other scholars argue that CAR is negatively related to financial performance. Yang (2011) analyses the CARs of listed banks in China and concludes that though capital requirements help enhance a bank's ability to absorb potential credit losses, they also constrain its credit-supplying capacity, influence its capital allocation, and reduce its profitability. Guo and Chen (2011) use the data of 11 banks in China from 1997 to 2009 to establish a model of the relationships between bank profitability, capital size, and market constraints. They find that increasing CAR weakened banks' profitability. In a study of CARs in Europe, the

United States, India, and China, Lu (2011) determined that though international banks were able to meet the capital requirements of Basel III in the short term, a capital gap remained in the long term. To narrow this gap, banks increased operating costs, which will lead to the further slowing of credit and economic growth. Martin and Parigi (2013) establish a model of bank financial capital regulation and innovation with structured financial characteristics. They argue that capital regulation reduces bank profits – profits that are required to spur financial innovation and thus further increase profits. Accordingly, they suggest that structured finance could improve welfare to a certain extent, instead of intending for innovation to circumvent regulation. Yang and Lin (2013) argue that commercial banks in China mainly issue long-term debt to supplement capital in order to raise CAR. According to such research, a higher CAR is not more favourable; excessively high CAR could increase banks' interest rate risk, which might reduce the stability of the banking sector.

Some studies suggest differing views. Rime (2001) analyses the data of 154 Swiss banks and finds that banks raised capital levels to meet regulatory requirements, but that this did not help improve the banks' efficiency. Yu (2003) studies the effectiveness of capital adequacy regulation and concludes that there is no optimal capital ratio because of the difference in the capital structures of different banks. Ayuso (2004) examines the relationship between CAR and macroeconomic cycle and determines that a bank's capital buffering is negatively correlated with the economic cycle, indicating that regulating capital adequacy is not an effective means of improving bank financial performance. Godlewski (2005) finds that in developing countries, capital adequacy regulation effectively maintains the stability of the banking sector but does not significantly affect bank profitability. Zhang and Wu (2007) analyse data of Chinese commercial banks from 2002 to 2005 and conclude that the effect of raising CAR to reduce operating risk is weakened when regulatory conditions are in place.

2.2. Impact of IR on financial performance

Zheng (2004) states that a basic goal of bank risk management is preventing and controlling insolvency risk such that it does not reach a dangerous level. Insolvency risk reflects the operating status of a bank from a general perspective. By studying insolvency risk, bank operators and regulators can more clearly understand the overall risk status of their banks and adjust their operating strategies or regulatory strategies to maintain the steady development of the banking sector. Zhang (2007) considers Chinese commercial bank deposits and intermediary services as requiring the occupation not of bank assets but of capital support. Because return on assets (ROA) cannot accurately measure the performance of commercial banks, Zhang proposes that changes in return on equity (ROE) be used to measure the operating risk of these banks. Through empirical analysis, he finds that the average risk level of joint-stock banks surpassed that of the four state-owned banks. The main reasons for this lie in the protection of state-owned property rights in the

state-owned banks as well as the rapid asset expansion and income level fluctuations of joint-stock banks. In addition, six factors are determined to significantly affect banks' risk level, namely the proportion of equity capital, fluctuation of asset size, shareholder equity ratio, the proportion of nonperforming loans to total loans, shareholder equity, and the number of commercial bank branches. State credit protection by state property rights significantly advantages state-owned commercial banks in risk-bearing. Jiang and Feng (2010) identify the five following factors as influencing the IR of five major U.S. investment banks: bank size, shareholder equity ratio, the proportion of financial derivatives of total assets, the proportion of net loans of total assets, and liquidity ratio. The index is often used as a measure of bank safety; indeed, it is a standard indicator in U.S. investment banking risk measurement. Insolvency risk index can not only provide valuable information regarding banking management but also be used in the supervision of banking regulatory authorities, who use major IR-related factors as criteria for determining banking sector risk status. Tan, Floros, and Anchor (2017) assess the effect of risk-taking behaviours such as credit risk, liquidity risk, capital risk, security risk, and insolvency risk on bank profitability in China. They find that insolvency risk significantly influences the profitability of Chinese commercial banks. The higher the risk of insolvency is, the higher profitability is, either in terms of ROA or ROE.

