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Master Thesis U.S.E.

Investigating the Influence of Bank Characteristics and Macroeconomic Variables on the Profit Levels of China's Commercial Banks: A Comprehensive Panel Data

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Abstract

This thesis investigates the factors influencing the profitability of Chinese commercial banks, focusing on bank specific factors and macroeconomic variables during the COVID-19 pandemic. The central question addresses how bank-specific factors like capital adequacy, asset quality, liquidity, and deposit ratios, alongside macroeconomic factors, affect profitability measures such as ROAA, ROAE, and NIM. Using fixed-effects models on data from 64 banks spanning 2012 to 2022, the study finds significant relationships between these variables and bank profitability. Notably, the COVID-19 pandemic significantly impacted profitability, and liquidity and deposit ratios showing strengthened positive effects during this period. These findings suggest that effective liquidity and risk management are crucial for maintaining bank profitability in crises. Chinese policymakers and banks must adapt to dynamic economic conditions and regulatory changes to enhance stability.

Keywords: Chinese Commercial Banks, Bank Profitability, COVID-19

Content

1. Introduction

Commercial banks function as credit intermediaries, seeking to optimize liquidity, safety, and capital efficiency. They achieve this by acquiring funds and extending loans to generate income from the difference between deposit and lending rates. The profitability and stability of the banking industry are crucial markers of a nation's economic health under the current high degree of global economic integration, as well as essential components of preserving global financial stability. The banking sector is essential to accelerating economic growth because it converts deposits into profitable ventures (Levine et al., 2000; Tabash & Dhankar, 2014; Tabash, 2018). To achieve efficiency and effectiveness, the banking system must fulfill three main objectives: ensuring profitability, providing quality services to customers, and supplying adequate funds for lending needs. Bank profitability is vital at both the micro and macro levels since the sound development of the banking industry is essential to the expansion of any economy (Al-Homaidi, Tabash, Farhan, & Almaqtari, 2018). Macroeconomically, a robust banking industry can efficiently absorb adverse external shocks, ensuring the stability of the financial system (Al-Homaidi, Tabash, Farhan, & Almaqtari, 2018).

Especially since the outbreak of the COVID-19 pandemic, which has had unprecedented impacts on the global economy, research by Elnahass, Trinh, and Li (2021) discovered that the COVID-19 crisis significantly decreased the profitability, cost efficiency, financial stability, and stock market valuations of banks. This necessitates a deeper investigation into the determinants of commercial banks' profitability. By the end of 2021, COVID-19 had spread to over 200 countries and regions worldwide, with more than 250 million confirmed cases and close to 5 million deaths (WHO, 2021). As the largest developing country in the world, China faced significant challenges at the early stage of the pandemic and confronted prolonged trials. The Chinese government implemented stringent

epidemic prevention measures, including city lockdowns, travel restrictions, social distancing, and mass nucleic acid testing, to control the virus's spread (Wuhan Municipal Health Commission, 2020; National Health Commission of the People's Republic of China, 2020).

The requirement for social distancing and lockdown measures has resulted in significant economic damage. COVID-19 created a negative supply shock, forcing businesses to shut down and disrupting global supply chains (Funke & Tsang, 2020). Concurrently, the pandemic's adverse impact on future income growth expectations led to a demand-driven recession (Funke & Tsang, 2020). Weak aggregate demand further discouraged corporate investment (Funke & Tsang, 2020). The immense uncertainty heightened the wait-and-see approach of consumers and firms, destabilizing the global economy and causing financial market valuations to plummet (Funke & Tsang, 2020). To mitigate the negative impact of the COVID-19 pandemic on the economy and the financial sector, the People's Bank of China implemented a series of specific measures. From January 31 to July 16, 2020, it provided ample liquidity to the market through open market operations, standing lending facilities, central bank loans, and central bank discounting; additionally, it reduced the interest on business loans and supported special central bank lending (re-lending) to aid financial institutions; to further support small and medium-sized enterprises, the bank increased credit availability and reduced financing costs by lowering the reserve requirement ratio and adjusting loan interest rates (Funke & Tsang, 2020). The research findings indicate that the People's Bank of China (PBoC) effectively maintained liquidity and supported credit supply by utilizing a combination of price-based tools (such as interest rate adjustments) and quantity-based tools (such as reserve requirement ratios and various lending facilities) (Funke & Tsang, 2020). In addition, the implementation of creative strategies enabled the PBoC to accomplish these objectives without substantially augmenting the total debt load, so

bolstering economic endeavours and averting a more pronounced economic decline (Funke & Tsang, 2020). Furthermore, Gao, Li, and Wen (2023) validate that Chinese banks observed a substantial surge in deposit rates amid the COVID-19 pandemic. This pattern exemplifies the cautious approach of Chinese investors in response to the economic concerns brought forth by the pandemic.

