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The Determinants of Profitability in the City Commercial Banks: Case of China

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Abstract: This study uses a panel data regression model to investigate how internal and external factors affect the profitability of city commercial banks in China. The research sample consists of 16 listed city commercial banks with an unbalanced dataset covering the time period within the period of 2008–2020. A panel data regression method is utilized to investigate the factors that influence the profitability of city commercial banks in China. There are several estimation methods in panel data, and the most commonly employed models are the fixed effects and random effects models. The pooled OLS model is often used for comparison for panel data regression, and the appropriate model will be determined by statistical hypothesis testing. The results show that internal explanatory variables such as bank size, capital adequacy, credit quality, and operating efficiency and external explanatory variables such as province GDP and inflation have a significant impact on the profitability of city commercial banks, while liquidity has no significant effect on the bank's profitability. The paper contributes to the relevant literature by identifying the determinants of city commercial banks' profitability considering the latest situation of the banking sector in China and provides practical implications from the perspective of improving bank profitability, which are important for both banking management and regulators and for the municipal and state.

Keywords: city commercial banks; profitability; capital adequacy; credit quality; operating efficiency; liquidity; China



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1. Introduction

Commercial banks are the main component of China's financial system. Among various financial institutions, commercial banks have the longest history, the most extensive business scope, and the greatest impact on social and economic life. In order to assist the government's reform agenda, China's banking system started to develop and diversify since 1979. China has embarked on many phases of banking reforms with the intention of encouraging competitiveness. At present, China's modern commercial banking system has been formed. China's commercial banking system consists of state-owned commercial banks, national joint-stock commercial banks, city commercial banks, and rural commercial banks. As of 30 April 2022, there were 59 listed banks, of which 30 were city commercial banks. Total assets and net profits of listed banks accounted for 83% and 91% of all commercial banks in China, respectively.

City commercial banks are a subgroup of China's banking system, with the goal of providing financial services to small and medium-sized enterprises while also supporting the regional economy. City commercial banks originate from city credit cooperatives and are the result of China's economic reform. China's city commercial banks are regional small joint-stock commercial banks based on the original city credit cooperatives and invested by local governments, local enterprises, and residents. The first city commercial bank in China is Shenzhen City Cooperative Bank established in July 1995. The development of city commercial banks plays an extremely important role in promoting regional economic

development, financial reform, and especially supporting the development and growth of small and medium-sized local enterprises (Cao and Tan 2006; Chen 2012; Ding 2020). As of the end of December 2021, the number of city commercial banks has reached 128, accounting for 13.3% of China's banking industry by asset size.

As China's economic development enters the "new normal", which is a new stage of economic development in China during the 13th Five-Year Plan period (2016–2020), China's economy is transitioning from rapid growth to medium-to-rapid growth. Supervision of the banking industry has been continuously strengthened, resulting in a contraction of the entire social credit and increased downward pressure on the domestic economy. The development of private banks and foreign banks has intensified the pressure of competition among Chinese commercial banks. At the same time, the continuous deepening of interest rate liberalization and the development of FinTech have had a great impact on the long-term development of China's commercial banking industry. Chen et al. (2019) investigated how FinTech influences the current financial industry, including banking, payment, brokerage, asset management, and insurance as sub-sectors. The valuation result indicates that FinTech contributes positively to the financial industry as a whole; however, there is substantial cross-sectional difference in the value impacts on sub-sectors. E-transaction technologies, for instance, have a negative impact on the banking. The relationship between FinTech and banks can be described as the co-opetition paradigm, in which FinTech and banks compete and cooperate in the same financial service segment with distinctive properties (Moro-Visconti et al. 2020).

The banking sector in China has distinctive characteristics. Zhang and Lopez-Pascual (2012) investigated the cultural differences between Chinese and Spanish banks from a dynamic and static cultural perspective, which revealed a distinctive feature of the Chinese banking industry: pursuit of effectiveness rather than a concern for efficiency. Spaniards, on the other hand, are more oriented with efficiency, with the objective of reducing costs and increasing profits. From the perspective of competition within the industry, large state-owned commercial banks and national joint-stock commercial banks are in absolute and relatively dominant positions. City commercial banks and rural commercial banks are developing and their market shares are increasing. Compared with other types of commercial banks, city commercial banks have regional advantages and government support, and their smaller scale and simpler organizational structure make their operations more efficient and flexible, and it is easier to adjust and implement development strategies. However, with the development and change of China's economic and financial situation, the existing problems of city commercial banks are gradually exposed. The asset quality and profitability of city commercial banks are lower than the average level of China's banking industry. The non-performing loan ratio of city commercial banks has continued to rise since 2017, exceeded the banking industry average in the first quarter of 2019, and then continued to rise and reached a peak of 2.48% in the third quarter of 2019. The overall provision coverage ratio of city commercial banks continued to decline from 2017, reaching the lowest level of 147.99% in the third quarter of 2019. Although the overall provision coverage ratio of city commercial banks has increased since then, it is still lower than the banking industry average (Gao and Lu 2022). Moreover, empirical researchers found that city commercial banks perform very differently, and the profitability indicators of individual city commercial banks are uneven (Ding 2020).

The above-mentioned unique features, economic changes, and existing makes it interesting to investigate the influence of determinants on the profitability of city commercial banks in China. In recent years, empirical research on the profitability of Chinese city commercial banks has mainly focused on the impact of a specific factor on profitability, including: (a) the impact of FinTech on the profitability of city commercial banks (Ye 2019; Huang 2020; Kan 2022), (b) the impact of interest rate liberalization on the profitability of city commercial banks (Li and Li 2022; W. Zhang 2020), and (c) the impact of shareholder localization on the profitability of city commercial banks (Luo 2021; Liao 2019), etc.

The purpose of this paper is to analyze the influencing factors that affect city commercial banks' profitability as comprehensively as possible. The main determinants of profitability are divided into two types: internal and external. Empirical results found that both internal factors (such as bank size, non-performing loan, loss provision) and external factors (external economic conditions) influence banks' profitability (Gu 2008; Sufian and Habibullah 2009; Lu et al. 2013; Xin Chen 2016; Koroleva et al. 2021).

The purpose of this study is to investigate the impacts of both internal and external factors on the profitability of city commercial banks. Banks' profitability is measured by return on assets (ROA) and return on equity (ROE). The internal factors include bank size, credit quality, Capital adequacy, operating efficiency, and liquidity. Economic conditions are what define the external factors, measured by natural logarithm of province GDP and inflation rate. The following two research questions are attempted to be answered: (a) Which factors affect city commercial banks' profitability? (b) How do these factors affect the profitability of city commercial banks (positively or negatively)? Panel data regression models including pooled OLS, fixed effects model (FE), and random effects model (RE) are used as the methodology for analyzing the panel dataset consisting of 16 city commercial banks within the research period from 2008 to 2020. According to the statistical hypothesis testing, the fixed effects model is suitable for the panel data. The empirical results of the study show that both internal and external variables have significant impact on city commercial banks' profitability. More specifically, bank size and inflation have a negative impact on city commercial banks' profitability; credit quality, operating efficiency, and province GDP have a positive impact on city commercial banks' profitability; Capital adequacy has a positive impact on ROA, while it has a negative impact on ROE.