2.3. Impact of LDR, LLR, and NPL on financial performance

Zhai (2013) analyses Chinese listed bank data from 2007 to 2012 and concludes that LDR is an accurate means of measuring bank liquidity. Wang (2015) argues that relaxing LDR could promote the scale of bank credit. Ceteris paribus, Wang suggests, the return of bank interest-earning assets would be effectively improved. In an empirical study of panel data of Chinese commercial banks from 2006 to 2013, Liu and Lu (2015) show that the LDR of state-owned commercial banks and national joint-stock banks was positively correlated with credit risk. Zhang (2016) proposes that although LDR had not been used as a statutory regulatory indicator, it could still be used as a measure of bank liquidity. He uses the annual data of 16 listed Chinese commercial banks as a sample for a regression model, with the result revealing that LDR was positively correlated with the performance of the banks. Those with higher LDR had more credit funds and higher yields.

Sun and Yang (2005) suggest that when encouraged by supervisory authorities to prepare for loan losses, Chinese banks should focus on the expected loss rather than the actual loss in addition to meeting regulatory requirements. Wang (2009) notes that commercial banks usually take less provision of LLR during an economic boom whereas they are forced to take the greater provision of it during an economic downturn. Li and Lu (2009), in a study of loan loss and bank financial performance, argue that whether the provision of LLR is sufficient or not directly affects the performance of capital regulation. However, they find that the LLR of banks in China was generally insufficient and that the

impact on the bank's profitability was not obvious. Xu (2012) suggests that Chinese banks currently administer LLR in a subjective manner, with the related regulatory requirements differing according to the various and inconsistent regulatory objectives of banks' finance, accounting, and tax departments. Thus, Xu proposes, different reporting systems should be constructed to resolve these differences.

Peng et al. (2015) use the Granger causality test to elucidate the relationship between NPL rate and key indicators in commercial banks' balance sheets. They conclude that NPL affects ROE, which decreases with increases in NPL rate and the reversal of nonperforming loans. Banks investing in high-risk, high-return activities could not increase ROE and in fact, raise the overall level of bank risk. Deng et al. (2016) argue that the NPL rates of China's commercial banks decreasing annually after the financial crisis indicates that the credit risk of the country's banking sector is gradually decreasing while the ability to cope with external risks is gradually increasing. He, Chen, and Liu (2017) showed that Chinese non-state-owned banks' ratios of impaired loans to total assets, which represent an indicator of NPL, outperformed those of state-owned banks during the period of 2000–2012. However, the state-owned banks had fewer NPLs than joint-stock, foreign, and city banks did after the implementation of banking reform by the Chinese government in 2005. Research on a developing country, Pakistan, also showed that NPLs had negative effects on banks' profitability, either ROE or ROA (Malik, Baig, Abbass, & Zia-ur-Rehman, 2015).

2.4. Impact of SIZE on financial performance

Chinese literature on the country's own banking sector differs from non-Chinese literature on developing countries regarding whether bank size is associated with profitability. Regarding Chinese literature, He and Gou (2006) conclude that commercial banks attain economies of scale under certain conditions through the establishment of a bank scale economy model. However, the greater the scale does not necessarily mean the better the performance. Li (2011) finds a larger size to be negatively correlated to performance for commercial banks but to benefit financial performance for smaller banks. Zhu et al. (2014) study 115 Chinese commercial banks' data from 2007 to 2010 and determine that expansion may increase net income from fees and commissions but that it may also negatively affect net interest income. Hou and Zeng (2016) examine 6 years of financial indicator data from eight Chinese commercial banks and conclude that an upper limit exists for economies of scale among commercial banks in the country. Specifically, they find that the yield for such banks falls when the scale exceeds the critical point. They also observe that large-scale commercial banks are weaker than their medium-scale counterparts in economies of scale. However, in an analysis of Chinese urban commercial banks' data from 2007 to 2012, Zhang (2014) finds that the scale of expansion of most commercial banks in China is conducive to the improvement of financial performance.

