ANNALS OF ECONOMICS AND FINANCE **19-2**, 523–554 (2018)

The Impacts of Competition and Risk on Profitability in Chinese Banking: Evidence from Boone Indicator and Stability Inefficiency

Yong Tan*

This paper tests the competition in different banking markets (deposit market, loan market, and non-interest income market) using a sample of Chinese commercial banks between 2003-2013 and further examines the impact of competition on bank profitability while controlling for different types of risk. The results show that the non-interest income market has a higher level of competition compared to the other two markets during early years of the examined period. The findings further report that in a higher competitive deposit market, Chinese commercial banks have lower levels of profitability. Finally, it is suggested that bank profitability is significantly affected by liquidity risk.

Key Words: Bank profitability; Bank competition; GMM; China.
JEL Classification Numbers: G21, C23.

1. INTRODUCTION

The Chinese banking sector has undergone a sustainable and healthy development through several rounds of banking reforms initiated by the government since 1978. The main purpose of these banking reforms has been to increase competitive conditions, enhance stability and improve performance of the Chinese banking sector. With regards to the competitive condition in the Chinese banking industry, it is noticed that the state-owned commercial banks (SOCBs)[1] still dominate the industry. However, according to the statistics from the China Banking Regulatory Commission (CBRC), the share of SOCB assets in total banking sector assets decreased between 2003 and 2013 to a low point of 43.3%. On the other hand, the

* Department of Accountancy, Finance and Economics, Huddersfield Business School, University of Huddersfield, Queensgate, Huddersfield, HD1 3DH, United Kingdom. Email: a.y.tan@hud.ac.uk.

[1] There are five state-owned commercial banks in China now including Bank of China, Industrial and Commercial Bank of China, China Construction Bank, Agricultural Bank of China and Bank of Communication.

1529-7373/2018

joint-stock commercial banks (JSCBs) and city commercial banks (CCBs) have kept increasing in size and in 2013 they held 17.8% and 10.03% of total banking sector assets, respectively. Therefore, the statistics show that the competitive condition is still quite low under the consideration that five largest banks hold more than 40% of total banking sector assets. Table 1 summarizes the assets of SOCBs, JSCBs, CCBs and total banking institutions in China over the period 2003-2013.

TABLE 1.
Summary of the assets of SOCBs, JSCBs, CCBs and total banking institutions in China over the period 2003-2013

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
SOCBs	160512 (58.03%)	179817 (56.9%)	210050 (56.1%)	242364 (55.2%)	285000 (53.7%)	325751 (51.59%)	407998 (51.31%)	468943 (49.2%)	536336 (47.34%)	600401 (52.84%)	656005 (43.34%)
JSCBs	29599 (10.7%)	36476 (11.5%)	44655 (11.92%)	54446 (12.4%)	72742 (13.69%)	88337 (13.99%)	118181 (14.86%)	149037 (15.64%)	183794 (16.22%)	235271 (20.71%)	269361 (17.8%)
CCBs	14622 (5.3%)	17056 (5.4%)	20367 (5.44%)	25938 (5.9%)	33405 (6.29%)	41320 (6.54%)	56800 (7.14%)	78526 (8.24%)	99845 (8.81%)	123469 (10.87%)	151778 (10.03%)
Banking institutions	276584	315990	374697	439500	531160	631515	795146	953053	1132873	1136224	1513547

The impact of competition on profitability in the banking industry has been documented in the traditional structure-conduct-performance (SCP) paradigm, which mainly argues that in a higher concentrated industry with a lower level of competition, firms tend to collude with each other to obtain higher profit. In addition, there is a large number of literature investigating the impact of competition on profitability in the banking industry (Smirlock, 1985; Bourke, 1989; Goldberg and Rai, 1996; Demirguc-Kunt and Huizinga, 1999; Maudos and Fernandez de Guevara, 2004; Athanasoglou et al., 2008; Tan and Floros, 2014; Tan, 2016; among others). In comparison to the traditional SCP hypothesis discussed above, the efficient-structure hypothesis (ES) argues that it is the superior efficiency rather than the collusive behavior that actually leads to an improvement in bank profitability. Accounting cost-income ratio or parametric stochastic frontier estimation is used to derive the bank efficiency. The empirical literature has different findings with regard to the impact of efficiency on bank profitability (Berger, 1995a, Garcia-Herrero et al., 2009; among others). All the empirical studies examined the competitive condition in the whole banking industry and further tested its impact on bank profitability. However, Tan (2017) contributes to the empirical banking literature by explicitly investigating the competitive conditions of different banking market (deposit market, loan market and non-interest income market) using a sample of

Chinese commercial banks over the period 2003-2013 under the Boone indicator.

Through consistent effort made by the CBRC since 2003, the Chinese banking industry has in general reduced the level of risk undertaken from different perspectives. To be more specific, The level of credit risk has been reduced over the period 2003-2013. The non-performing loan ratios over the period 2011-2013 were kept at 1% which were lower than the figures for 2008-2010. The Chinese banking industry also reduced its capital risk as measured by the capital adequacy ratio. CRBC statistics show that, by the end of 2013, the average capital ratio of Chinese banks was 12.2% which increased by 1.6% compared to the previous year. In addition, the liquidity risk has been reduced as measured by the liquidity ratio. The CBRC statistics report that the liquidity ratio of Chinese commercial banks was 44% by the end of 2013, the ratio was lower than the figure for 2012, which was 45.8%, but it was higher than the ones for 2010 and 2011 which were 42.2% and 43.2%, respectively. The impacts of these different types of risk-taking behavior on bank profitability have been extensively tested by the empirical literature focusing on European countries, United States, Emerging Economies as well as the Chinese banking industry. More recently, Tan (2016) tests the insolvency risk in the Chinese banking industry and further examines its impact on bank profitability and the results show that there is no impact of insolvency risk on bank profitability in China over the period 2003-2011. Tan et al. (2017) test the joint impacts of efficiency, competition and different types of risk (credit risk, liquidity risk, capital risk and insolvency risk) on profitability of Chinese commercial banks over the period 2003-2013. The insolvency risk is measured by Z-score and competition is measured by Lerner index.

This study contributes to the empirical banking literature and more specifically extend the work of Tan (2016); Tan (2017) and Tan et al. (2017) by the following ways: firstly, the current study uses stability inefficiency rather than Z-score as the indicator of insolvency risk, which is supposed to provide more accurate results. Secondly, the robustness of the results is cross checked by including competition in each of the three different banking markets (deposit market, loan market and non-interest income market) separately in the estimation. Thirdly, the current study examines the impacts of competition and risk on bank profitability for different ownership types of Chinese commercial banks (state-owned commercial banks, joint-stock commercial banks and city commercial banks).

The results of the current paper show that in general, there is a higher level of competition in the non-interest income market compared to deposit market and loan market. Furthermore, it is found that in a higher competitive deposit market, Chinese commercial banks have lower levels of profitability. In addition, it is found that the profitability of Chinese

commercial banks is significantly affected by bank size, liquidity risk, inflation and GDP growth. With regard to the impact of competition on the profitability of different ownership types of Chinese commercial banks, the findings suggest that a higher competitive loan market leads to higher bank profitability while Chinese commercial banks have lower levels of profitability in a more competitive deposit market. In particular, we find that in a higher competitive non-interest income market, joint-stock commercial banks have lower levels of net interest margin (NIM).

This paper will be structured as follows: Relevant literature investigating bank profitability will be reviewed in section 2; section 3 will present the methodology and data, which will be followed by section 4 describing and discussing the findings and section 5 will provide a summary and conclusion of the whole paper.

2. LITERATURE REVIEW ON BANK PROFITABILITY IN CHINA

The profitability in the Chinese banking sector has been extensively tested by the empirical literature. Shih et al. (2007) evaluate the performance of a sample of Chinese commercial banks in 2002 under a principal analysis. The results indicate that joint-stock commercial banks have better performance compared to state-owned commercial banks and city commercial banks. Their findings further suggest that bank size does not have any significant impact on bank performance in China.

Using a sample of Chinese commercial banks over the period 2000-2005, Sufian and Habibullah (2009) investigate the impact of credit risk on bank profitability. Their results suggest that credit risk has a significant and positive impact on the profitability of Chinese state-owned commercial banks and joint-stock commercial banks. In addition, Sufian (2009) uses four state-owned commercial banks and twelve joint-stock commercial banks during 2000-2007 to examine the determinants of bank profitability in China with a focus on the impacts of credit risk and liquidity risk under a fixed effect model. The results show that Chinese commercial banks with higher levels of credit risk and liquidity risk have higher profitability.

Heffernan and Fu (2010) analyze the profitability of Chinese commercial banks over the period 1999-2006 using two econometric techniques including a Generalized Method of Moments (GMM) estimator as well as a fixed effect estimator. Their findings report that bank efficiency, bank listing, GDP growth rate and unemployment are significantly related to bank profitability.