The paper contributes to the relevant literature by identifying the determinants of city commercial banks' profitability considering the latest situation of the banking sector in China. The paper also provides practical implications from the perspective of improving bank profitability, which are important for both banking management and regulators and for the municipal and state.

There are six main components to this study. The introduction is found in Section 1. Review of the literature and variable selection are presented in Section 2. The methods and data are outlined in Section 3. Results from the panel data regression model are shown in Section 4. On the basis of empirical findings, Section 5 evaluates hypotheses and discusses how variables affect profitability. The conclusion is included in Section 5, which also lists the research's benefits, drawbacks, and potential future directions.

2. Literature Review

Numerous studies have examined commercial banks' profitability since they are one of the primary elements of the financial industry. The previous empirical studies provide evidence that a wide range of factors may affect the profitability of banks. Empirical studies on the profitability of China's banking industry have undergone changes in both research objects and research methods. The early research objects mostly focus on the analysis of the profitability of state-owned commercial banks, and the research methods are mostly in the form of financial index comparison. As China's banking reform proceeded after 2003, the research object gradually expanded to national joint-stock commercial banks, city commercial banks, rural commercial banks, etc. The scope of the study is from a simple study of the influence of internal factors or external factors on the profitability of China's banking industry, to the premise of the coexistence of the two or more factors, to investigate the determinants of the profitability of China's banking industry.

Zhao and Yang (2009) examined the influence of the financing structure, capital adequacy ratio, etc. of Chinese commercial banks on profitability from the perspective of bank capital structure and concluded that the bank's financing structure is positively correlated with profitability. Although the capital adequacy ratio of commercial banks is significantly positively correlated with the ROA, the correlation coefficient is relatively small. Wang et al. (2009) studied the impact of capital adequacy ratio on profitability and

found that capital adequacy ratio regulation had a negative impact on bank profitability, but the impact was not sustainable. However, Xin Chen (2016) analyzed 17 commercial banks in China measuring profitability by ROA, the growth rate of operating income, and the operating profit rate and believed that the growth rate of operating income of commercial banks in China is not balanced, and the operating income of small-scale banks is not balanced. The growth rate is relatively high, but the operating income growth rate of large-scale commercial banks is relatively low.

Yong and Dong (2005) investigated the determinants of the profitability of Chinese commercial banks from the perspectives of both internal and external factors. According to the findings of the study, only internal variables have a relevant impact on profitability, whereas external ones have a negligible effect. X. Qu (2007) revealed that internal factors such as bank size significantly affect profitability; however, external factors such as the natural logarithm of GDP and inflation have no significant impact for the research sample consisting of state-owned and joint-stock banks in China for the time period from 1999 and 2005. According to Zhong (2013), internal factors such as bank size, non-performing loan, and capital adequacy have a significant impact on bank profitability, while external factors such as natural logarithm of GDP have no significant impact on bank profitability for the 16 listed banks in China during 1999 to 2011.

Huang et al. (2006) observed that the internal (asset quality, capital adequacy, liquidity, operational efficiency, and bank size) and external variables (GDP and inflation rate) are significantly correlated with profitability. Sufian (2009) revealed that the majority of internal and external factors included in his research have significant impact on the profitability of state-owned and joint-stock banks for the time period 2000–2007.

Dependent variables and explanatory variables are selected based on the empirical results of empirical studies on the banking industry. Explanatory variables are divided into two groups—internal factors (bank-specific variables) and external factors (macro-economic conditions)—to identify how different factors will influence banking profitability. Internal factors (bank-specific variables) are determinants that are predominantly affected by the decision making and policy priorities of a bank such as the capital adequacy and liquidity requirements, credit risk management, loan loss provision policy, etc. External factors (macro-economic conditions) are the determinants that reflect the economic and legal environment where the banking institutions operate (Tan and Floros 2012).

(a) Dependent variables (Profitability measures)

Empirical literature has used different financial metrics for measuring banks' profitability. Return on equity and return on assets are widely used measures of profitability. The efficiency of utilizing a company's total assets to generate returns is shown by the ROA (net income/total asset). ROE (net income/total equity) defines the investment return (Guru et al. 2002). In other words, ROE gauges a bank's ability to generate profits by utilizing its equity. (Tan and Floros 2012). According to empirical studies, ROA is more commonly employed than ROE as the primary measure for assessing bank profitability. Other profitability metrics are also found in the literature (Noman et al. 2015), such as return on average assets (ROAA), return on average equity (ROAE), etc.

A measure for the gains that equity holders are obtaining from banking operations, ROE is a profit indicator from the viewpoint of a shareholder. The return indicator, or ROA, is mainly utilized as a reflection of a bank's operational effectiveness from an enterprise viewpoint. The ratio of assets to equity, which measures financial leverage, may be used to illustrate the relation between ROA and ROE as $ROE = ROA \times (\text{Asset}/\text{Equity})$. This relation demonstrates that ROE rises with increasing financial debt. The amount of bank capital funds is subject to Basel III's capital adequacy requirement. The equity capital cannot be excessively low.

The metrics of bank profitability applied in this study are ROA and ROE.

(b) Internal explanatory variables

(1) Bank size

Commercial banks are intermediaries between depositors (who lend money to the bank) and borrowers (to whom the bank lends money). For commercial banks, like other profit-oriented enterprises, the “size effect” is also a main focus of researchers. Asset size (measured by natural logarithm of asset) and deposit size (measured by deposit/asset) are used in this research to measure the bank size, which have been used in prior studies to estimate the size of banks.

Asset size (measured by natural logarithm of asset) is a commonly used metric for bank size. A bank is considered as systemically important if its assets surpass 1–2 percent of GDP (Huber 2021). Asset quality and asset management is also a major component that influences banking profitability, which are also correlated with asset size to some extent. According to the literature review, the impact of asset size on profitability may be positive (Staikouras and Wood 2004; UL Mustafa et al. 2012; Lu et al. 2013; Gremi 2013; Li 2017) or negative (Bai 2010). It is worth mentioning that the direction of the effect of bank size depends on how big the bank is.

Deposit size (measured by deposit/asset) measures the relative portion of the bank’s asset funded by the form of deposit. For commercial banks that rely on the interest difference between loans and deposit as the main source of profit, deposits are the essential for guaranteeing positive profits, and a high ratio means the bank’s assets are funded from a stable source. However, a high ratio indicates additional operating costs to attract deposits and a liquidity problem may occur if deposits are withdrawn in large numbers in a short period of time. A positive impact of deposit size on profitability is revealed by empirical results (X. Qu 2007; Acaravci and Çalim 2013; Karimzadeh et al. 2013; Gremi 2013). Contrary, UL Mustafa et al. (2012) found a negative correlation between deposit size and profitability.

Hypothesis 1 (H1). *Asset size has a negative impact on city banks’ profitability.*

Hypothesis 2 (H2). *Deposit size has a positive impact on city banks’ profitability.*

(2) Capital adequacy

Capital adequacy is the adequate amount of capital a bank needs to hold as a percentage of its risk-weighted assets, which is usually defined by regulators. Capital adequacy relates to solvency ability to satisfy obligations; the more capital a bank has, the stronger its ability to withstand worse financial conditions. Capital adequacy ratio (CAR) is the most commonly used measurement for capital adequacy. China has implemented Basel III since 2013, which enforced bank capital regulations. CAR is used as the metric for capital adequacy in this paper.