In contrast to such Chinese-centric research, most of the non-Chinese literature on developing countries supports a positive relationship between bank size and performance. Alper and Anbar (2011) investigate bank profitability in Turkey by examining bank-specific and macroeconomic determinants from 2002 to 2010, revealing that asset size and noninterest income positively and significantly affect bank profitability. Muda, Shaharuddin, and Embaya (2013) use generalized least squares regression to analyse Islamic banks in Malaysia from 2007 to 2010 and find that bank size as well as other factors such as loan efficiency and overhead expenses significantly affect profitability. Specifically, their results indicate that bank size positively affects domestic Islamic banks' profitability. Stancic, Cupic, and Obradovic (2014) investigate 74 commercial banks from four transition economies of southeast Europe from 2005 to 2010, using ordinary least squares regression to analyse a set of 377 observations. They observe that bank size and capitalization are crucial factors influencing bank profitability. Regarding size, they find that larger and well-capitalized banks are more profitable than smaller and less-capitalized banks. Al-Jafari and Alchami (2014) use the generalized method of moments to analyse Syrian bank data from 2004 to 2011. Their empirical results show that all bank-specific determinants including liquidity risk, credit risk, bank size, and management efficiency significantly affect bank profitability. Malik et al. (2015) analysed the relationships between banks' profitability and their internal and external causes in Pakistan. The internal causes include size, capital, liquidity, debt to equity ratio, nonperforming loan to gross advances, portfolio composition, and loan to total assets whereas the external causes included gross domestic product, inflation, and unemployment. Both ROA and ROE are used as a measure of profitability. The results reveal that bank size has a significant positive effect on profitability. Seemule, Sinha, and Ndlovu (2017) investigate the effects of bank-specific factors on bank profitability in Botswana, using ordinary least squares regression to analyse data from 2004 to 2013. Their main findings are that capital adequacy, operating efficiency, asset quality, and bank size are positively associated with bank profitability.

A small body of literature shows negative or nonsignificant effects of risk management on financial performance. Maredza (2014) applies a two-step methodology framework to a panel of banks in South Africa for the period 2005–2011, empirically finding that large bank size, high-cost inefficiency, diversification activities, and high credit risk lead to lower profitability. Kolapo, Ajayi, and Aluko (2016) investigate the association between bank size and profitability in Nigeria after the 2005 push to consolidate that country's excessive number of banks. They employ the static panel data regression method and reveal that bank size has a negative but nonsignificant relationship with profitability.

3. METHODOLOGY

3.1. Data description

The sample period for this study extends from the first quarter of 2009 to the first quarter of 2017. The sample data are obtained from financial reports released on the Shanghai Stock Exchange and Shenzhen Stock Exchange websites. At present,

China has 20 listed commercial banks, five state-owned and 15 non-state-owned. Agricultural Bank of China completed restructuring on January 15, 2009, and was listed in July 2010; as a result, data from before 2010 cannot be obtained. Seasonal data of China Everbright Bank and Bank of Beijing were also unobtainable, as were the pre-IPO data of four local commercial banks listed in 2016. To ensure the accuracy of the empirical results, the seven aforementioned banks are removed, leaving 13 listed commercial banks with 429 data sets. As the selected commercial banks differ in management style, capital size, ownership structure, and other aspects, the sample banks are classified into state-owned commercial banks and non-state-owned commercial banks according to the China Banking Regulatory Commission designation of each. Based on this classification, the state-owned commercial bank samples comprise 132 data sets from Bank of China, Industrial and Commercial Bank of China, Bank of Communications, and China Construction Bank, whereas the non-state-owned commercial bank samples comprise 297 data sets from Ping An Bank, Shanghai Pudong Development Bank, China Minsheng Banking, China Merchants Bank, Hua Xia Bank, Industrial Bank, China CITIC Bank, Bank of Ningbo, and Bank of Nanjing.

The selection of these banks as samples is mainly due to the following reasons. First, in terms of representation, the total assets of these 13 listed commercial banks account for more than two-thirds of total bank assets in China. Thus, the selected data are broadly representative of risk and financial performance in the country's banking sector. Second, in terms of accuracy, because the selected banks are Chinese A-share-listed banks, their quarterly, semi-annual, and annual financial statements are reviewed or audited by third parties before being released. The mandatory requirements of audit standards guarantee the accuracy of data acquisition. Third, in terms of availability, the listed banks' financial statements are regularly published on official websites and the Shanghai Stock Exchange or Shenzhen Stock Exchange website, so the acquisition of data is more convenience.