Based on the aforementioned research and the findings of Al-Homaidi et al. (2018), this study aims to delve deeper into the specific factors related to the banking industry and macroeconomic parameters, and how the pandemic has impacted the profitability of Chinese commercial banks. The significant increase in liquidity and deposit rates of Chinese commercial banks during the COVID-19 pandemic is noteworthy (Funke & Tsang, 2020; Gao, Li, and Wen, 2023). Therefore, this study will also focus on liquidity and deposit ratio to analyse whether and how their impact on the operating capacity of commercial banks has changed during the pandemic. During the COVID-19 pandemic, how have the liquidity levels and deposit ratios of Chinese commercial banks affected their profitability? Have their impacts remained positive? Has the strength of their positive impact weakened during the pandemic? This study aims to answer these questions.

Studying China is extremely important because of its status as the largest developing nation and the second-largest economy in the world, as well as the severe effects it experienced during the early stages of the pandemic. Previous literature has extensively examined the impact of the pandemic on the financial and banking sectors of various countries. For instance, studies by Duan, El Ghoul, Guedhami, Li, and Li (2021) discussed changes in global banking system risks during the COVID-19 pandemic, Elnahass, Trinh, and Li (2021) researched the impact of COVID-19 on global banking stability, and Katusiime (2021) investigated the effect of the pandemic on the profitability of banks in low-income countries like Uganda. However, these studies primarily utilized datasets covering the early

stages of the pandemic. Given that the COVID-19 pandemic has largely been controlled, it is essential to include data spanning from 2020 to 2022 to comprehensively understand its impact on Chinese commercial banks. Therefore, this study aims to address this gap, enrich existing academic discourse, provide insights for other developing countries on maintaining banking profitability and stability amid global health crises, and offer a framework for the banking sector's response to potential future global challenges.

The paper is organized as follows: Section 2 explores existing literature on how bank-specific factors, macroeconomic parameters and COVID-19 impact commercial banks' profitability. Section 3 outlines the methodology, including model, data and variables utilized in the research. Section 4 discusses the empirical results, and Section 5 provides the conclusion.

2. Literature review

In the field of research on the determinants of profitability in commercial banks, both early and recent scholarly works have provided us with a rich theoretical foundation and empirical analysis. Existing research on bank profitability can mainly be divided into three categories: cross-country comparisons, regional comparisons, and single-country studies. Cross-country comparison studies explore common factors affecting the profitability of banks in different countries, for example, the analysis of 122 countries by Perera and Wickramanayake (2016), the study of 118 countries by Dietrich and Wanzenried (2014), and the regression analysis of 14 countries by Masood and Ashraf (2012). Regional comparison studies focus on the profitability comparison among different banks within the same region, like the study on GCC countries by Chowdhury and Rasid (2017), the analysis of 27 EU countries by Petria, Capraru, and Ihnatov (2015), and the research on nine African countries

by Lemma and Negash (2013). Single-country studies delve into the determinants of bank profitability in specific countries, for instance, the studies on China by Tan and Floros (2015) and Tan (2016). This review aims to systematically revisit these related studies, with a particular focus on how specific bank factors and macroeconomic factors influence bank profitability, in order to theoretically support the research on the profitability of Chinese commercial banks before and during the COVID-19 outbreak.

The profitability of banks is usually measured by the return on average assets (ROA), with its determinants broadly classified into internal and external factors (Short, 1979; Bourke, 1989). Internal factors involve bank-specific variables such as bank size, risk management capabilities, capital ratio, and operational efficiency. External factors, on the other hand, include environmental variables that affect the profitability of the banking sector as a whole, such as inflation rates, GDP growth, and central bank rates (Bourke, 1989; Molyneux & Thornton, 1992; Demirguc-Kunt & Huizinga, 1999). Therefore, this paper will review the existing literature from three perspectives: internal factors, external factors, and the impact of the pandemic.