Capital adequacy ratio measures how much capital a bank has in comparison to risk-weighted assets, which indicates how resilient a bank is towards its risk assets. Empirical findings indicate that Capital Adequacy Ratio positively affects ROA (Mayes and Stremmel 2012; Malik et al. 2015; Albuлесcu 2015; Islam and Nishiyama 2016). The bank’s capacity for generating profits as well as the structure of funding available to assets in accordance with the level of risk affect the amount of the capital adequacy. According to a study by Dao (2020), capital adequacy ratio has a positive impact on ROA, while it has negative impact on ROE, considering 16 commercial banks in Vietnam during 2010–2017. The finding is consistent with the previous study by Dao and Nguyen (2016), which was performed from 2011 to 2014 on 20 listed Vietnamese commercial banks.

It is worth mentioning that CAR may have different effects on ROA and ROE, since ROE itself includes an indicator of the leverage, and the leverage ratio is directly related to the equity held by the bank.

Hypothesis 3 (H3). *Capital adequacy has a positive impact on city banks’ profitability.*

(3) Credit quality

The basic concepts of credit quality (or loan quality) consist of non-performing loan and loan loss provision. Basel Committee's "Prudential treatment of problem assets—definitions of non-performing exposures and forbearance" emphasizes the importance of the number of days overdue, and a loan will be identified as a non-performing loan when it has the following conditions: there is a significant risk of being overdue for more than 90 days; the bank determines that the borrower may not be able to repay its debt to the bank in full unless recourse measures are taken, or the debtor's substantial credit obligations to the bank are overdue for more than 90 days; there is a loss situation stipulated by international accounting standards; there is evidence that the loan cannot be repaid in full (regardless of the number of days past) without selling the collateral. China Banking and Insurance Regulatory Commission defines loans more than 90 days past due as non-performing loans, and commercial banks need to calculate loan loss provision for potential loan defaults. Empirical studies have utilized a variety of metrics to assess a bank's loan quality, non-performing loan ratio, and loan loss provision ratio used as measurements for the credit quality in this study.

Non-performing loan ratio (non-performing loan/total loan) reflects unsatisfactory asset condition as well as the poor efficacy of credit management, which is directly linked to low profitability (Zhong 2013; Noman et al. 2015; Fu 2020). X. Qu (2007) found that non-performing loan ratio does not significantly impact profitability.

Loan loss provision ratio (loan loss provision/total loan) reflects a bank's trustworthiness as provision is a buffer against potential losses. Commercial banks must account for possible loan defaults and costs so that they can protect against credit risk when a non-performing loan turns default loans. The level of provision is an indicator not only of banking sector financial health, but also that of the national economy overall. Empirical evidence shows that there may be a positive or negative link between the loan loss provision ratio and profitability (Lu et al. 2013; Staikouras and Wood 2004; Noman et al. 2015).

Hypothesis 4 (H4). *Non-performing loan ratio has a negative impact on city banks' profitability.*

Hypothesis 5 (H5). *Loan loss provision ratio has a positive impact on city banks' profitability.*

(4) Operation efficiency

Like any other profit-oriented firm, a bank's profit can be simplified as revenue subtract expenses. Operational efficiency is a critical indicator for determining how effectively revenue is generated in relation to operational costs. Prior studies implemented various measurements to assess the operational efficiency. Operating ratio (operating expense/operating income) is used in this study to measure the operation efficiency.

Operating ratio (operating expense/operating income) measures the efficiency of banking activities and the effectiveness of management. The lower the level of the ratio means the higher operational efficiency of the bank, indicating the bank has the better profitability of using its funds and controlling operational costs, which leads to a higher level of profit. Akbar and Afiezan (2018), Buchory (2015), Xin Chen (2016) found that operating ratio has a significant negative effect on banking profitability. It is reasonable to predict that profitability is positively correlated with operation efficiency, with a negative sign in terms of operating ratio.

Hypothesis 6 (H6). *Operating ratio has a negative impact on city banks' profitability.*

(5) Liquidity

Liquidity refers to the ability of the bank to meet its maturing obligations and new demands for loans. Liquidity can come from cash and cash equivalent directly and can come from the realization of other liquid assets with minimal cost. If the bank holds fewer liquid assets, it will encounter difficulty fulfilling its matured obligations. New regulations under the Basel III regulatory framework for banks were developed as a result of the

recent financial crisis during 2007 and 2009, which was caused by deficiencies in financing and liquidity management within financial institutions. Compared to Basel I and II, the Basel III standards include new requirements for capital, liquidity, and debt. According to the CBIRC, the liquidity ratio implemented by Chinese banks is the current ratio, which is calculated by current assets divided by current liabilities. This research measures the liquidity using the current ratio.

Current ratio (current assets/current liabilities) determines the bank's capacity to meet short-term liabilities, which typically mature in less than one year. [Akter and Mahmud \(2014\)](#) found that bank liquidity and profitability are correlated. The correlation between two variables might be positive ([Eljelly 2004](#); [Khan and Ali 2016](#)) or negative ([Nabeel and Hussain 2017](#)).

Hypothesis 7 (H7). *Current ratio has a positive impact on city banks' profitability.*

External explanatory variables

(c) Economic condition of a country

Economic conditions are the external factors that determine the profitability of economic activity. Each segment of the economy, including the banking institutions, is intimately correlated with economic condition of the country. The interest differential between loans and deposits is the primary source of the bank's revenue. Demand and supply as the two main dimension of banking system may be directly impacted by a nation's economic position. During an economic boom, banks will see an increase in profitability. In contrast, all of the banking activities will be negatively impacted during a recession, which would lower their profitability. Based on a review of the literature, this research highlighted the two most widely used quantitative aspects: annual GDP (measured by natural logarithm of GDP) and inflation (measured by inflation rate).

The natural logarithm of GDP is a widely used metric to assess the country's overall economic status. The conclusions of empirical research on the impact of GDP on bank profitability vary, with some demonstrating positive effects ([Karimzadeh et al. 2013](#); [Bi 2014](#); [Du 2015](#); [Li 2017](#)) and some studies supporting the opposite conclusion ([Sufian 2009](#)). The natural logarithm of a province's GDP in which the bank is located is used in this study since the city commercial banks are regional banks.

Inflation is another commonly used metric for the macroeconomic condition of a country. According to the National Bureau of Statistics of China and World Bank statistics, the extent of inflation is measured by consumer prices index (CPI) in China. Empirical studies show that inflation is an important determinant of banking profitability via influencing interest rate. The movement of interest rate is influenced by the rate of inflation, and vice versa. When high inflation occurs, the central bank or authorities usually raise the level of interest rates to keep inflation low and stable. When interest rates rise, saving becomes more beneficial, which encourages people to spend less and save more, and inflation tends to decline. In general, high inflation rates are associated with high profitability of the banks. According to [Perry \(1992\)](#), whether commercial banks expect inflation or not affects the interaction between inflation and bank profitability. If the banks are able to increase revenues faster than costs by anticipating inflation and modifying interest rates, there will be a positive impact on profitability. The findings of previous studies on the correlation between inflation and profitability are different. [L. Qu \(2012\)](#), [Xin Chen \(2016\)](#), [J. Zhang \(2009\)](#), and [Sufian \(2009\)](#) found that inflation has a positive impact on banks' profitability. [Du \(2015\)](#) and [Karimzadeh et al. \(2013\)](#) found that inflation has a negative impact on banks' profitability. [X. Qu \(2007\)](#), [Lu et al. \(2013\)](#), [Jumono and Mala \(2019\)](#), [Yong \(2016\)](#), and [Sufian and Habibullah \(2009\)](#) found that inflation has no significant impact on banks' profitability.