3.2. Definition of variables

3.2.1. Dependent variable

Return on equity is the percentage of net profit divided by average shareholder equity (in other words, after-tax profit divided by net assets and expressed as a percentage); as such, it reflects the ability of shareholder equity earnings and is commonly used to measure a bank's capital effectiveness. In addition, ROE reflects the ability of a bank to bolster net income using its own capital and can thus be used to compare banks according to their relative performances in the banking sector. A higher ratio indicates a higher return rate of bank capital invested by shareholders, greater profitability, and stronger solvency.

We use ROE to measure financial performance for several reasons. First, ROE directly reflects a bank's own capital profitability, which is more in line with the wealth maximization of shareholders. Second, ROE is a broad and comprehensive indicator that can fully reflect the performance of a bank's operating activities. Third, the denominator of ROE is net assets, which is likely to increase or reduce assets and liabilities than ROA. Fourth, the numerator of ROE is net profit after tax, which is less likely to be manipulated than operating profit margin.

3.2.2. Independent variables

1) *Capital adequacy ratio.* Capital adequacy ratio is the proportion of bank net capital to risk-weighted assets. Governments control and track CAR to ensure that banks have the ability to independently resolve and absorb certain risk. Specific CARs are established to ensure banks and other financial institutions have the capacity for normal operation and development (Guo & Chen, 2011; Martin & Parigi, 2013; Pan, 2013).

2) *Insolvency risk index.* A growing number of scholars are studying the impact of bank IR on risk management (Gong, 2002; Jiang & Feng, 2010). Both ROA and ROE constitute IR. When a bank's capital gains fluctuate, its IR increases. When a bank's capital gains are fixed, the increase in revenue reduces IR. Furthermore, IR also decreases when ROE increases.

3) *Loan and deposit ratio.* Loan and deposit ratio is an important indicator of the liquidity risk of commercial banks. A higher LDR indicates superior liquidity and profitability (Wang, 2015; Zhai, 2013).

4) *Provision coverage.* Of the numerous measurements of LLR available, PC – the ratio of bad debt reserves that may be incurred in bank loans – is the measurement most widely used by commercial banks. It is a crucial indicator of the adequacy of bad debt reserves of commercial banks (Li & Lu, 2009; Sun & Yang, 2005). The index reflects numerous elements including the risk of bank loans, the social and economic environment, and integrity. Provision coverage can also be used to analyse the financial stability and risk controls of banks.

5) *Nonperforming loan ratio.* Nonperforming loan ratio is one of the most important indicators for evaluating the security status of financial institutions' credit assets (Peng et al., 2015). A higher NPL ratio is associated with a greater proportion of loans that may not be recovered, whereas a lower NPL ratio indicates only a small proportion of loans that cannot be recovered. Nonperforming loans can be divided into subprime loans, suspicious loans, and loss loans.

3.2.3. Controlled variable

Bank size is used to analyse bank financial performance (Hou & Zeng, 2016; Zhu et al., 2014). The ability of a bank to diversify risk is significantly related to scale efficiency. This paper adopts the natural logarithm of total bank assets as a proxy variable for measuring bank size.

3.3. Methods and models

Regression analysis is used to explore the effects of risk management indices on financial performance for different types of banks. The panel data regression model of state-owned banks is

$$ROE_{it} = \alpha_0 + \alpha_1 CAR_{it} + \alpha_2 IR_{it} + \alpha_3 LDR_{it} + \alpha_4 PC_{it} + \alpha_5 NPL_{it} + \alpha_6 SIZE_{it} + \varepsilon_{it} \tag{1}$$

where i = 1, 2, 3, 4   t = 1, 2, 3,…,33

whereas that for non-state-owned banks is

$$ROE_{it} = \beta_0 + \beta_1 CAR_{it} + \beta_2 IR_{it} + \beta_3 LDR_{it} + \beta_4 PC_{it} + \beta_5 NPL_{it} + \beta_6 SIZE_{it} + \varepsilon_{it} \tag{2}$$

where i = 1, 2, 3,…,9   t = 1, 2, 3,…,33.