More recently, Tan and Floros (2012a, 2012b, 2012c) use a sample of Chinese commercial banks over the period 2003-2009 to examine the determinants of bank profitability with a focus on the impacts of credit risk

and competition on bank profitability under a GMM estimator. The competition is measured by 3-bank and 5-bank concentration ratios. To be more specific, Tan and Floros (2012a) use both 3-bank concentration ratio and 5-bank concentration ratio to investigate the joint effects of credit risk and competition on bank profitability in China. They do not find any significant impact. The findings from Tan and Floros (2012b) show that the profitability of Chinese commercial banks is significantly affected by credit risk. Finally, the results from Tan and Floros (2012c) report that Chinese joint-stock commercial banks with higher levels of credit risk have higher profitability.

Using a sample of Chinese commercial banks over the period 2003-2009, Tan and Floros (2014) investigate the inter-relationships between risk, profitability and competition in the Chinese banking industry, two types of risk are considered which are credit risk and insolvency risk while the competitive condition is measured by the Lerner index. They also use the Seemingly Unrelated Regression to analyze the inter-relationships. The results show that there is a negative impact of competition on bank profitability in China while there is no robust impact of different types of risk on bank profitability in China.

Using a sample of Chinese commercial banks over the period 1997-2004, Garcia-Herrero et al. (2009) explain the low profitability in the Chinese banking industry with a focus on the impacts of competition and efficiency on bank profitability. The authors use a GMM estimator as the econometric technique. The efficiency is measured by the parametric stochastic frontier approach while the competition is measured by a Herfindahl-Hirshman index. The results show that Chinese commercial banks with higher efficiency have higher levels of profitability and there is no clear impact of competition on bank profitability in China.

More recently, Tan (2016) uses a sample of Chinese commercial banks over the period 2003-2011 to examine the impacts of risk and competition on bank profitability under a GMM estimation. Two types of risk are evaluated which are credit risk and insolvency risk and the competition is measured by the Lerner index. The results show that there is no robust impacts of risk and competition on bank profitability in China.

Tan et al. (2017) test the joint impacts of efficiency, competition and risk on profitability of Chinese commercial banks over the period 2003-2013. Different types of risk including credit risk, liquidity risk, capital risk, security risk and insolvency risk are considered, while the Lerner index is used to measure the level of competition in the Chinese banking industry. The cost efficiency is derived from a stochastic frontier analysis. The results from the Generalized Method of Moments (GMM) estimator show that different types of risk are significantly related to the profitability

of Chinese commercial banks and a higher level of competition leads to lower profitability in the Chinese banking industry.

Tan (2017) innovatively uses the Boone indicator to measure the competitive conditions in the Chinese banking industry and test its joint impacts with shadow banking on the profitability of Chinese commercial banks under the GMM estimator. The findings show that the non-interest income market has a higher level of competition compared to the deposit market and loan market. It is further reported that a lower level of competition in the deposit market leads to an increase in the profitability of Chinese commercial banks.

3. METHODOLOGY AND DATA

3.1. Measurement of competition in different banking markets in China

The current study uses the method proposed by Boone (2008) to measure the competition. The Bonne indicator holds the idea that the performance of efficient firms is improved and the performance of inefficient firms is weakened by competition. The basic logic of Boone indicator is in line with the argument of efficiency structure hypothesis as developed by Demsetz (1973) which links the influence of efficiency on performance. The performance can be measured by profit or market share. The stronger effect will lead to a more negative Boone indicator. The Boone indicator for bank i can be defined by the simplest equation as follows:

$$\ln(MS_{ki}) = \alpha + \beta \ln(MC_{ki}) \tag{1}$$

Where i represents a specific bank, k stands for a specific bank output, MS is the market share while MC measures the marginal cost. β denotes the Boone indicator. In this paper, we focus on the analysis of competition in different markets reflecting interest income activities as well as non-interest generating business, Thus, K =loans, deposits, non-interest income.

Compared to other competition indicators such as Lerner index, Panzar-Rosse H-statistic or Herfinal-Hirschman index (Degryse and Ongena, 2007; Anginer et al., 2014, among others), the Boone indicator has the advantages of measuring competition for several specific product markets and different categories of banks. This advantage provides more insight for future research and also provides more valuable information for government and banking regulatory authorities to make relevant policies due to the fact that it is not only known from this indicator on which banking output is subject to more or less competitive pressures but also different types of banks in terms of competition is compared (Tabak et al., 2012).

Because the Boone indicator is time dependent, it reflects the changes in competition over time, thus, the Boone indicator-beta, will be estimated on a year by year basis. There is no benchmark for the value of beta, it is only known that the more negative of the value, the stronger competition it is.

A number of studies use the ratio of average variable cost to revenues as the approximation of marginal cost (Boone and Weigand, 2000; Boone et al., 2004, among others). To be more specific, the relative values of profit are used by Boone and Weigand (2000) as the dependent variable and the ratio of variable cost to revenues as the independent variable, while the absolute rather than relative values of profits are considered by Boone et al. (2004).

With regard to the calculation of marginal cost, rather than using the average variable cost, we use a translog cost function to estimate it. The advantage of using the translog cost function to estimate the marginal cost lies to the fact that it allows focusing on segments of the market, such as loan market, deposit market, and non-interest income market, where no direct observations of individual cost items are available. Furthermore, rather than using the profit as the dependent variable, we use the market shares following Tabak et al. (2012). The advantage of using market share rather than profit as the dependent variable is that the market shares are always positive while the profit values can be either positive or negative. If the log-linear specification is used, the negative profits would be excluded. In other words, the biased estimation results will be obtained due to the fact that banks with higher inefficiency and higher levels of losses would have to be ignored.

The marginal cost is estimated on the basis of a translog cost function with four outputs (total loans, total deposits, other earning assets and non-interest income) and two input prices (price of labour, price of capital). The specification of the translog cost function is shown as below (Tabak et al., 2012):

$$\begin{aligned}\ln\left(\frac{C}{W_2}\right)_{it} &= \delta_0 + \sum_j \delta_j \ln(Y_{jit}) + \frac{1}{2}\sum_j\sum_k \delta_{jk}\ln(Y_{jit})\ln(Y_{kit}) + \beta_1 \ln\left(\frac{W_1}{W_2}\right)_{it} \\ &+ \frac{1}{2}\beta_{11}\ln\left(\frac{W_1}{W_2}\right)_{it}\ln\left(\frac{W_1}{W_2}\right)_{it} + \sum_j \theta_j \ln(Y_{jit})\ln\left(\frac{W_1}{W_2}\right)_{it} + \varepsilon_{it} \quad (2)\end{aligned}$$

where C represents total cost of a bank, Y represents four outputs including total deposits, total loans, non-interest income and other earning assets, W stands for two input prices with W1 representing the price of funds which is measured by the ratio of interest expenses to total deposits, $W2$ represents the price of capital, which is measured by the ratio of non-interest expenses to fixed assets, two input prices are considered due to the

fact that non-interest expenses include the labour cost as well (Hasan and Morton, 2003). In other words, the price of capital considers the factors relating to the price of physical capital as well as the price of human capital. The linear homogeneity is ensured by normalizing the dependent variable and W1 by anther input price $W2$. The summary statistics of the variables are reported in Table 2.

TABLE 2.

Summary statistics

Variables	Observations	Mean	S.D	Min	Max
Total cost (interest expenses and non-interest expenses)	777	3.35	0.97	−0.79	6.86
Price of funds (the ratio of interest expenses to total deposits)	777	1.27	0.18	0.74	1.96
Price of capital (the ratio of non-interest expenses to fixed assets)	776	1.92	0.26	0.68	2.83
Total loans	784	4.59	0.99	0.34	7.95
Securities	782	4.21	1.04	−0.41	7.87
Non-interest income	767	2.34	1.1	−2.4	5.81
Total deposits	784	4.85	0.98	0.66	8.26

The marginal cost of loans can be obtained by taking the first derivative of the dependent variable in the above (equation 2) in relationship to the output loans as follows:

$$MC_{ilt} = \left(\frac{C_{it}/W_2}{Y_{ilt}}\right)\left(\delta_{j=l} + 2\delta_{ll}\ln(Y_{ilt}) + \sum_{k-1,\ldots,k,k\neq l}\delta_{lk}\ln(Y_{ikt}) + \theta_l \ln\left(\frac{W_1}{W_2}\right)\right) \tag{3}$$

The marginal cost of deposit and non-interest income can be obtained similarly by taking the first derivative of the dependent variable in the above (equation 2) in relationship to the outputs deposits and non-interest income as below:

$$MC_{idt} = \left(\frac{C_{it}/W_2}{Y_{idt}}\right)\left(\delta_{j=d} + 2\delta_{dd}\ln(Y_{idt}) + \sum_{k-1,\ldots,k,k\neq d}\delta_{dk}\ln(Y_{ikt}) + \theta_l \ln\left(\frac{W_1}{W_2}\right)\right) \tag{4}$$

$$MC_{int} = \left(\frac{C_{it}/W_2}{Y_{int}}\right)\left(\delta_{j=n} + 2\delta_{nn}\ln(Y_{int}) + \sum_{k-1,\ldots,k,k\neq n}\delta_{nk}\ln(Y_{ikt}) + \theta_l \ln\left(\frac{W_1}{W_2}\right)\right) \tag{5}$$

3.2. Estimation on different types of risk in the Chinese banking industry

This paper investigates different types of risk-taking behaviour in the Chinese banking industry including credit risk, liquidity risk, capital risk, as well as insolvency risk, the current paper uses relevant accounting ratios to measure the former three types of risk. To be more specific, The ratio of non-performing loans to total loans measures the credit risk, the higher figure of this ratio indicates higher credit risk, the ratio of liquid assets to total assets measures the liquidity risk, the higher figure of this ratio shows that the bank has lower liquidity risk; the total regulatory capital ratio measures the capital risk, higher total regulatory capital ratio indicates that the bank has lower capital risk, the last type of risk-taking behaviour is insolvency risk, rather than using the accounting ratio, namely the Z-score[2], the current study uses a translog specification to estimate the stability inefficiency (Tabak et al., 2012) which is supposed to provide more robustness results.