Hypothesis 8 (H8). *GDP has a positive impact on city banks' profitability.*

Hypothesis 9 (H9). *Inflation has a negative impact on city banks' profitability.*

3. Data and Methodology

There are 28 listed city commercial banks in China at the end of 2020; not all the banks are included in the sample due to no data being available for more than five years and due to serious missing data. Table 1 presents the 16 city commercial banks and the time period of data used in this paper.

Table 1. Sample of the listed city commercial banks and time period.

City Commercial Banks	Time Period
Bank of Beijing	2009–2020
Bank of Shanghai	2008–2020
Bank of Jiangsu	2008–2020
Bank of Ningbo	2008–2020
Bank of Nanjing	2008–2020
Huishang Bank	2012–2020
Shengjing Bank	2011–2020
Haerbin Bank	2011–2020
Bank of Hangzhou	2009–2020
Bank of Zhengzhou	2010–2020
Bank of Tianjin	2011–2020
Bank of Chengdu	2009–2020
Bank of Chongqing	2010–2020
Bank of Changsha	2009–2020
Bank of Xi'an	2011–2020
Bank of Suzhou	2011–2020

The dataset is an unbalanced panel dataset, and all the time periods for banks are within the range of 2008–2020. We used data after the 2008 financial crisis, so the financial crisis was not included as a control variable in the model. Bank-level data is collected directly from the annual reports of individual banks or calculated indirectly by definitions. Macroeconomic statistics (GDP and inflation) are collected from the dataset provided by the National Bureau of Statistics of China.

Panel data analysis is a two-dimensional approach, where the same individuals are observed repeatedly over different periods in time (Hill et al. 2018). The panel data regression is utilized to identify the factors that affect the profitability of the banks. The fixed effects model (FE) and the random effects model (RE) are the most commonly used models within the framework of econometric techniques regarding panel data analysis, whereas the pooled OLS model is commonly implemented for comparison. The appropriate model is determined by statistical hypothesis testing.

A linear regression model for panel data consisting of k explanatory variables can be written as:

$$y_{it} = \beta_0 + \alpha_i + \beta_1 \times x_{1,it} + \beta_2 \times x_{2,it} + \dots + \beta_k \times x_{k,it} + \varepsilon_{it} \quad (1)$$

In the mathematical algorithm of models, the indicator of the individual is i ($i = 1, 2, 3, \dots, n$) and t ($t = 1, 2, 3, \dots, T$) is the indicator of time. y_{it} is the dependent variable. $x_{k,it}$ is the explanatory variable matrix with k columns and $N = i \times t$ rows, $x_{k,it}$ is the k th explanatory variable. α_i is specific for each individual, which can explain correlations between observations that are not caused by dynamic trends over time. Either the FE or the RE could be chosen based on whether the specific feature is fixed or random for each individual (Sheytanova 2015).

Panel data analysis is being used to control the features that cannot be observed or be evaluated, these unique features change over time but not within individuals; it accounts for individual heterogeneity. Besides the selected explanatory variables, there may be unobserved, omitted factors that will compose random error term of the regression. There are three types of unobserved effects in panel data regression: (1) individual-specific

random error, means the unobserved and/or unmeasurable, time-invariant individual characteristics, which is also known as unobserved heterogeneity. (2) The usual type of random errors, consist of the unobserved, and/or unmeasurable individual and time-varying factors, which is also known as idiosyncratic error. (3) Time-specific random error, an effect that varies over time but not individual (Hill et al. 2018). If the unobserved heterogeneity term is correlated with independent variables, then a fixed effects model will be preferred; if it is correlated with all explanatory variables and the time-invariant, then random effects model will be preferred.

Pooled OLS (pooled least squares) is the model that integrates dataset without distinguishing individuals with no assumption on individual differences and applies OLS technique on this pooled dataset with $i \times t$ observations for obtaining efficient estimates. The algorithm of pooled OLS model can be expressed as:

$$y_{it} = \beta_0 + \beta_1 \times x_{1,it} + \beta_2 \times x_{2,it} + \dots + \beta_k \times x_{k,it} + \varepsilon_{it} \quad (2)$$

Pooled OLS regression ignores unobserved heterogeneity between individuals that may be associated with explanatory variables and lead to inconsistent estimates. The assumptions for the pooled OLS are:

- (1) model fits: $E(\varepsilon_{it}) = 0$.
- (2) no multicollinearity: $rank(x) = rank(x'x) = k$.
- (3) exogeneity: $E(\varepsilon_{it} | x) = 0$, $Cor(\varepsilon_{it} | x) = 0$.
- (4) homoscedasticity: $Var(\varepsilon_{it} | x) = \sigma_\varepsilon^2$.
- (5) no cross-sectional or time-series correlation: $Cov(\varepsilon_{it}, \varepsilon_{js} | x) = 0$, for $i \neq j$, $t \neq s$.
- (6) normal distribution of the disturbances ε_{it} .

If none of the above assumptions are violated, pooled OLS will provide unbiased and consistent estimator. However, panel data tends to violate certain assumptions in practice. For instance, the fifth assumption will be violated when autocorrelation of the disturbances within individuals occurs; this would lead to biased estimates of the standard errors (Sheytanova 2015).

Individual fixed effects model captures the unobserved heterogeneity, which is mathematically as:

$$y_{it} = \alpha_i + \beta_1 \times x_{1,it} + \beta_2 \times x_{2,it} + \dots + \beta_k \times x_{k,it} + \varepsilon_{it} \quad (3)$$

Comparing with the algorithm of pooled OLS expressed as Equation (2), there is no constant term β_0 , whereas α_i is added, which accounts for the unique component that produces different intercept for individual regression. However, there is no difference between β parameter (slope of regression line). FE examines the links between predictor and outcomes within an individual, assuming that each individual has their own unique features those might have an impact on the predictor. Estimation assumption of FE is expanded by adding the normality (normal distribution of the disturbances ε_{it}) based on the assumption of Pooled OLS.

The fixed effect (within) estimator is consistent and converges to the true value of the population, which eliminates potential unobserved heterogeneity caused by the correlation between unobserved heterogeneity and independent variables. FE has strict exogeneity assumption $E(\varepsilon_{it} | x_i, \alpha_i) = 0$ (there is no the assumption for $E(\varepsilon_{it} | x_i) = E(\alpha_i) = 0$) means that the disturbance term must be uncorrelated with the explanatory variables of each period (rather than just the explanatory variables of the current period). The error term for each individual and the constant should not be correlated (Sheytanova 2015). Moreover, time-invariant attributes are unique to the individual and should not be interrelated with other unique individual features (Hill et al. 2018).

Fixed effects are tested by the Fisher test (F test), and the null hypothesis of the test is that all individual-specific components are equal to zero, i.e., $H_0 : \alpha_i = 0$ in the fixed effects model expressed as Equation (3) $y_{it} = \alpha_i + \beta_1 \times x_{1,it} + \beta_2 \times x_{2,it} + \dots + \beta_k \times x_{k,it} + \varepsilon_{it}$. There is a significant fixed effect if the null hypothesis is rejected (Park 2011).