The Hausman specification test is used to determine the appropriate model and solve the problems of heteroskedasticity and autocorrelation arising because the dataset of this study was panel data comprising both time series and cross-sectional elements (Hausman, 1978). The Hausman test statistic is

$$m = (\hat{\beta}_{FE} - \hat{\beta}_{RE})'(\widehat{Cov}(\hat{\beta}_{FE}) - \widehat{Cov}(\hat{\beta}_{RE}))^{-1}(\hat{\beta}_{FE} - \hat{\beta}_{RE}) \sim \chi_6^2 \tag{3}$$

and is used to test whether there is a significant correlation between the unobserved (unit of observation) specific random effects and the regressors. If there is no statistically significant difference between the covariance matrices of the two models, the correlations of the random effects and the regressors are not statistically significant and the random-effects model may be more powerful and parsimonious. If there is such a correlation, the random-effects model may be inconsistently estimated and the fixed effects model would be the appropriate model of choice.

4. EMPIRICAL RESULTS

4.1. Descriptive statistics

This subsection provides the minimum, maximum, median, mean, and standard deviation of the ROE, CAR, IR, LDR, PC, NPL, and SIZE for both the state-owned and non-state-owned commercial banks. The results are shown in Table 1.

Table 1. Descriptive statistics

	Variable	*Minimum*	*Maximum*	*Median*	*Mean*	*Std. dev.*
State-owned commercial banks	ROE (%)	12.100	26.190	19.490	19.572	3.571
	CAR (%)	11.090	15.550	13.125	13.153	1.056
	IR	0.003	0.011	0.007	0.007	0.002
	LDR (%)	57.600	78.170	70.350	68.800	4.676
	PC (%)	119.870	295.550	207.725	200.921	47.304
	NPL (%)	0.810	2.240	1.145	1.233	0.288
	SIZE	14.926	17.031	16.375	16.247	0.528
Non-state-owned commercial banks	ROE (%)	10.040	29.680	19.420	19.927	3.793
	CAR (%)	8.110	16.582	11.360	11.567	1.345
	IR	0.004	0.020	0.011	0.011	0.004
	LDR (%)	43.010	93.949	71.140	69.377	8.095
	PC (%)	130.430	499.600	245.450	259.123	82.024
	NPL (%)	0.340	1.920	0.890	0.962	0.368
	SIZE	11.629	15.645	14.530	14.311	0.979

The results show that the mean ROEs of the state-owned and non-state-owned commercial banks are 19.572% and 19.927%, respectively. Although these rates are similar, that of the state-owned commercial banks is lower. The ROE of the non-state-owned commercial banks has a minimum of 10.040%, a maximum of 29.680%, and a standard deviation of 3.792. Compared with the standard deviation of the state-owned banks of 3.571, the ROE of the non-state-owned banks is in larger fluctuation with less steady profitability than state-owned banks.

The mean CAR of the state-owned commercial banks is 13.153%, notably higher than the 11.567% of the non-state-owned banks. The higher CAR indicates that the state-owned banks have more net capital to risk assets than the non-state-owned banks do, which means that the state-owned banks possess stronger risk-response abilities. The CAR of the state-owned commercial banks has the minimum of 11.090%, the maximum of 15.550%, and the standard deviation of 1.056, which is smaller than the standard deviation of the non-state-owned banks of 1.345. Because the CAR of the state-owned banks is relatively stable across various quarters, both for each bank individually and among all the banks, the median CAR is in an intermediate position between the minimum and maximum CAR values.

The mean IR of the state-owned commercial banks is 0.007, lower than the 0.011 of their non-state-owned counterparts, which indicates that state-owned banks have more stable profitability. During the sample period, the assets of the non-state-owned banks suddenly increase in scale, particularly after the banks' successful listings. According to the IR formula, changes in asset scale leads to fluctuations of ROA, thus leading to increases in IR.

The mean LDRs of the state-owned and non-state-owned commercial banks are 68.800% and 69.377%, respectively. For the non-state-owned banks, the minimum is 43.010%, the maximum is 93.949%, and the standard deviation is 8.095. The fluctuation of LDR of the non-state-owned banks is larger compared with the state-owned banks' LDR minimum of 57.600%, maximum of 78.170%, and standard deviation of 4.676. This is mainly because non-state-owned banks differ greatly in asset scale, loan structure, and ability to offer loans. State-owned banks are similar in size and ability to absorb deposits and offer loans, thus their LDR is more stable.