3.2.1. Estimation of stability in the Chinese banking sector-Stability inefficiency

Tabak et al. (2012) argue that the Z-score cannot reflect the potential stability of banks. The deviation from the bank's current stability and the maximum stability is a better measurement. The current study provides a measure of the bank's stability inefficiency by estimating a stochastic frontier (Aigner et al., 1977; Meeusen and Van den Broeck, 1977) with the Z-score as the dependent variable of a translog specification. The frontier has the following form:

$$\ln\left(\frac{Z-score}{W_2}\right)_{it} = \delta_0 + \sum_j \delta_j \ln(Y_{jit}) + \frac{1}{2}\sum_j\sum_k \delta_{jk}\ln(Y_{jit})\ln(Y_{kit}) + \beta_1 \ln\left(\frac{W_1}{W_2}\right)_{it} + \frac{1}{2}\beta_2 \ln\left(\frac{W_1}{W_2}\right)_{it} + \sum_j \theta_j \ln(Y_{jit}) \ln\left(\frac{W_1}{W_2}\right)_{it} + \nu_{it} - v_{it} \quad (7)$$

[2]The Z-score reflects the extent to which banks have the ability to absorb losses. Thus, a higher value of Z-score indicates lower risk and greater stability. The empirical studies comprehensively use the Z-score to measure the stability of financial institutions (Iannotta et al. 2007; Liu and Wilson 2013, Liu et al., 2013). The calculation of Z-score has the following form

$$Z = \frac{ROA + E/A}{\sigma(ROA)} \quad (6)$$

Where ROA is bank's Return on Assets, E/A is the ratio of equity to total assets, is the standard deviation of Return on Assets.

Where W represents input prices, there are two input prices which are price of funds (the ratio of interest expenses to total deposits) and price of capital (the ratio of non-interest expenses to fixed assets). Y represents four outputs which are total loans, total deposits, other earning assets and non-interest income. The sub-index i and t represent bank i operates at time t while j and k represent different outputs. The error term ε_{it} equals $v_{it}-u_{it}$. The first term ν_{it} captures the random disturbance, which is assumed to be normally distributed and represents the measurement errors and other uncontrolled factors, i.e. $\nu_{it} \sim N(0, \sigma_\nu^2)$. The second term v_{it} captures the technical and allocative inefficiency, both under managerial control, and it is assumed to be half-normally distributed, i.e. $v_{it} \sim N^+(\mu_{it}, \sigma_v^2)$. Higher stability inefficiency indicates higher risk while lower stability inefficiency means the risk is lower.

3.3. Estimation on the determinants of bank profitability

The main goal of this paper is to test the impacts of risk and competition on bank profitability in China while controlling for comprehensive bank-specific, industry-specific and macroeconomic variables. There are two profitability indicators considered in the study: Return on Assets (ROA) and Net Interest Margin (NIM). ROA and NIM are used to compare the results with the findings reported in the existing literature.

When estimating bank profitability, either measured by ROA or NIM, a number of challenges are presented. First, it is endogeneity: more profitable banks may be able to increase their equity more easily by retaining profits. The relaxation of the perfect capital markets assumption allows an increase in capital to raise expected earnings. Another important problem is unobserved heterogeneity across banks, which may be very large in the Chinese case given the differences in corporate governance. Finally, the profitability could be very persistent for the Chinese banks because of political interference.

We tackle these three problems together by moving beyond the methodology used in the previous studies on bank profitability. Most previous studies use fixed or random effects[3]. Wooldridge (2002) argues that the fixed effects model produces unbiased and consistent estimates of the coefficients. Arellano and Bover (1995) and Blundell and Bond (2000) argue that more efficient results are expected to be generated by a random effects estimator where a lagged dependent variable is included as an explanatory

[3]Fixed or random effects are used by Maudos and Fernandez de Guerara (2004) and Claeys and Vennet (2008) while Generalized Least Square and Weighted Least Square are employed by Angbazo(1997) and Demirguc-Kunt and Huizinga(1999).

variable. They further suggest that a random effects model generates more efficient results after controlling for possible endogeneity and autocorrelation effect with dynamic lag models. However, the random effect models do not consider the issues of profit persistence and unobserved heterogeneity. In our study, the General Method of Moments (GMM) is selected, which is firstly used by Arellano and Bond (1991). GMM is widely used in the investigation of determinants of bank profitability. For instance, Athanasoglou et al. (2008) apply the GMM to a panel of Greek banks; Liu and Wilson (2010) and Dietrich and Wanzanried (2011) also use the GMM approach for the Japanese and Switzerland banking industries, respectively. This methodology accounts for endogeneity. The GMM estimator uses all available lagged values of the dependent variable plus lagged values of the exogenous regressors as instruments which could potentially suffer from endogeneity. The GMM estimator also controls for unobserved heterogeneity and for the persistence of the dependent variable. Overall, this method yields consistent estimations of the parameters. To be more specific, comparing between difference and system GMM estimators, we prefer the latter because the system GMM estimator addresses the issue of unit root property and produces more precise results (Bond, 2002), while compared to two-step GMM estimator, the one-step estimator is chosen due to the fact that it produces a smaller bias and a smaller standard deviation of the estimation (Judson and Owen, 1999). Besides using the one period lag of profitability indicators, through the Sargan over-identifying test, we confirm that the capital risk will be treated as an endogenous variable, while credit risk will be treated as a predetermined variable, other variables do not suffer any endogenous issue. In order to make sure there is no second order autocorrelation in the estimation, the predetermined variable is instrumented using levels lagged by a one year period, while the endogenous variable is instrumented using levels lagged by two years periods.

This study follows and expands the specification proposed by Athanasoglou et al. (2008), which can be expressed as follows:

$$II_{it} = C + \delta II_{i,t-1} + \sum_{j=1}^{j} \beta_j X_{it}^j + \sum_{l=1}^{l} \beta_l X_{it}^l + \sum_{m=1}^{m} \beta_m X_{it}^m + v_{it} + \mu_{it} \quad (8)$$

Where i refers to year and t refers to an individual bank, II_{it} represents the profitability indicator for the specific bank at a specific year, C is the constant term, $II_{i,t-1}$ is one period lagged profitability. X_{it} are determinants of bank profitability. They are grouped into bank-specific determinants including credit risk, liquidity risk, capital risk, insolvency risk,

bank size, overhead cost and bank diversification X_{it}^{j}; industry-specific determinants including competition in different banking markets, stock market development and banking sector development X_{it}^{l}; and macroeconomic determinants including inflation and GDP growth X_{it}^{m}. The unobserved bank-specific effect and the idiosyncratic error are represented by ν_{it} and μ_{it}, respectively. β_j, β_l, and β_m are coefficients to be estimated, while δ represents the speed of adjustment to equilibrium. Its value ranges from 0 to 1, with a higher figure representing slower adjustment and less competitive structure, while a lower figure indicates that there is a stronger competitive condition and a higher speed of adjustment.

3.4. Data

Our sample consists of data from five SOCBs, twelve JSCBs, and eighty-three CCBs. The sample covers the period 2003-2013 and the bank-specific data is collected from Bankscope database produced by Bureau Van Dijk (www.bvdinfo.com). The industry-specific and macroeconomic variables are retrieved from the website of China Banking Regulatory Commission (www.cbrc.gov.cn) and the World Bank database (data.worldbank.org). Due to the fact that not all the banks have available information every year of the examined period, we opt for an unbalance panel dataset not to lose degrees of freedom. We use two different profit measures which are ROA (Athanasoglou et al., 2008; Garcia-Herrero-et al., 2009) and NIM (Dietrich and Wanzenried, 2011; Athanasoglou et al., 2008; Tan and Floros 2012a, 2012b, 2012c). The bank-specific determinants of profitability include credit risk, liquidity risk, capital risk, insolvency risk, bank size, bank diversification and overhead cost. The industry-specific variables include competition, banking sector development and stock market development. With regards to the macroeconomic determinants, we include both annual inflation rate and annual GDP growth rate. Table 3 provides a summary of the variables used in the current study and their expected effects on bank profitability.