RE considers individual-specific effects α_i as a random variable with mean μ and variance σ_{α}^2 , which is independently distributed of x_{it} . RE can be obtained by expanding the FE by adding μ (the average individual effect) to the Equation (3).

$$y_{it} = \beta_1 \times x_{1, it} + \beta_2 \times x_{2, it} + \dots + \beta_k \times x_{k, it} + \varepsilon_{it} + \alpha_i - \mu + \mu \quad (4)$$

Define $u_{it} = \varepsilon_{it} + \alpha_i - \mu$ and Equation (4) can be rewritten as:

$$y_{it} = \beta_1 \times x_{1, it} + \beta_2 \times x_{2, it} + \dots + \beta_k \times x_{k, it} + u_{it} + \mu \quad (5)$$

Equation (5) is the mathematical expression of the RE, which is based on the idea that the individual differences are random. RE assumes that the unobserved heterogeneity term is not correlated with any of the explanatory variables and is not correlated with the time-invariant. α_i is treated as a component of the composite error term u_{it} (Cameron and Trivedi 2009). Random effects estimation assumptions include:

- (1) model fits: $E(u_{it}) = E(\varepsilon_{it}) = 0$.
- (2) no multicollinearity: $\text{rank}(x) = \text{rank}(x'x) = k$.
- (3) exogeneity: $E(u_{it} | x_i, \alpha_i) = 0$, $E(\alpha_i - \mu | x_i) = E(\alpha_i - \mu) = 0$.
- (4) homoscedasticity: $\text{Var}(u_{it} | x_i, \alpha_i) = \sigma_u^2$, $\text{Var}(\alpha_i | x_i) = \sigma_{\alpha}^2$.
- (5) normal distribution of the disturbances u_{it} .

The random effects estimates are consistent only if assumption (1) and assumption (3) are not violated (Sheytanova 2015).

Breusch and Pagan's Lagrange Multiplier (LM) test can be used to test random effects, and the null hypothesis is that all individual-specific components are equal to zero, i.e., $H_0: \alpha_i = 0$ in the random effects model expressed as Equation (4) $y_{it} = \beta_1 \times x_{1, it} + \beta_2 \times x_{2, it} + \dots + \beta_k \times x_{k, it} + \varepsilon_{it} + \alpha_i$. There is a significant random effect if the null hypothesis is rejected. (Breusch and Pagan 1980; Park 2011).

The FE estimator is more precise than the RE estimator and is always consistent. The RE estimator with small variance indicates it is more efficient. As mentioned before, the appropriate model can be determined by statistical hypothesis testing. Hausman test is the frequently used test for FE and RE by examining the presence of endogeneity. The null hypothesis is that there is no correlation between the error term and the independent variables ($H_0: \text{Cov}(\alpha_i, x_{it}) = 0$). Hausman test basically compares the parameters of FE ($\hat{\beta}_{FE}$, the coefficient estimating vector of FE) and the parameters of RE ($\hat{\beta}_{RE}$, the coefficient estimating vector of random effects model). Hausman statistic is calculated from the formula: $H = (\hat{\beta}_{RE} - \hat{\beta}_{FE})' [\text{Var}(\hat{\beta}_{RE}) - \text{Var}(\hat{\beta}_{FE})]^{-1} (\hat{\beta}_{RE} - \hat{\beta}_{FE})$, this statistic is $\chi^2(k)$ distributed. If the null hypothesis is rejected, FE will be the appropriate model, and vice versa. (Hill et al. 2018; Sheytanova 2015).

4. Results and Discussion

The content of the pooled OLS model used in this paper as the basic of panel data regression analysis is as following:

$$\begin{aligned} Profitability_{it} = & \alpha_0 + \alpha_1 \times LNA_{it} + \alpha_2 \times DTAR_{it} + \alpha_3 \times CAR_{it} + \\ & \alpha_4 \times NPL_{it} + \alpha_5 \times LLP_{it} + \alpha_6 \times OEOI_{it} + \alpha_7 \times LIQ_{it} + \alpha_8 \times LNGDP_P_{it} + \\ & \alpha_9 \times INFL_t + \varepsilon_{it} \end{aligned} \quad (6)$$

where:

i refers to an individual bank, t refers to time.

α_0 is the constant; $\alpha_1 - \alpha_9$ are coefficients; ε_{it} is the error terms.

$Profitability_{it}$ is measured by ROA_{it} and ROE_{it} .

Table 2 presents the descriptive statistics for city commercial banks including mean, standard deviation, minimum, and maximum value.

Table 2. Descriptive statistics.

Variable	Description of Variable	Obs	Mean	Std. Dev.	Min	Max
ROE	return on equity	171	15.84	4.86	1.51	29.48
ROA	return on assets	171	1.01	0.25	0.12	1.67
LNA	natural logarithm of asset	171	13.08	0.86	10.96	14.88
DTAR	deposit to asset ratio	171	63.44	7.76	45.86	80.94
CAR	capital adequacy ratio	170	13.14	1.71	10.24	24.12
NPL	non-performing loan to total loan ratio	170	1.14	0.50	0.33	3.26
LLP	loan loss provision to total loan ratio	171	2.88	0.68	0.61	5.02
OEOI	operating expense to operating income ratio	170	48.51	12.60	22.05	72.50
LIQ	liquidity ratio	158	49.85	12.60	27.75	92.53
LNGDP_P	natural logarithm of province's GDP in which the bank is located	171	18.05	0.30	17.11	18.43
INFL	inflation rate	171	2.53	1.18	−0.70	5.90

There are 16 banks and 171 observations in the unbalanced panel dataset, the time period of the data of different banks is not the same, and the longest time period covers 2008–2020. There are missing data of some observations. Descriptive statistics show that the city banks have average ROE of 15.84% (with standard deviation 4.86) and average ROA of 1.01% (with standard deviation 0.25). The standard deviation of OEOI and LIQ are relatively high, both equal to 12.60, indicates that values of these variables are relatively different among observations. The standard deviations of the other variables are quite small, indicating that differences between banks are small.

Table 3 presents the correlations between the selected variables.

Table 3. Correlation matrix.

	ROE	ROA	LNA	DTAR	CAR	NPL	LLP	OEOI	LIQ	LNGDP_P
ROE	1									
ROA	0.73	1								
LNA	−0.44	−0.57	1							
DTAR	0.45	0.45	−0.61	1						
CAR	−0.12	0.27	−0.24	0.03	1					
NPL	−0.72	−0.68	0.27	−0.21	−0.01	1				
LLP	−0.51	−0.57	0.53	−0.37	0.10	0.52	1			
OEOI	−0.19	−0.26	0.11	0.00	0.06	0.12	0.22	1		
LIQ	−0.44	−0.34	0.10	−0.24	0.16	0.36	0.36	0.34	1	
INFL	0.22	0.27	−0.28	0.31	0.33	−0.24	−0.17	−0.01	−0.05	−0.17

The correlation matrix shows that DTAR and INFL are positively correlated with both ROE and ROA. LNA, NPL, LLP, OEOI, LIQ, and LNGDP_P are negatively correlated with both ROE and ROA. CAR is negatively correlated with ROE, while it is positively correlated with ROA. NPL has the highest correlation with both ROE and ROA, equal to −0.72 and −0.68. There are some high correlations are observed among explanatory variables, the correlation of DTAR with LNA equal to −0.61; the correlation of LLP with LNA is equal to 0.53, with NPL equal to 0.52. Correlation between the rest of the explanatory variables is relatively low; the absolute value of correlation between explanatory variables are distributed in the area 0.01–0.37, which indicates that there is no strong correlation between explanatory variables.