Regarding PC, the state-owned commercial banks have a mean of 200.921%, a minimum of 119.870%, and a maximum of 295.550%, which is smaller than the non-state-owned commercial banks' mean of 259.123%, minimum of 130.430%, and maximum of 499.600%. These results indicate that non-state-owned banks have more sufficient reserves for absorbing loan losses than state-owned banks do. This can be attributed to the fact that non-state-owned banks, because they have no recourse to the state capital, must accrue more loan loss reserves to prepare for the risk of nonperforming loans. Furthermore, the standard deviation of the non-state-owned banks' PC is 82.024, which is considerably higher than the 47.304 of the state-owned banks. The higher standard deviation of the non-state-owned banks' PC is due to the differences in their risk-taking ability and their amount of total nonperforming loans.

The mean NPL of the state-owned commercial banks is 1.233%, which is nearly 30% higher than the 0.962% of the non-state-owned commercial banks. In addition, the 0.810% minimum and 2.240% maximum of the state-owned banks are both higher than those of the non-state-owned banks. This is mainly because state-owned banks can rely on protection in the form of the state capital and thus can take greater risks in terms of penalties and reimbursement from nonperforming loans.

4.2. Panel data regression results

This paper uses regression analysis to analyse the impact of risk management on the financial performance of state-owned commercial banks. The Hausman test results reveal that the model has a cross-section fixed effect. The model fits well, with an F value of 76.343. The adjusted R^2 indicates that the explanatory variables selected by the model explain a total of 83.81% of the explanatory variables representing financial performance. The Kolmogorov-Smirnov and Breusch-Pagan test results exhibit no residual abnormality or heterogeneity. From the regression results, IR, LDR, NPL, and SIZE are revealed to significantly impact the financial performance of state-owned commercial banks. Neither CAR nor PC affects financial performance, mainly due to the high capital scale of state-owned banks and the existence of state-capital support that ensures these banks have enough capital to proceed with profitable activities regardless of having a high CAR or sufficient PC. Furthermore, IR and SIZE positively affect state-owned commercial banks' financial performance whereas LDR and NPL negatively affect it.

Table 2. Panel data regression

	State-owned banks model	Non-state-owned banks model
	Coefficient (standard error)	Coefficient (standard error)
Constant	97.725*** (12.711)	15.948*** (4.563)
CAR	-0.036 (0.268)	-0.384** (0.165)
PC	-0.009 (0.009)	0.004 (0.004)
NPL	-7.083*** (1.509)	-7.386*** (1.152)
LDR	-0.119* (0.066)	0.043 (0.042)
IR	685.436** (318.845)	-52.086 (53.143)
SIZE	3.931*** (0.873)	0.834** (0.338)
F statistic	76.343	48.465
R^2	84.92%	54.21%
Adjusted R^2	83.81%	49.03%
Hausman Test	Cross-section fixed effect	Period random effect
Kolmogorov–Smirnov	1.096	0.735
Breusch–Pagan	9.813	6.094

*Note: * denotes significance at the 10% level, ** denotes significance at the 5% level, *** denotes significance at the 1% level.*

The IR of state-owned banks is positively related to their financial performance, with a higher ratio associated with greater profitability. Because the bankruptcy risk of state-owned banks is relatively low and their asset yield has been relatively stable, appropriate increases in risk investment will help state-owned banks to improve profitability. For such banks, larger size leads to better profitability. The profitability of state-owned banks is mainly based on traditional deposit and loan activities. Thus, having a larger size and more branches raises profits by increasing deposits and loanable funds. Furthermore, both the LDR and NPL of state-owned commercial banks are negatively related to financial performance. State-owned banks have a great capacity to absorb deposits and offer loans and administer large amounts of deposits and loans. However, due to the policies of national and local governments, state-owned banks are required to provide loans to less profitable enterprises, resulting in the banks having loans that are large in number and quantity but weak in quality. Therefore, LDR increases for state-owned banks also raise their NPL but are not conducive to improving the banks' profitability. In recent years, the continuing expansion of joint-stock banks and local city banks has diluted the market shares of loan and intermediary activities of state-owned banks, also gradually reducing their profitability.