Table 4 shows the summary statistics of the independent variables used in the current study. The table shows that the difference in liquidity risk undertaken by Chinese commercial banks is smaller than the ones for credit risk and capital risk, while the higher levels of credit risk undertaken by Chinese commercial banks are attributed to the fact that during 2003-2006, there are large volumes of non-performing loans in SOCBs, especially in the Agricultural Bank of China. Further, the large difference in capital risk is attributed to the opening of one joint-stock commercial bank; namely, the China Bohai Bank in 2006 which had a total regulatory capital ratio

TABLE 3.

Description of the variables and their impact on bank profitability

Variables	Measurement	Expected effect	Source
Profitability indicators			
ROA	Net income/total assets		Bankscope
NIM	Net interest income/earning assets		Bankscope
Bank-specific variables			
Credit risk	impaired loans/gross loans	-	Bankscope
Liquidity risk	liquid assets/total assets	?	Bankscope
Capital risk	Total regulatory capital ratio	?	Bankscope
Insolvency risk	stability inefficiency	-	Bankscope
bank size	natural logarithm of total assets	+	Bankscope
Bank diversification	Non-interest income/gross revenue	+	Bankscope
Overhead cost	Overhead expenses/total assets	?	Banksocpe
Industry-specific variables			
Bank competition	Boone indicator	+	
Banking sector development	Banking sector assets/GDP	+	China Banking Regulatory Commission
Stock market development	Market capitalization of listed companies/GDP	+	World Bank
Macroeconomic variables			
Inflation	Annual inflation rate	?	World Bank
GDP growth	Annual GDP growth rate	-	World Bank

of over 60%. The data indicates that Chinese banks have big differences in the degree of diversified activities engaged in. The difference in bank size is attributed to the fact that SOCBs are bigger than JSCBs, while CCBs are the smallest. The statistics show further that there is a stronger volatility with regard to the development of the stock market than of the banking sector and the macroeconomic environment. The stronger volatility of stock market development can be attributed mainly to the segregation reform initiated by the Chinese government in 2005 which led to a substantial amount of companies being listed on the stock exchange. By the end of 2007, there were 1550 listed companies on the Shanghai and Hong Kong Stock Exchanges, the value of which reached RMB 32.71 billion, accounting for 132.6% of GDP in that year.

TABLE 4.

Descriptive statistics of all variables considered in this study

Variables	Observations	Mean	S.D	Min	Max
Credit risk	632	2.78	4.48	0	41.86
Liquidity risk	777	0.27	0.11	0.02	0.67
Capital risk	637	11.91	4.7	0.62	62.62
Insolvency risk	1100	0.33	0.21	0.025	0.789
Bank size	843	4.9	0.992	0.71	8.51
Bank diversification	828	13.98	13.31	−12.94	79.4
Overhead cost	788	0.01	0.004	0.002	0.04
Banking sector development	1100	2.22	0.24	1.98	2.66
Stock market development	1027	71.2	43.49	31.9	184.1
Inflation	1227	2.86	1.92	−0.77	5.86
GDP growth rate	1199	10.19	1.87	7.7	14.2

4. EMPIRICAL RESULTS

Tables 5a-5d present the descriptive statistics of the two different profitability measures (ROA and NIM) for the whole Chinese banking industry as well as for different ownership types. The table shows that the profitability of CCBs is the highest over the examined period which is followed by

SOCBs while the profitability of JSCBs is the lowest. When looking at the profitability of different ownership types of Chinese commercial banks on a year by year basis, Figure 1 shows that, in general, SOCBs and CCBs have higher profitability than JSCBs.

TABLE 5.

5a: Descriptive statistics for profitability measures of Chinese banking industry

	Observations	Mean	Standard deviation	Minimum	Maximum
ROA	808	0.0088	0.0066	−0.04	0.106
NIM	799	3.04	1.13	0.42	8.99

5b: Descriptive statistics for profitability measures of state-owned commercial banks

	Observations	Mean	Standard deviation	Minimum	Maximum
ROA	55	0.009	0.004	0.0002	0.014
NIM	56	2.57	0.41	1.05	3.29

5c: Descriptive statistics for profitability measures of joint-stock commercial banks

	Observations	Mean	Standard deviation	Minimum	Maximum
ROA	127	0.006	0.006	−0.04	0.0133
NIM	131	2.43	0.477	0.68	3.42

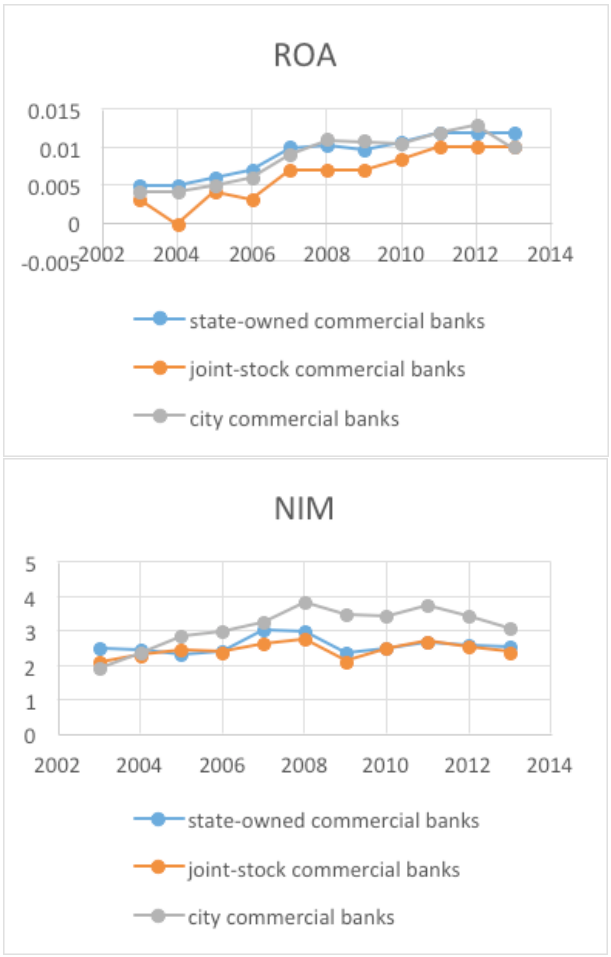
5d: Descriptive statistics for profitability measures of city commercial banks

	Observations	Mean	Standard deviation	Minimum	Maximum
ROA	598	0.0093	0.007	−0.005	0.106
NIM	612	3.22	1.22	0.42	8.99

It is noticed that over the period 2006-2013, the competitive condition in the deposit market, loan market and non-interest income market were the same, the main difference is noticed during the period 2003-2005. Figure 2 shows that the competitive conditions in the non-interest income market is the highest in general between 2003-2005 compared to the other two markets while the competitive condition in the loan market and the deposit market were the same over the same period.

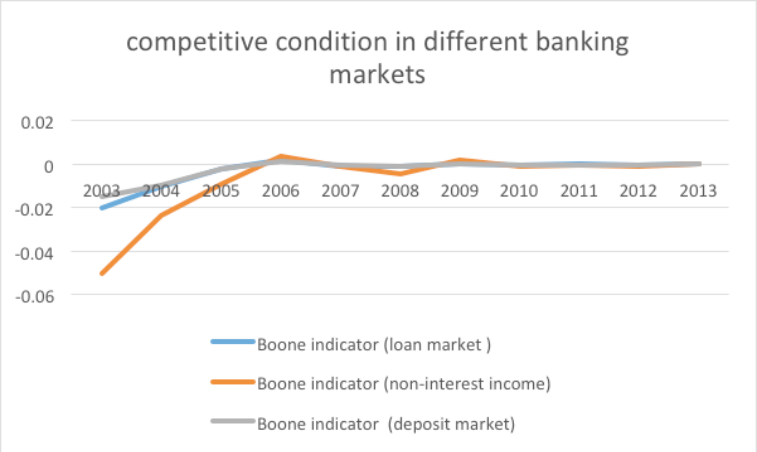
Figures 3a, 3b, 3c, and 3d report the risk conditions of Chinese banks over the period 2003-2013. Figure 3a shows that the credit risk of SOCBs is substantially higher than that of JSCBs and CCBs between 2003 and 2008. Although after 2008 these three types of banks have a smaller difference in the level of credit risk undertaken, the credit risk of CCBs is higher than that of JSCBs between 2005 and 2010. Figure 3b shows that in general,

FIG. 1. The profitability of three different ownership types of Chinese commercial banks over the period 2003-2013



the ratio of liquid assets to total assets for SOCBs is lower than that of JSCBs and CCBs; in other words, the SOCBs have the highest liquidity risk. However, liquidity is the highest in CCBs from 2005 to 2008 and in JSCBs after 2010. In general, the capital level of CCBs kept increasing for most of the years examined, with slight decreases in some years (Figure 3c). The capital level of SOCBs and JSCBs increased in 2010 compared to the previous year. Figure 3d shows insolvency risk year by year, as measured