Two regression models are built for city commercial banks using ROA and ROE as dependent variables separately; each includes pooled OLS, FE, and RE, dummy variable

for province is used to control for systematic differences across different provinces. The regression results are presented in Tables 4 and 5. Presence of unobserved/individual specific effects are tested with suggested tests in order to choose between the listed three models. Fisher (F) test and Wald test are used to test FE. Breusch and Pagan's Lagrange Multiplier test is used to test RE. Hausman test is used to select the best-fitting econometric model.

Table 4 presents regression results for ROE. The FE is preferred for ROE according to statistical tests. The pooled OLS and the RE are presented for comparison.

Table 4. Regression results for ROE.

Models	POOL	RE	FE
LNA	0.90 −0.60	0.90 −0.60	−2.58 ** −1.27
DTAR	0.09 ** −0.04	0.09 ** −0.04	0.05 −0.05
CAR	−0.29 * −0.16	−0.29 * −0.16	−0.34 ** −0.16
NPL	−5.57 **** −0.59	−5.57 **** −0.59	−5.62 **** −0.60
LLP	0.35 −0.46	0.35 −0.46	1.25 ** −0.55
OEOI	−0.04 −0.03	−0.04 −0.03	−0.06 ** −0.03
LIQ	−0.03 −0.02	−0.03 −0.02	−0.03 −0.02
LNGDP_P	−4.77 *** −1.49	−4.77 *** −1.49	−0.38 −2.10
INFL	0.11 −0.19	0.11 −0.19	−0.03 −0.19
_cons	77.72 **** −18.66	77.72 **** −18.66	63.53 *** −20.63
r2_a	0.75		0.68
r2_w		0.71	0.73
r2_o		0.78	0.62
r2_b		1	0
N	154	154	154
N_g		15	15

* $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$; **** $p < 0.001$.

The goodness of fit of FE (the R-squared within) is at a satisfactory level of 0.73. Estimators for coefficients of LNA, CAR, NPL, LLP, OEOI are significant at the at 5% level, and among them, NPL has the highest absolute value of coefficient (−5.62) which is significant at the at 1% level. LNA and LLP have relatively high absolute value of coefficients equal to −2.58 and 1.25, respectively.

Table 5 presents the three types of regression results for ROA.

The goodness of fit of FE (the R-squared within) is at a satisfactory level of 0.74. All the absolute values of coefficients are lower comparing with the regression of ROE. Coefficients of LNA, DTAR, NPL, and OEOI are significant at the at 1% level. Coefficients of CAR, LNGDP_P, and INFL are significant at the at 5% level. LNA and NPL has the highest absolute value of coefficient, −0.21 and −0.18, respectively.

Table 5. Regression results for ROA.

Models	POOL	RE	FE
LNA	−0.06 ** −0.03	−0.06 ** −0.03	−0.21 **** −0.06
DTAR	0.01 ** 0.00	0.01 ** 0.00	0.01 *** 0.00
CAR	0.03 *** −0.01	0.03 **** −0.01	0.02 ** −0.01
NPL	−0.22 **** −0.03	−0.22 **** −0.03	−0.18 **** −0.03
LLP	−0.01 −0.02	−0.01 −0.02	0.01 −0.03
OEOI	−0.01 **** 0.00	−0.01 **** 0.00	−0.01 **** 0.00
LIQ	0.00 0.00	0.00 0.00	0.00 0.00
LNGDP_P	−0.06 −0.07	−0.06 −0.07	0.19 ** −0.10
INFL	−0.02 * −0.01	−0.02 * −0.01	−0.02 ** −0.01
_cons	2.63 *** −0.92	2.63 *** −0.92	0.83 −0.96
r2_a	0.75		0.69
r2_w		0.72	0.74
r2_o		0.78	0.50
r2_b		1	0
N	154	154	154
N_g		15	15

* $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$; **** $p < 0.001$.

From the regression result, it can be seen that:

- (1) Bank size in terms of asset size has a negative impact on city banks' profitability, while in terms of deposit size it has positive impact (Hypotheses 1 and 2 are accepted).

Statistics at the end of 2021 show that the total assets of the four city banks are more than 2 trillion yuan, of which the Bank of Beijing has the highest total assets of 3058.959 billion, followed by the Bank of Shanghai with 2653.199 billion yuan. Bank of Jiangsu and Bank of Ningbo ranked third and fourth with 2618.874 billion and 2015.607 billion, respectively. The total assets of Bank of Nanjing, Bank of Hangzhou, Huishang Bank, and Shengjing Bank are between 1000–2000 billion. The total assets of Bank of Changsha, Bank of Chengdu, Bank of Tianjin, Bank of Harbin, Bank of Chongqing, and Bank of Zhengzhou range from 500 billion to 1 trillion. The total asset of Bank of Suzhou is 453.029 billion, and Bank of Xian holds the total asset as 345.864 billion. The banks in the sample are medium-sized banks, asset size has a negative impact on the profitability of the city commercial banks, regression for ROE has a significant coefficient equaling -2.58 at 5% level, and regression for ROA has a significant coefficient -0.2088 at 0.1% level. The empirical result is consistent with the literature (X. Qu 2007; Athanasoglou et al. 2008) and differs from the empirical findings, which concluded that asset size has no significant effect on profitability (Zhong 2013; Gu 2008).

The most direct effect of asset size is the scale effect. Commercial banks' economies of scale relate to the economic benefits that accrue from expanding their asset scale, and in the early stages, commercial banks' returns from scale expansion are incremental. Due to the fact that under the premise of the existence of economies of scale, the continuous expansion

of the bank's asset size will certainly bring about an increase in profits. The potential for scale efficiency appears to be exclusive to small banks (Berger and Humphrey 1994). The relationship between size and profitability may not be linear; small and large banks do not have economies of scale, but medium-sized banks do (Eichengreen and Gibson 2001; Athanasoglou et al. 2008).

Another metric for bank size used in this paper is deposit ratio (DTAR), since the city commercial banks in China mainly rely on traditional deposit and loan business. Deposit ratio estimates the range that assets are backed by the part of constant deposit. The main sources of funds that banks could use to earn profit are deposits. Bank size measured by deposit ratio has a positive impact on the profitability of the city commercial banks, but the coefficients are relatively small, regression for ROE has a non-significant coefficient, and regression for ROA has a significant coefficient equaling 0.01 at 1% level. The empirical result is consistent with Karimzadeh et al. (2013), who examined that deposit ratio has a positive impact on profitability of commercial banks in India. The empirical evidence is also consistent with the view of Berger and Humphrey (1994); the city commercial banks as medium-sized banks might achieve potential economies of scale, and increasing the proportion of deposit in total assets can make them benefit from the interest spread. Bank deposits are a more secure and cost-effective source of financing than other alternatives and should contribute to an increase in the sector's profitability (García-Herrero et al. 2009). However, the high proportion of deposits also indicates a high amount of interest is required for paying to the depositors, since interest spread is the source of profit of city banks.