In the non-state-owned bank model results, the Hausman test shows that the model of non-state-owned banks is estimated by the period random effect model. The model fits well, with an F value of 48.465. The adjusted R^2 indicates that the explanatory variables selected by the model explain a total of 49.03% of the explanatory variables representing financial performance. The Kolmogorov–Smirnov and Breusch-Pagan test results also exhibit no residual abnormality or heterogeneity. From the regression results, CAR, NPL, and SIZE are observed to be positively related to the financial performance of non-state-owned commercial banks, whereas IR, LDR, and PC have no effect on profitability. In addition, CAR and NPL negatively affect non-state-owned banks' performance, but SIZE positively affects it.

The main reason that IR does not affect the profitability of non-state-owned banks is that fluctuation of ROA caused by the increase of asset scale in the sample period. Because of its instability, bank size is not a useful measure of the possibility of bankruptcy risk. For non-state-owned banks, LDR

has no significant effect on profitability. Non-state-owned banks are poor in absorbing deposits, leading them to have smaller amounts in deposits and loans than state-owned banks do. Furthermore, non-state-owned banks' profits are based on diversified investments and innovative finance more than traditional deposit and loan activities. Thus, LDR, as an indicator of traditional business liquidity, cannot reflect the liquidity of non-state-owned banks' profitable business. Non-state-owned banks have a relatively low total amount of loans, thus have less nonperforming loans than state-owned banks do. Although non-state-owned banks do not require great accrual of loan loss reserves, more loan loss reserves will be accrued in advance for reversal use in less profitable years. Therefore, the PC does not significantly affect the profitability of non-state-owned banks.

Capital adequacy ratio negatively affects the profitability of non-state-owned commercial banks mainly because regulating CAR requires banks to reserve more capital for risky assets. As non-state-owned banks lack in their capacity to absorb deposits, they cannot rely on loan interest for profitability. Increasing capital reserves reduces the total amount of investment capital, thereby reducing the profitability of non-state-owned banks. Increasing NPL reduces the profitability of non-state-owned banks to compensate for the losses caused by nonperforming loans. Although non-state-owned banks adopt diversified and innovative investments as their main profit-making business, loan interest remains a profitable operation. Therefore, as with state-owned banks, the expansion of bank size positively affects the deposit and loan business of non-state-owned banks and positively affects the profitability of these banks.

4.3. Discussion

A higher capital adequacy ratio, the regulatory standard for commercial bank capital management, has no significant impact on state-owned banks' financial performance but does negatively impact that of non-state-owned banks. State-owned banks' profit mainly comes from traditional deposit and loan business that does not require much of a bank's own capital. Therefore, for state-owned banks, CAR remains at the level set by regulatory requirements and does not significantly impact their performance or ability to improve their performance. However, non-state-owned banks' profitability depends on financial diversification. The capital of non-state-owned banks determines their financial performance. Supervisory authorities enforce CAR requirements more stringently for non-state-owned banks than for state-owned banks, thus affecting how much of their own capital non-state-owned banks can use. Improving capital management requirements negatively affects the financial performance of non-state-owned banks and restricts their venture capital. Therefore, in contrast to state-owned banks, non-state-owned banks should pay more attention to capital management capacity and improve their capital profitability while meeting regulatory requirements.

A higher insolvency risk index, as an indicator of bankruptcy risk, has a positive impact on profitability for state-owned banks and no impact for non-state-owned banks. The bankruptcy risk of

state-owned banks can be ignored because such banks can rely on support and protection from the central government. On the basis of traditional interest business, appropriate increases in risk investment will increase ROA and promote profitability. For non-state-owned banks, the fluctuation of IR is not clearly caused by the expansion of asset scale or the risk of bankruptcy. Therefore, the effect of IR on non-state-owned banks' financial performance is not significant.

As measures of liquidity risk, LDR and PC have different effects on state-owned and non-state-owned banks. Whereas a higher LDR has a negative effect on the financial performance of state-owned banks and no significant effect on that of non-state-owned banks, PC has no effect on the profitability of state-owned or non-state-owned banks. For state-owned banks, a higher LDR and better liquidity are not associated with increased profits; thus, state-owned banks should focus more on the quality of assets than on liquidity. The impact of loan asset quality on the financial performance of state-owned banks is much greater than that of asset liquidity. Fundamentally solving the problem of loan quality is not possible by preparing sufficiently for loan losses; rather, maintaining liquidity in a conservative range before resolving asset quality issues is more important for state-owned banks.