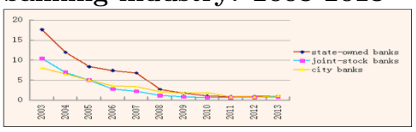
FIG. 2. Competitive condition in different banking markets in China over 2003-2013



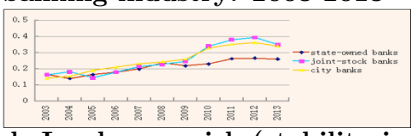
by the stability inefficiency. Risk conditions from 2003 to 2006 were highly volatile, but they became less so between 2007 and 2013.[4]

FIG. 3. Risk conditions in the Chinese banking industry: 2003-2013

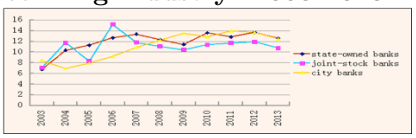
a: Credit risk in the Chinese banking industry: 2003-2013



b: Liquidity risk in the Chinese banking industry: 2003-2013



c: Capital risk in the Chinese banking industry: 2003-2013



d: Insolvency risk (stability inefficiency) in the Chinese banking industry: 2003-2013

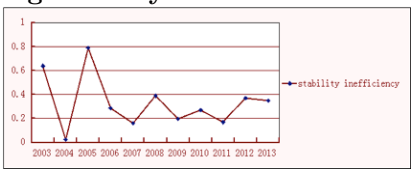


Table 6 shows the results with regard to the impacts of risk and competition in different banking markets on bank profitability in China. The F statistic shows that the variables in the model are jointly significant while

[4]For the estimation of insolvency risk, we follow Tan (2016) by estimating stability inefficiency derived from a translog specification with Z-score as the dependent variable. Four outputs (total loans, total deposits, other earning assets, and noninterest income) and two input prices (price of funds and price of capital) are considered.

the Sargan test statistic shows that there are no over-identified restrictions. The results further indicate that the first-order autocorrelation is present for all the cases while the second-order autocorrelation is rejected, which guarantees the consistency of the results. The finding shows that the lagged dependent variable (either ROA or NIM) is significant and positive, which indicates that the dynamic specification of the model is correct, while the significant and positive signs of the lagged dependent variables further suggest that the profitability of Chinese commercial banks in the current year is significantly and positively affected by its previous year's profitability. The values of both of these two coefficients are less than 0.4, which means that the profitability of Chinese commercial banks does not persist to a large extent. This result is in line with the findings of Tan (2016).

With regard to the bank-specific determinant of profitability, the results report that liquidity risk is significantly and negatively related to ROA and NIM of Chinese commercial banks, indicating that Chinese commercial banks with higher levels of liquidity (lower levels of liquidity risk) have higher profitability. This is in contrast with the findings of Molyneux and Thornton (1992). Our results can be explained by the fact that higher liquidity (lower liquidity risk) reduces the borrowing cost for banks, which further proceeds an improvement in bank profitability.

The table further suggests that Chinese commercial banks with higher levels of capital risk have higher bank profitability in terms of ROA. This result is in accordance with Berger (1995b). Chinese commercial banks have lower levels of capital to some extent can be explained by the fact that they use certain amount of capital in engaging in the traditional and non-traditional banking activities, a larger amount of business leads to an improvement in bank profitability.

The results indicate that bank size is significantly and negatively related to bank profitability, as reflected by the significant and negative signs of the variable. This result is in accordance with the finding of Goddard to al. (2001). The negative impact of size on bank profitability can be explained by the fact that large banks are difficult to be managed (Tan and Floros, 2012a), which induces a larger amount of efforts and the resulted increase in the cost leads to a decline in bank profitability.

Overhead cost is found to be significantly and positively related to bank profitability, indicating that Chinese commercial banks with higher levels of overhead cost have higher profitability. This result is different from the finding reported by Tan and Floros (2012b). however, our results can be explained by the efficiency wage theory, which argues that higher cost derived from higher wage/salary to bank staff is supposed to significantly

TABLE 6.
Empirical results: The impacts of competition and risk on bank profitability (whole sample)

	ROA		NIM	
	Coefficient	t-statistic	Coefficient	t-statistic
Lag of dependent variable	0.08^{**}	2.53	0.36^{***}	9.34
Bank characteristics				
Credit risk	−0.0001	−1.40	0.09^{*}	1.72
Liquidity risk	0.0003^{**}	2.06	0.05^{***}	3.57
Capital risk	-0.005^{**}	−2.24	−0.92	−0.68
Insolvency risk	−0.001	−0.37	−0.05	−0.09
Bank size	-0.0003^{**}	−2.10	-0.13^{***}	−2.73
Overhead cost	0.18^{***}	3.05	136.76^{***}	10.28
Bank diversification	0.00003^{**}	2.14	-0.04^{***}	−3.35
Industry characteristics				
Boone indicator (loan)	-4.91^{***}	−4.19	−365.23	−1.48
Boone indicator (deposit)	5.38^{***}	3.63	310.61^{**}	2.60
Boone indicator (non-interest income)	0.1	0.19	75.4	0.80
Banking sector development	0.005^{***}	4.59	0.41	1.44
Stock market development	-0.00003^{***}	−2.66	-0.006^{***}	−2.68
Macroeconomics				
Inflation	0.0004^{***}	3.29	0.1^{***}	4.47
GDP growth rate	−0.0001	−0.88	0.06^{***}	2.64
F test	339.02^{***}		1275.24^{***}	
Sargan test	57.73		30.95	
AR(1)	−5.68	0.000	−3.63	0.000
AR(2)	−1.01	0.312	−1.16	0.248
No. of observations	409		387	

*, ** and *** denote significance at 10%, 5% and 1% levels, respectively.

increase the labor productivity, the resulted improvement in revenue exceeds the labor cost. Therefore, higher overhead cost leads to higher bank profitability.

Our results show that bank diversification is significantly related to bank profitability, however, the sign of the variable is different between ROA and NIM. To be more specific, the findings suggest that Chinese commercial banks with a higher degree of business diversification have higher ROA but lower NIM. Due to the fact that ROA focuses on bank's ability to generate income from total assets, which considers both the interest generating business as well as non-interest income activities, in comparison, NIM concentrates on the interest-generating activities only. Our results underline

TABLE 7.
Empirical results: The impacts of competition and risk on bank profitability (loan market)

	ROA		NIM	
	Coefficient	t-statistic	Coefficient	t-statistic
Lag of dependent variable	0.07**	2.29	0.36***	10.13
Bank characteristics				
Credit risk	−0.0002**	−2.06	0.05	1.15
Liquidity risk	0.0004**	2.52	0.05***	3.73
Capital risk	−0.003	−1.62	−0.23	−0.20
Insolvency risk	−0.003**	−2.27	−0.26	−1.41
Bank size	−0.0004**	−2.46	−0.14***	−3.10
Overhead cost	0.13**	2.18	134.87***	11.01
Bank diversification	0.00004**	2.23	−0.04***	−3.66
Industry characteristics				
Boone indicator	0.19*	1.84	45.9**	2.48
Banking sector development	0.004***	4.78	0.37	1.52
Stock market development	2.47e-06	0.46	−0.003***	−3.28
Macroeconomics				
Inflation	0.0005***	5.66	0.07***	5.05
GDP growth rate	−0.0003***	−2.67	0.05**	2.59
F test	341.7***		1746.16***	
Sargan test	68.90		39.55	
AR(1)	−5.95	0.000	−3.56	0.000
AR(2)	−0.83	0.405	−1.54	0.123
No. of observations	409		387	

*, ** and *** denote significance at 10%, 5% and 1% levels, respectively.

that Chinese commercial banks with more diversified business can generate higher income while more resources/funds used in engaging in the non-interest generating business reduces the volumes of traditional loan business, which further proceeds a decrease in NIM of Chinese commercial banks.