- (2) Capital adequacy has a negative impact on ROE but has a positive impact on ROA of city banks.

According to empirical results, Hypothesis 3 is partially accepted. Capital adequacy ratio has a negative impact on ROE but has a positive impact on ROA. Capital adequacy ratio has a negative significant coefficient equaling -0.3354 at 5% level for ROE, and regression for ROA has a significant coefficient equaling 0.0170 at 5% level. The absolute value of the negative regression coefficient for ROE (0.3354) is relatively higher than the absolute value of the positive regression coefficient for ROA (0.0170). From the perspective of profitability, the lower the capital adequacy ratio, the better, since a lower capital adequacy ratio means that the amount of supporting capital required by commercial banks to carry out its business is relatively small; this is consistent with the empirical results that CAR has a positive effect on ROA. From the perspective of ROE, ROE reflects return on shareholders' equity. Commercial banks generally receive funds from retained earnings or new share offerings. The higher the amount of capital, the lower the bank's return on equity. If a bank needs to strengthen its capital, it may choose to use retained earnings rather than issuing new shares to arise capital, avoiding the consequence of more dividend payments, which in turn reduces the return on equity (Setiawan and Muchtar 2021). Therefore, it can be assumed that the empirical result of this study that CAR has a negative effect on ROE is reasonable. The empirical results are consistent with Liu and Lin (2016). Their research is based on a panel dataset of 145 commercial banks in China from 2003 to 2014, which found that capital adequacy has positive impact on ROA.

Capital adequacy ratio is the ratio of the bank's total capital to the bank's risk-weighted assets and reflects the bank's ability to withstand losses with its own capital before creditors and depositors suffer losses. Capital adequacy ratio is defined by regulators as a risk control measure generally adopted by the financial regulatory authorities in various countries, which can be used for the purpose of restraining the excessive growth of bank risk assets, and ensuring that banks have the ability to resist risks, thereby protecting the interests of bank creditors and depositors. Capital adequacy ratio reflects the ability of a commercial bank's capital to not only withstand the risk of non-performing loan losses, but also operate continuously and achieve normal profit.

The capital adequacy ratio captures the general safety and stability of the commercial bank. China has implemented Basel III since 2013, China Banking Regulatory Commission

announced the implementation of the Basel III capital regulations for all 511 commercial banks in China, the new capital regulations raised the minimum capital adequacy ratio (CAR) to 10.5% (from 8%), and for systemically important banks, the minimum CAR requirement is 11.5%. On 15 October 2021, there were 19 domestic systemically important banks including the four city commercial banks: Bank of Ningbo, Bank of Shanghai, Bank of Jiangsu, Bank of Beijing. For those banks that are identified as systemically important banks, the minimum CAR requirement is 11.5%, which is 1% higher than the requirements for other banks.

- (3) Credit quality has a significant impact on profitability: non-performing loan ratio has a negative impact; loan loss provision ratio has positive impact (Hypotheses 4 and 5 are accepted).

Non-performing loan ratio is a metric for assessing the credit quality and loan management of a commercial bank. A high ratio of non-performing loans means that the bank is facing credit risk and potential payment default, which has a direct effect on profitability: coefficient estimators negative, -5.62 (for ROE) and -0.18 (for ROA) at 0.1% level. The Loan Loss Provisioning Ratio measures a bank's ability to mitigate against credit risk. For city commercial banks, the regression coefficient for ROE is significant at the 5% level and is 1.25, while the regression coefficient for ROA is not significant. Zhong (2013)'s research on three city banks during 1999–2011 and a study by Gao and Yue (2020) on 15 city commercial banks during 2015–2018 showed the same results; non-performing loans have a negative impact, but provision has no significant effect.

It can be seen that credit quality has relatively significant impacts on profitability, indicating that non-performing loans can negatively affect bank profitability and the loan loss provision offsets the losses caused by non-performing loans to a certain extent. Although loan loss provisions give protection from loan payment defaults, they also have a negative impact on bank profitability since it is a part of the remaining profit that the bank can invest in. Moreover, a high ratio of loan loss provisions indicates a high ratio of non-performing loans, which is evidence for poor credit quality with the potential loss.

Commercial banks are financial intermediaries whose main business is absorbing deposits and issuing loans, and their profitability highly depends on the credit quality and credit management. Credit risk management is a great concern to both the Chinese banking industry and regulators. The China Banking Regulatory Commission requires commercial banks to regularly report their credit risk management-related indicators, including: non-performing loan ratio, non-performing asset ratio, provision coverage ratio, single-customer credit concentration, etc. According to China Banking and Insurance Regulatory Commission, a loan can be considered non-performing if the loan passes the payment deadline more than 90 days without the borrower paying the agreed installments or interest. Bank profitability is affected as a result of non-performing loans since banks cannot recuperate their interest and principal. Commercial banks are required by regulators to make loan loss provisions for potential losses, which serves as a protection against irrecoverable losses from anticipated defaulted loans.

- (4) Operating ratio has a negative impact on profitability (Hypothesis 6 is accepted).

Operational efficiency measures the ability of a commercial bank to effectively employ its resources to generate income. The greater the efficiency of operations, the more profitable the bank, since the bank can generate higher income or returns for the same or lower cost compared to an alternative. A smaller operating ratio indicates that the bank is more efficient in its business activities, and the bank is able to increase its profit by lower operating cost.

The regression result reveals that the significant coefficient for ROE is -0.06 at 5% level, and for ROA is -0.01 at 0.1% level. It can be seen that the values of coefficients are relatively small, indicating that the effect of operating ratio on profitability is limited for the banks in the sample. The regression result is consistent with the research by Gao and Yue (2020), which shows operating ratio has negative impact on ROA; their data covers

15 city commercial banks during 2015–2018. The lower the operating ratio, the lower the expense of the bank's unit income, indicating that the bank's ability to obtain income is stronger. However, from the perspective of long-term stable operation of banks, a higher operating expense may also be necessary for investment in infrastructure, technology systems, and human capital, which may not pay off in the short term, while in the long term these investments are essential for development and for generating more profit from banking activities.

(5) Current ratio has a non-significant impact on profitability (Hypothesis 7 is not accepted).

Current ratio (current assets/current liabilities) is implied as a measurement of liquidity, which aims to measure the financial security and short-term solvency of companies. The minimum regulatory standard for the current ratio of Chinese commercial banks is no less than 25%. The regression result shows that current ratio has a non-significant impact on profitability, which is different from Hypothesis 7. This indicates that for city commercial banks in China, liquidity risk has little constraint on the profitability of commercial banks. The main reason is that the liquidity risk of commercial banks is more short-term, and the profitability measured by ROE and ROA focus on relatively long periods of time. The information disclosure requires Chinese commercial banks to publish core financial indicators on a quarterly, semi-annual, and annual basis. Therefore, as long as the profitability indicators and liquidity indicators released by commercial banks are non-negative. During the 2007–2020 research period of this study, the average value of annual current ratio for city commercial bank is 63.09. A commercial bank with a higher current ratio means that the bank has a higher current assets value since the funds are more allocated in current assets, which indicates that the bank has high liquidity that will decrease liquidity risk. However, high current ratio also shows that the bank loses its opportunity in gaining more profit since the fund is not used properly (Ulzanah and Murtaqi 2015).