As a measure of credit risk, a higher NPL has a negative impact on the financial performance of both state-owned and non-state-owned banks. Credit risk is the greatest threat to the entire banking sector and has the most direct and significant impact on banks' financial performance. Losses from nonperforming loans directly contribute to declining financial performance for state-owned banks, based on traditional interest business, as well as non-state-owned banks, based on financial diversification. Therefore, for China's commercial banks, effectively controlling high NPL and optimizing loan structure have become the most critical elements of credit risk management.

The regression results show that SIZE has a positive impact on the financial performance of both state-owned and non-state-owned banks; specifically, the larger the SIZE, the better the profitability. This finding is consistent with those of related literature (Menicucci & Paolucci, 2016). Given the expansion of China's credit market, the scale of bank assets is yet to peak. To improve financial performance, state-owned banks can increase their number of branches whereas non-state-owned banks can diversify their investment portfolios to meet the demands of the credit market. However, banks should carefully assess the costs associated with branch expansion as well as the potential risk of investment innovation.

5. CONCLUSION AND SUGGESTIONS

Comprehensive risk management is a vital part of commercial banks' financial performance. Based on the analysis of four state-owned commercial banks and nine non-state-owned commercial banks from the third quarter of 2009 to the first quarter of 2017, this section presents conclusions and recommendations regarding the varying effects of risk management objectives on financial performance. The limitations of this research and

the possibilities for future studies are also identified in this section.

According to the discussion in Section 4.3, both NPL and SIZE have a significant impact on banks' financial performance. Therefore, commercial risk management should put particular emphasis on reducing NPL and increasing SIZE by adhering to CAR, PC, and liquidity regulations. At present, with the gradual deepening of interest rate marketization in China, it is quite difficult to maintain bank loan interest income at a high-speed profit growth rate after deducting the costs of deposits and daily operating expenses. High NPL is also constraining the profits of state-owned banks. In this situation, state-owned banks must adjust their profit models in a timely manner in order to expand their intermediary business and increase noninterest income, thereby easing the losses caused by high NPL. State-owned banks can improve their financial performance by increasing the profits of the intermediate business, such as investment banking, custodian services, billings, financial management, and gold trading. State-owned banks can follow the diversified business expansion of large non-state-owned banks, such as improving personal financial asset management and financial product development. State-owned banks may direct capital to areas that can generate more investment income and financial adviser earnings in order to reduce capital credit risk. At the same time, regarding the balance of nonperforming loans of state-owned banks, accelerating liquidation and promoting the marketization of debt-to-equity swap is necessary to improve asset quality.

Non-state-owned banks cannot ignore the impact of traditional deposit and loan business on bank assets while maintaining the diversified development of intermediary business. To maintain a favorable CAR, non-state-owned banks should focus on infrastructure development, improving people's livelihoods, supporting SMEs, and other production needs. Non-state-owned banks should also strictly control loan quality and improve loan qualification verification to reduce their NPLs. These banks can also expand their internet-based services, such as online personal finance, as well as implement inclusive finance and raise asset coverage to adjust their structures during expansion.

Regulators also need to generate new legal constraints to guide commercial banks as they seek to improve their financial efficiency. Regulators should introduce custody business laws and regulations to clarify the duties of banks and clients, thereby ensuring the interests of both. The growth of online finance must come with consideration of financial innovation as well as regulation. Regulators must establish financial constraints and related laws, improve the credit and information disclosure systems, and strengthen personal information protections. In conclusion, improving the financial performance of China's commercial banks requires not only the banks to seek a positive way of innovation and transformation but also the supervision of regulators to ensure the healthy and stable development of the country's banking sector.

Regarding the limitations of this study, there are numerous risk factors that may affect a bank's financial performance. This research mainly selected internal risk factors; external factors, such as inflation and GDP growth, which may affect a bank's financial performance but which the bank cannot control, are not included in this paper. Furthermore, some financial derivative-related factors, such as foreign exchange derivatives and interest rate derivatives, are becoming increasingly important profitability analysis tools for banks but are not discussed herein due to space constraints. Hence, future research may expand the scope of variables to include external factors and may investigate how derivatives affect banks' financial performance.

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