In terms of the industry-specific determinants of bank profitability, in particular, the impacts of competition in different banking markets on bank profitability, the results show that higher levels of competition in the loan market lead to higher ROA of Chinese commercial banks. This is attributed to the fact that a higher competitive loan market can be an indicator that there is a business boom in the economy, and different companies seeking the loans have lower default risk while the reduction in the

TABLE 8.
Empirical results: The impacts of competition and risk on bank profitability (deposit market)

	ROA		NIM	
	Coefficient	t-statistic	Coefficient	t-statistic
Lag of dependent variable	0.07**	2.32	0.36***	9.95
Bank characteristics				
Credit risk	−0.0001*	−1.96	0.06	1.28
Liquidity risk	0.0003**	2.43	0.05***	3.70
Capital risk	−0.004*	−1.67	−0.34	−0.29
Insolvency risk	−0.003**	−2.36	−0.31	−1.59
Bank size	−0.0004**	−2.40	−0.15***	−2.99
Overhead cost	0.13**	2.28	135.61***	10.97
Bank diversification	0.00004**	2.22	−0.04***	−3.61
Industry characteristics				
Boone indicator	0.25**	2.24	65.12***	2.69
Banking sector development	0.004***	4.87	0.39	1.57
Stock market development	9.03e-07	0.16	−0.003***	−3.63
Macroeconomics				
Inflation	0.0005***	5.83	0.08***	5.07
GDP growth rate	−0.0003***	−2.62	0.05***	2.53
F test	345.39***		1690.50***	
Sargan test	68.09		37.73	
AR(1)	−5.95	0.000	−3.58	0.000
AR(2)	−0.82	0.409	−1.46	0.145
No. of observations	409		387	

*, ** and *** denote significance at 10%, 5% and 1% levels, respectively.

cost of monitoring the loans leads to an increase in bank profitability. In comparison, the findings suggest that a higher competitive deposit market leads to a decline in bank profitability (ROA and NIM). This can be mainly explained by the fact that in a higher competitive deposit market, banks will try to increase the deposit interest rate, the resulted increase in the interest expenses leads to a decline in NIM. Furthermore, more efforts and resources will be given by the bank to attract more deposits from the market, the resulted increase in the cost leads to a decline in ROA.

Banking sector development is found to be significantly and positively related to bank profitability (ROA). This can be explained by the fact that in a higher developed banking market, there will be a higher volume of demand for banking products (Tan and Floros, 2012a). This result indi-

TABLE 9.
Empirical results: The impacts of competition and risk on bank profitability (non-interest income market)

	ROA		NIM	
	Coefficient	t-statistic	Coefficient	t-statistic
Lag of dependent variable	0.08**	2.29	0.36***	10.08
Bank characteristics				
Credit risk	−0.0001**	−2.02	0.06	1.21
Liquidity risk	0.0004**	2.49	0.05***	3.75
Capital risk	−0.003	−1.65	−0.27	−0.23
Insolvency risk	−0.002*	−1.93	−0.14	−0.83
Bank size	−0.0004**	−2.41	−0.44***	−3.08
Overhead cost	0.13**	2.24	134.51***	10.89
Bank diversification	0.00004**	2.22	−0.04***	−3.61
Industry characteristics				
Boone indicator	0.096**	2.11	20.29**	2.49
Banking sector development	0.004***	4.74	0.35	1.44
Stock market development	5.18e-07	0.09	−0.003***	−3.64
Macroeconomics				
Inflation	0.0005***	5.74	0.08***	5.08
GDP growth rate	−0.0003**	−2.54	0.06***	2.78
F test	342.70***		1719.92***	
Sargan test	68.28		38.6	
AR(1)	−5.99	0.000	−3.58	0.000
AR(2)	−0.79	0.431	−1.50	0.134
No. of observations	409		387	

*, ** and *** denote significance at 10%, 5% and 1% levels, respectively.

cates that there will be a significant increase in the demand of non-interest generating business in a higher developed banking market, which proceeds a significant increase in ROA but not NIM. The stock market development is found to be significantly and negatively related to ROA and NIM of Chinese commercial banks, indicating that Chinese commercial banks have lower profitability in a higher developed stock market. In a higher developed stock market, rather than investing the money in purchasing the non-interest generating products, the investors are more likely to invest the money in the stock market, which leads to a decline in ROA. Furthermore, for different companies, they will also go to the stock market rather than the banks to raise funds for their operation under the environment of higher developed stock market, this will proceed a decline in the volumes of loan

granted by the banks and further result in a decrease in NIM of Chinese commercial banks.

Finally, with regard to the macroeconomic determinants of bank profitability, the findings suggest that Chinese commercial banks have higher profitability in terms of ROA and NIM in a higher inflationary environment. The higher inflationary environment is associated with higher loan interest rate, which will increase the bank profitability (Tan and Floros, 2012a). In theory, this result indicates that Chinese commercial banks have the ability to anticipate the interest rate and adjust the interest rate accordingly (Perry, 1992). Finally, the results suggest that in a period of higher economic growth, Chinese commercial banks have higher NIM. This is in line with the findings of Demirguc-Kunt and Huizinga (1999) and can be explained by the fact that the demand for lending increases during cyclical upswings.

In order to check the robustness of the results, we estimate the impacts of risk and competition on bank profitability by using just one specific competition indicator for a specific banking market in the model. To be more specific, Table 7, Table 8 and Table 9 test the impact of competition in the loan market, deposit market and non-interest market on bank profitability while controlling for other bank profitability determinants. We confirm some of the findings reported from Table 7 as follows: 1) bank profitability in terms of ROA and NIM is significantly and positively affected by the past year's profitability; 2) liquidity risk is significantly and negatively related to the profitability of Chinese commercial banks; 3) large Chinese commercial banks have lower levels of ROA and NIM; 4) Chinese commercial banks with higher levels of business diversification have higher levels of ROA but lower levels of NIM; 5) higher developed banking sector leads to higher levels of ROA of Chinese commercial banks; 6) higher developed stock market leads to lower levels of NIM; 7) Chinese commercial banks have higher levels of ROA and NIM during the periods of higher inflation; 8) during the periods of economic boom, Chinese commercial banks have higher levels of NIM; 9) Chinese commercial banks have higher levels of profitability in a lower competitive deposit market.

Not only for the whole sample but more importantly, we test the impacts of competition in different banking markets on bank profitability for different ownership types. To be more specific, we test the impact of competition in the different markets on bank profitability for state-owned commercial banks, joint-stock commercial banks as well as city commercial banks, the results of which are reported in Table 10, Table 11, and Table 12, respectively. With regard to the state-owned commercial banks, Table 10 shows

TABLE 10.

Empirical results: The impacts of competition and risk on bank profitability (state-owned banks and all indicators)

	ROA		NIM	
	Coefficient	t-statistic	Coefficient	t-statistic
Lag of dependent variable	0.47***	3.60	0.27**	2.46
Bank characteristics				
Credit risk	0.001	1.29	−0.06	0.91
Liquidity risk	0.001**	2.18	0.02	0.48
Capital risk	−0.03**	−2.39	0.45	0.31
Insolvency risk	−0.01	−1.33	1.002	0.98
Bank size	−0.00002	−0.01	0.02	0.10
Overhead cost	0.16	0.55	98.13*	1.98
Bank diversification	0.00001	0.24	−0.03***	−3.70
Industry characteristics				
Boone indicator (loan)	−7.88**	−2.35	−806.5*	−1.78
Boone indicator (deposit)	11.03***	2.82	357.87*	1.72
Boone indicator (non-interest income)	−0.83	−0.63	225.48	0.28
Banking sector development	0.004	1.18	−0.06	−0.12
Stock market development	−0.00004	−1.53	−0.006	−1.57
Macroeconomics				
Inflation	0.0002	0.68	0.09**	2.65
GDP growth rate	−0.0005	−1.29	0.06	1.02
F test	129.90***		370.46***	
Sargan test	48.79		48.21	
AR(1)	−0.31	0.760	−0.49	0.662
AR(2)	−1.28	0.200	−0.45	0.654
No. of observations	40		41	

*, ** and *** denote significance at 10%, 5% and 1% levels, respectively.

that the profitability in the current year is significantly affected by the previous year's profitability and state-owned commercial banks with higher levels of liquidity risk have lower levels of ROA. In addition, the results report that state-owned commercial banks with higher levels of capital risk have higher levels of ROA. State-owned commercial banks with higher levels of overhead cost are found to have higher levels of NIM. Finally, it is shown from the table that state-owned commercial banks engaging in more diversified business have lower NIM, while the coefficient of this variable is insignificant for ROA, indicating that for Chinese state-owned commercial banks, the traditional interest generating activities contribute more to the overall profitability compared to the non-interest generating activities. It

is further argued that in a higher competitive loan market, state-owned commercial banks have higher ROA and NIM while a higher competitive deposit market leads to lower profitability of Chinese state-owned commercial banks. Finally, it is found that Chinese state-owned commercial banks have higher profitability (NIM) in a higher inflationary environment.

TABLE 11.

Empirical results: The impacts of competition and risk on bank profitability (joint-stock banks and all indicators)

	ROA		NIM	
	Coefficient	t-statistic	Coefficient	t-statistic
Lag of dependent variable	0.16	1.12	0.29^{***}	3.59
Bank characteristics				
Credit risk	0.0002	0.69	0.013	0.71
Liquidity risk	0.0004^{**}	2.40	0.03	1.62
Capital risk	0.0004	0.08	0.14	0.25
Insolvency risk	−0.00005	−0.01	1.28^{*}	1.95
Bank size	0.01	1.36	0.22^{**}	2.86
Overhead cost	0.16	0.91	107.13^{***}	5.54
Bank diversification	0.0001^{*}	1.87	-0.01^{**}	−2.04
Industry characteristics				
Boone indicator (loan)	-4.75^{*}	−1.71	-752.22^{**}	−2.66
Boone indicator (deposit)	4.43^{*}	1.70	114.66	1.26
Boone indicator (non-interest income)	0.43	0.36	292.5^{**}	2.67
Banking sector development	−0.002	−0.91	-0.66^{***}	−3.10
Stock market development	−0.00004	−1.57	-0.009^{***}	−3.50
Macroeconomics				
Inflation	0.0001	0.72	0.11^{***}	6.39
GDP growth rate	0.00004	0.15	0.09^{***}	3.42
F test	84.44^{***}		776.77^{***}	
Sargan (p value)	42.84		94.98	
AR(1)	−2.47	0.013	−2.14	0.032
AR(2)	−0.98	0.329	0.57	0.570
No. of observations	65		66	

*, ** and *** denote significance at 10%, 5% and 1% levels, respectively.