Our result can be confirmed by the conclusions of empirical studies on Chinese commercial banks and on banks from other countries, which states the same conclusion that current ratio is not related to profitability. Zhong (2013) and Gao and Yue (2020) confirmed that the current ratio has no significant impact on China's city banks' profitability. Staikouras and Wood's (2004) study on 685 European banks (from 13 countries) and Jumono and Mala's (2019) empirical analysis for 97 Indonesian banks support the same conclusion.

Liquidity refers to the ability of commercial banks to meet customer withdrawal and payment needs at any time. Liquidity risk refers to the risk that commercial banks cannot obtain sufficient cash in a short time at a fair cost for fulfilling payment obligations and satisfying regular business operations. Commercial bank liquidity includes asset liquidity and liability liquidity. Asset liquidity refers to the ability to realize assets, and the measurement criteria include the cost and speed of asset realization: the lower the asset realization cost, the stronger the liquidity of the asset; the faster the asset realization speed, the stronger the asset liquidity. Liability liquidity refers to the ability of a bank to obtain available funds at an appropriate price. The measurement criteria include the price of available funds and the timeliness; the lower the price of available funds, the stronger the liquidity of liabilities; the shorter the timeliness for obtaining available funds, the stronger the liquidity.

(6) Economic condition has significant effect on city banks' profitability: GDP has a positive effect (Hypothesis 8 is accepted), and inflation has a negative effect (Hypothesis 9 is accepted).

According to regression results, natural logarithm of GDP has a positive impact (0.19, at 5% significance level) on the profitability measured by ROA, while it has a non-significant impact on the profitability measured by ROE. Inflation has a negative significant impact on the profitability measured by ROA (−0.02, at 5% significance level), while it has an insignificant impact on the profitability in terms of ROE.

Economic conditions are the external factors that determine the profitability of commercial banks. Robinson (1952) states that the financial system merely reacts to movements

in the economy and does not actively stimulate economic growth—“where enterprise leads, finance follows”. The demand-following hypothesis assumes a causal connection between financial development and economic growth, which supports a positive impact of economic growth on financial development.

GDP as measure of the economic condition of the country has a direct impact on the profitability of commercial banks. In growing economies, there is demand for more credit. The economic condition of a country directly affects the supply and demand in the financial market, which directly affects the quantity and quality of bank operations. During the positive economic condition, enterprises will expand and the investment environment will be attractive, which will lead to an increase in demand for loans. At the same time, people’s consumption demand and investment demand will also increase. As the demand for credit increases, the profitability of the bank will increase accordingly. Conversely, during a negative economic condition, bank deposits, loans, and intermediary businesses will be affected negatively, which will lead to a decline in profitability.

The consequences of inflation can be significant, affecting both the stability of the financial system and the regulator’s capability to monitor the financial intermediaries’ solvency (Staikouras and Wood 2004). The effects of inflation on consumers and the resulting shifts in demand for various financial services have a significant indirect impact on commercial banks. Unexpected increases in inflation would make it harder for borrowers to maintain their finances, which might result in non-performing loans that will lead to increasing loan losses. In addition, inflation could also affect bank margins by influencing interest rates.

5. Conclusions

This study investigated the influence of internal and external determinants on the profitability of Chinese city commercial banks. The regression results demonstrate that bank-based internal factors and external macro-economic factors have a statistically significant effect on profitability and can be verified by the bank’s practical point of view. Asset size has a negative impact on city commercial banks, which may have achieved economies of scale as medium-sized banks in the Chinese banking system; Hypothesis 1 can therefore be shown to be acceptable. Deposits, interbank, and selling financial products are the main sources of funds for city bank. Interbank has high capital cost compared with deposits, and financial products offered by city banks are disadvantaged in competition with large banks; therefore, raising deposits is the most effective way for city banks to increase their profits. This is consistent with Hypothesis 2 and the regression validation. Regarding the impact of the capital adequacy ratio in Hypothesis 3, the paper draws different conclusions for different measures of profitability (positive for ROA, negative for ROE); however, the different results are reasonable from the different point of view of ROA and ROE. The mathematical relation between ROA and ROE can be written as: $ROE = ROA \times (\text{Asset}/\text{Equity})$. Including leverage ratio distinguishes ROE from ROA; as a typical highly leveraged institution, a bank usually has a relatively high leverage ratio. Therefore, CAR is negatively correlated with the ROE indicator with high leverage ratio. Both indicators used in this paper verify Hypotheses 4 and 5, showing that quality of credit could influence profitability: non-performing loans have a negative effect, and loan loss provision has a positive effect. The study also verified Hypothesis 6: operating ratio is negatively correlated with profitability. However, according to the regression result, Hypothesis 7 is not accepted since liquidity has a non-significant impact on city banks’ profitability. This is consistent with the empirical results of Liu and Song (2017) using the semi-annual data of listed Chinese commercial banks. Under the current strict banking regulation requirements in China, capital regulation may affect profitability, but liquidity hardly constrains commercial banks’ profitability, since the commercial banks themselves are highly liquid. At the same time, the strong government trust behind China’s banking system has greatly reduced the possibility of run-on deposits. Liu and Song (2017) believe that regulation requirements for high liquidity should be set at an appropriate benchmark.

In addition, we accept Hypotheses 8 and 9, since province GDP and inflation have a significant impact on profitability measured by ROA, while they have a non-significant impact on profitability measured by ROE. The economic development level of the province where the bank is located has a positive effect on bank profitability, and inflation has a negative effect.

The paper contributes to the relevant literature by identifying the determinants of city commercial banks' profitability considering the latest situation of the banking sector in China and reveals the relevance of regression modelling in the case of analyzing bank's profitability. The paper also provides practical implications from the perspective of improving bank profitability and is important for both banking management and regulators, as well as for the municipal and state. "The Law of the People's Republic of China on Commercial Banks" stipulates that commercial banks operate on the principles of safety, liquidity, and profitability; these three principles are the main aspects of supervision by regulators. Profitability is the requirement of commercial banks' business objectives and occupies a core position, which means that the bank strives to obtain the maximum profit in its business activities—that is, the minimum cost and expense are exchanged for the maximum operating result. Security refers to the bank's management of operational risks and to avoid the impact of various uncertain factors on its assets, liabilities, profits, reputation, etc., to ensure the stable operation and development of the bank. Liquidity directly affects the solvency of a bank. It is the ability of a bank to meet customer deposits at any time and meet necessary loan demands.

The study has the following limitations. First, it only covers 16 Chinese-listed city commercial banks as the research sample. Further research can focus on other countries or types of banks and accept or reject our results. Second, we analyze ROA and ROE as the main indicators of banks' profitability. The possible further directions of research can expand our research by considering other indicators. With the beginning of economic differentiation among regions, the operating profitability of regional-based city banks has been significantly differentiated: in regions with strong economic vitality, banks show better profitability and resilience; in regions with slower economic growth, banks have fallen into the dilemma of the shrinking scale of business and rising non-performing loan rate. This is a point that also needs to be made up for in future research. Third, the focus of this paper is on using panel data regression from the quantitative perspective. The qualitative could be included in future research. Nevertheless, study limitations do not reduce the value of the results of the presented research.

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