In terms of the joint-stock commercial banks, which is reported from Table 11, the findings suggest that the NIM in the current year is significantly affected by the previous year's NIM, while the lagged ROA is not significant. This finding to some extent reflects the fact that joint-stock commercial banks' profitability derived from the non-interest generating business does not persistent, while in comparison, the profitability of the

traditional interest generating business tends to persist. This can be explained by the fact that compared to the state-owned commercial banks, joint-stock commercial banks have higher competition in the area of non-interest generating business. Liquidity risk is found to be significantly and negatively related to ROA of joint-stock commercial banks. The results report that larger joint-stock commercial banks have higher levels of NIM, this is attributed to the fact that large joint-stock commercial banks engage in larger volumes of loan business, the resulted reduction in the cost from economies of scale leads to higher NIM. Different from the state-owned commercial banks, the findings show insolvency risk leads to an increase in NIM of joint-stock commercial banks. This can be explained by the fact that, joint-stock commercial banks have more incentive and take more efforts to monitor the loan business during the periods of higher volatility of insolvency, the reduction in the volume of non-performing loans leads to an improvement in NIM. Same as the results reported for the state-owned commercial banks, joint-stock commercial banks with higher levels of overhead cost have higher NIM. Compared to the state-owned commercial banks, it is found that joint-stock commercial banks engaging in more diversified business have higher profitability while the impact is negative for NIM. These results reflect the fact that compared to the state-owned commercial banks, non-interest generating activities contribute more than the traditional interest generating business to the overall bank profitability. It is found that a higher competitive loan market leads to higher ROA and NIM of joint-stock commercial banks while joint-stock commercial banks have higher ROA in a lower competitive deposit market. We find that in a lower competitive non-interest income market, joint-stock commercial banks have higher levels of NIM. This can be explained by the fact that for joint-stock commercial banks, a lower competitive non-interest income market induces bank managers to put more efforts in the loan business, and more importantly, more funds will be available and transferred from the non-interest income generating business to the loan business, higher volumes of loan business engaged in by joint-stock commercial banks together with better risk monitoring and management leads to an improvement in NIM. Higher developed banking sector leads to a decline in NIM of joint-stock commercial banks. As argued previously, there will be a higher volume of demand for banking business when there is a higher developed banking sector, these results indicate that joint-stock commercial banks have less efforts in monitoring the loan business, which leads to a decline in NIM. The results further show that stock market development has a significant and negative impact on NIM of joint-stock commercial

banks. Finally, it is found that both inflation and GDP growth rate have significant and positive impacts on NIM for joint-stock commercial banks.

TABLE 12.

Empirical results: The impacts of competition and risk on bank profitability (city banks and all indicators)

	ROA		NIM	
	Coefficient	t-statistic	Coefficient	t-statistic
Lag of dependent variable	0.07**	2.05	0.61***	6.71
Bank characteristics				
Credit risk	−0.0001	−1.24	0.013	0.31
Liquidity risk	0.0001	0.49	0.036**	2.20
Capital risk	−0.003	−1.09	−0.6	−0.56
Insolvency risk	−0.002	−0.48	−0.27	−0.36
Bank size	−0.0001	−0.22	−0.14*	−1.93
Overhead cost	0.15**	2.26	110.27***	6.50
Bank diversification	0.00005**	2.46	−0.03***	−3.78
Industry characteristics				
Boone indicator (loan)	−5.01***	−3.35	−197.37	−0.63
Boone indicator (deposit)	5.99***	2.96	293.5	1.43
Boone indicator (non-interest income)	−0.06	−0.09	−20.7	−0.17
Banking sector development	0.006***	4.20	0.1	0.30
Stock market development	−0.00002*	−1.76	−0.006**	−2.03
Macroeconomics				
Inflation	0.0004***	2.82	0.07***	2.72
GDP growth rate	−0.0003*	−1.71	0.1***	3.10
F test	206.08***		772.58***	
Sargan(p value)	48.94		36.95	
AR(1)	−4.50	0.000	−3.50	0.000
AR(2)	−0.77	0.442	−1.42	0.155
No. of observations	304		208	

*, ** and *** denote significance at 10%, 5% and 1% levels, respectively.

Table 12 reports the results with regard to the impact of competition in different banking markets on bank profitability for city commercial banks. The findings suggest that the profitability of city commercial banks in the current year is significantly and positively affected by the previous year's profitability. The profitability of interest generating business (loan business) tends to be persisted to a larger extent compared to the overall bank profitability as reflected by the coefficients, this reflects the fact that there is a stronger competition in the non-interest activities compared to the loan business for city commercial banks. Liquidity risk is found to be signifi-

cantly and negatively related to NIM of city commercial banks. Bank size is found to be significantly and negatively related to NIM of city commercial banks, this can be explained by the fact that larger city commercial banks take more efforts and resources to engage in the non-interest generating activities, less amount of funds available for the traditional loan business reduces the banks' NIM. Overhead cost is found to be significantly and positively related to the profitability of city commercial banks, which is in line with the efficiency wage theory. It is further reported from the table that city commercial banks with more diversified business have higher ROA but lower NIM, this finding reflects the fact that non-interest generating activities contribute more to the overall profitability of city commercial banks.

With regard to the industry-specific and macroeconomic determinants of profitability, the results show that a higher competitive loan market leads to higher ROA of city commercial banks, while a higher competitive deposit market reduces the banks' ROA. The results further report that in a higher developed banking sector, ROA of city commercial banks increases but with no significant impact on NIM. We explain this finding by the fact that higher demand for banking services derived from higher developed banking sector focuses on the non-interest generating products. Because individual investors as well as different companies are more likely to invest their funds or raise money to/from the stock market rather than the banking market, the reduction in the volumes of traditional interest generating business as well as non-interest generating activities decreases the bank profitability, as reflected by the significant and negative coefficient of stock market development. Same as the findings reported previously, inflation is found to be significantly and positively related to the profitability of city commercial banks. Finally, GDP is found to be significantly and positively related to NIM of city commercial banks, but significantly and negatively related to ROA. This finding can be explained by the fact that during the periods of economic boom, city commercial banks mainly concentrate on the traditional interest-generating business, as discussed previously, non-interest generating activity contributes more to the overall profitability of city commercial banks, and the reduction in the volumes of non-interest generating business reduces the overall profitability of city commercial banks.

5. CONCLUSION

This study uses a sample of Chinese commercial banks (state-owned commercial banks, joint-stock commercial banks, and city commercial banks) over the period 2003-2013 to test the impacts of competition in different banking markets and different types of risk on bank profitability. Three different banking markets are analyzed which include the deposit market, loan market as well as the non-interest income market. The current study contributes to the empirical banking literature by using the stability inefficiency rather than Z-score as the indicator of insolvency risk and also the robustness of the results is cross checked by including the competition in the three different banking markets separately in the empirical estimation. The study also contributes to the banking studies by testing the impacts of competition and risk on profitability for different ownership types of Chinese commercial banks.

The findings suggest that for the whole bank sample being examined, the profitability of Chinese commercial banks tend to persist, although the extent is not very large. In other words, the profitability of Chinese commercial banks in the current year is significantly affected by the previous year's profitability. The results further suggest that Chinese commercial banks with higher levels of liquidity risk have lower levels of profitability. It is found that bank size has a significant and negative impact on profitability of Chinese commercial banks, and Chinese commercial banks with more diversified business have higher levels of ROA but lower levels of NIM. Higher developed banking sector is found to increase the banks' ROA while higher developed stock market has a significant and negative impact on NIM of Chinese commercial banks. The findings show that bank profitability in China is significantly and positively affected by inflation and GDP growth rate. Finally, a higher competitive deposit market leads to lower profitability of Chinese commercial banks.

With regard to the impact of competition on profitability for different ownership types of commercial banks, the results suggest that a higher competitive loan market leads to higher profitability of all these three types of banks while the impact of deposit market competition is significant and negative. The difference or special characteristics with regard to the determinants of profitability among these three different types of banks can be summarized as follows: 1) state-owned commercial banks with higher levels of capital risk have higher levels of profitability; 2) insolvency risk has a significant and positive impact on profitability for joint-stock commercial banks; 3) banking sector development has no impact on state-owned com-

mercial banks, while different impacts have been exhibited for joint-stock commercial banks and city commercial banks; 4) stock market development has a significant impact on the profitability of joint-stock and city commercial banks, while the impact is insignificant for state-owned commercial banks; 5) higher levels of GDP growth rate lead to higher NIM but lower ROA of city commercial banks.

The results of the current paper provides important implications to Chinese government as well as banking regulatory authorities to make relevant policies to reform the banking sector and further improve the bank performance as follows: 1) Chinese commercial banks should be required to hold higher levels of liquidity; 2) relevant policy should be established and implemented to attract people with higher levels of professional knowledge and experience through higher salaries and also the staff should be better and more motivated through bonus to improve their productivity; 3) Chinese commercial banks should further explore the business areas in terms of non-interest generating activities; 4) relevant monetary policy should be implemented to increase the competition in the loan market while better regulation of deposit market is needed to reduce its competition; 5) relevant policy should be introduced to balance the inflation and bank profitability. More specifically, with regard to different ownership types of Chinese commercial banks, the following policies can be made: 1) state-owned commercial banks can adjust the capital levels in a more appropriate way, i.e. reduce the capital level to a certain extent; 2) liquidity and capital levels of joint-stock commercial banks can be reduced to a certain extent to balance the increase in the level of risk and the increase in the level of profitability.

REFERENCES

Aigner, Dennis, C. A. Knox Lovell, and Peter Schmidt, 1977. Formulation and estimation of stochastic frontier production function models. *Journal of Econometrics* **6**, 21-37.

Angbanzo, Lazarus, 1997. Commercial bank net interest margins, default risk, interest-rate risk and off-balance sheet banking. *Journal of Banking and Finance* **21**, 55-87.

Anginer, Deniz, Asli Demirguc-Kunt, and Min Zhu, 2014. How does competition affect bank systemic risk? *Journal of Financial Intermediation* **23**, 1-26.

Arellano, Manuel and Stephen Bond, 1991. Some test of specification for panel data: Monta Carlo evidence and an application to employment equations. *Review of Economic Studies* **58**, 277-297.

Arellano, Manuel and Olympia Bover, 1995. Another look at the instrumental variable estimation of error-components models. *Journal of Econometrics* **68**, 29-51.

Athanasoglou, Panayiotis P., Sophocles N. Brissimis, and Matthaios D. Delis, 2008. Bank-Specific, Industry-Specific and Macroeconomic Determinants of Bank Prof-

itability. *Journal of International Financial Markets, Institutions and Money* **18**, 121-136.

Berger, Allen N., 1995a. The Profit-Structure Relationship in Banking-Test of Market-Power and Efficient-Structure Hypotheses. *Journal of Money, Credit and Banking* **27**, 404-431.

Berger, Allen N., 1995b. The relationship between capital and earnings in banking. *Journal of Money, Credit and Banking* **27**, 432-456.

Blundell, Richard and Steve Bond, 2000. GMM estimation with persistent panel data: an application to production functions. *Econometric Reviews* **19**, 321-340.

Bond, Stephen, 2002. Dynamic panel data models: a guide to micro data methods and practice. *Portuguese Economic Journal* **1**, 141-162.

Boone, Jan, Rachel Griffith, and Rupert Harrison, 2004. Measuring competition, presented at the Encore Meeting.

Boone, Jan, 2008. A new way to measure competition. *The Economic Journal* **118**, 1245-1261.

Bourke, Phillip, 1989. Concentration and other determinants of bank profitability in Europe, North America and Australia. *Journal of Banking and Finance* **13**, 65-79.

Boone, Jan and Jurgen Weigand, 2000. Measuring competition: how are cost differentials mapped into profit differentials. CPB working document, no. 131.

Claeys, Sophie and Rudi Vander Vennet, 2008. Determinants of bank interest margins in central and Eastern Europe: a comparison with the west. *Economic Systems* **32**, 197-216.

Degryse, Hans and Steven Ongena, 2007. The impact of competition on bank orientation. *Journal of Financial Intermediation* **16**, 399-424.

Demirguc-Kunt, Asli and Harry Huizinga, 1999. Determinants of commercial bank interest margins and profitability: some international evidence. *World Bank Economic Review* **13**, 379-408.

Demsetz, Harold, 1973. Industry structure, market rivalry and public policy. *Journal of Law and Economics* **16**, 1-19.

Dietrich, Andreas and Gabrielle Wanzenried, 2011. Determinants of bank profitability before and during the crisis: evidence from Switzerland. *Journal of International Financial Markets, Institutions and Money* **3**, 307-327.

Garcia-Herrero, Alicia, Sergio Gavila, and Daniel Santabarbara, 2009. What explains the low profitability of Chinese banks? *Journal of Banking and Finance* **31**, 2080-2092.

Goddard, John A., Philip Molyneux, and John O. S. Wilson, 2001. European banking: efficiency, technology and growth. Chichester: Wiley.

Goldberg, Lawrence G. and Anoop Rai, 1996. The Structure-Performance Relationship for European Banking. *Journal of Banking and Finance* **20**, 617-645.

Hasan, Iftekhar and Katherin Morton, 2003. Development and efficiency of the banking sector in a transitional economy: Hungarian experience. *Journal of Banking and Finance* **27**, 2249-2271.

Heffernan, Shelagh A. and Xiaoqing Fu, 2010. Determinants of financial performance in Chinese banking. *Applied Financial Economics* **20**, 1585-1600.

Iannotta, Giuliano, Giacomo Nocera, and Andrea Sironi, 2007. Ownership structure, risk and performance in the European banking industry. *Journal of Banking and Finance* **31**, 2127-2149.

Judson, Ruth A. and Ann L. Owen, 1999. Estimating dynamic panel data models: a guide for macroeconomics. *Economics Letters* **65**, 9-15.

Liu, Hong and John O.S. Wilson, 2010. The profitability of banks in Japan. *Applied Financial Economics* **20**, 1851-1866.

Liu, Hong and John O. S. Wilson, 2013. Competition and risk in Japanese banking. *European Journal of Finance* **19**, 1-18.

Liu, Hong, Philip Molyneux, and John O. S. Wilson, 2013. Competition and stability in European banking: a regional analysis. *The Manchester School* **81**, 176-201.

Maudos, Joaquin and Juan Fenandez de Guevara, 2004. Factors explaining the interest margin in the banking sectors of the European Union. *Journal of Banking and Finance* **28**, 2259-2281.

Meeusen, W, and J. van den Broeck, 1977. Technical efficiency and dimension of the firm: some results on the use of frontier production functions. *Empirical Economics* **2**, 109-122.

Molyneux, Philip and John Thornton, 1992. Determinants of European bank profitability: A Note. *Journal of Banking and Finance* **16**, 1173-1178.

Perry, Phillip, 1992. Do banks gain or lose from inflation? *Journal of Retail Banking* **14**, 25-30.

Shih, Victor, Qi Zhang, and Mingxing Liu, 2007. Comparing the performance of Chinese banks: a principle component approach. *China Economic Review* **18**, 15-34.

Smirlock, Michael, 1985. Evidence on the (non) relationship between concentration and profitability in banking. *Journal of Money, Credit, and Banking* **17**, 69-83.

Sufian, Fadzlan, 2009. Determinants of Bank profitability in a Developing Economy: Empirical evidence from the China Banking Sector. *Journal of Asia-Pacific Business* **10**, 201-307.

Sufian, Fadzlan and Muzafar Shah Habibullah, 2009. Bank specific and macroeconomic determinants of bank profitability: Empirical evidence from the China Banking Sector. *Frontier of Economics in China* **4**, 274-291.

Tabak, Benjamin, Dimas Fazio, and Daniel Cajueiro, 2012. The relationship between banking market competition and risk-taking: Do bank size and capitalization matter? *Journal of Banking and Finance* **36**, 3366-3381.

Tan, Yong and Christos Floros, 2012a. Bank profitability and inflation: the case of China. *Journal of Economic Studies* **39**, 675-696.

Tan, Yong and Chrisos Floros, 2012b. Bank profitability and GPD growth in China: a note. *Journal of Chinese Economics and Business Studies* **10**, 267-273.

Tan, Yong and Christos Floros, 2012c. Stock market volatility and bank performance in China. *Studies in Economics and Finance* **29**, 211-228.

Tan, Yong, 2016. The impacts of risk and competition on bank profitability in China. *Journal of International Financial Markets, Institutions and Money* **40**, 85-110.

Tan, Yong and Christos Floros, 2014. Risk, profitability and competition: evidence from the Chinese banking. *Journal of Developing Areas* **48**, 303-319.

Tan, Yong, Christos Floros, and John R. Anchor, 2017. The profitability of Chinese bank: impacts of risk, competition and efficiency. *Review of Accounting and Finance* **16**, 86-105.

Tan, Yong, 2017. The impacts of competition and shadow banking on profitability: evidence from the Chinese banking industry. *North American Journal of Economics and Finance* **42**, 89-106.

Wooldridge, Jeffrey M., 2002. Econometric Analysis of cross section and panel data. Cambridge, MA: MIT press.