2.1. Influence of internal factors on profitability

In the research on the profitability of commercial banks, bank-specific factors are considered critical determinants of bank profitability. The factors usually encompass characteristics such as bank size, capital sufficiency, asset quality, liquidity, deposit ratio, asset management efficiency, operational efficiency, leverage, and ownership structure. This section offers a thorough examination of how these factors impact the profitability of banks.

The size of a bank is typically quantified by the natural logarithm of its total assets (LnAS). Studies have shown a positive relationship between bank size and profitability, as

larger banks can achieve economies of scale and reduce operating costs (Demirguc-Kunt & Huizinga, 1999; Micco, Panizza, & Yanez, 2007; García-Herrero et al., 2009; Dietrich &Wanzenried, 2011). Islam and Rana (2017) found through panel data analysis of Bangladeshi banks that larger banks had higher profitability, mainly due to their ability to access low-cost funds and diversify risk. However, Goddard et al. (2013) pointed out that excessive bank size might lead to reduced management efficiency, thus negatively impacting profitability. Conversely, Yildirim (2014) found in a study on Turkish banks that bank size had no significant effect on profitability, possibly because smaller banks have greater flexibility and responsiveness in the market.

Capital adequacy (CAD), measured as the ratio of equity to total assets, is a crucial indicator of a bank's capital buffer. Existing research indicates that a bank's risk-bearing capability and profitability are generally improved by higher levels of capital adequacy (Demirguc-Kunt & Huizinga, 1999; Abreu & Mendes, 2002; Athanasoglou, Brissimis, & Delis, 2008; Menicucci & Paolucci, 2016). According to Athanasoglou et al. (2008), having enough capital has a significant positive impact on profitability, especially during times of economic uncertainty. Menicucci and Paolucci (2016) confirmed this in their study of European banks. They found that higher capital adequacy helps banks survive financial crises and stay profitable. However, Naceur and Omran (2011) found no significant effect of capital adequacy on bank profitability in their analysis of banks in the Middle East and North Africa. This difference might be due to the unique ways these countries manage risk and use capital.

The loans to total assets ratio (AQ) is commonly used to assess asset quality. Higher loan ratios can reduce bank profitability by increasing the number of non-performing loans. This has been noted by García-Herrero, Gavilá, and Santabárbara (2009), as well as Curak, Poposki, and Pepur (2012), and Menicucci and Paolucci (2016). García-Herrero et al. (2009) conducted an analysis of data from Chinese banks and identified a significant adverse effect

of asset quality on profitability, notably for banks with high loan concentrations. Menicucci and Paolucci (2016) also noted that poor asset quality negatively impacts net interest income and overall profitability. Conversely, Kosmidou (2008) found no significant impact of asset quality on profitability in Greek banks, likely because Greek banks have stricter loan approval and risk control processes, mitigating the impact of non-performing loans.

Liquidity (LIQ) refers to the ratio of liquid assets to total assets. High liquidity helps banks remain stable during market fluctuations but may also lead to holding low-yield assets, thereby affecting profitability (Bourke, 1989; Molyneux & Thornton, 1992; Demirguc-Kunt & Huizinga, 1999; Pasiouras & Kosmidou, 2007; Goddard et al., 2013).Demirguc-Kunt and Huizinga (1999) stated that banks with higher liquidity typically hold more low-yield assets, leading to decreased profitability. Pasiouras and Kosmidou (2007) found that highly liquid banks performed better during financial crises but worse during normal periods. Goddard et al. (2013) highlighted the dual effect of liquidity on bank profitability, depending on market conditions. However, Tan and Floros (2012) found no significant impact of liquidity on profitability in Chinese banks, possibly due to effective liquidity management strategies.

The deposit ratio (DEP), the ratio of deposits to total assets, is considered an important indicator of the stability of a bank's funding sources. Most studies suggest that a higher deposit ratio is usually associated with lower funding costs, thereby enhancing bank profitability (Demirguc-Kunt & Huizinga, 1999; Pasiouras & Kosmidou, 2007; Ogboi & Unuafe, 2013; Jara-Bertin et al., 2014; García-Herrero et al., 2009). Ogboi and Unuafe's study on Nigerian banks, Jara-Bertin et al. (2014) on Latin American banks, and García-Herrero et al. (2009) on Chinese banks all reached this conclusion. However, Dietrich and Wanzenried (2011) found that the deposit ratio had a minor impact on the profitability of Swiss banks, possibly due to more diversified funding sources in high-income countries.

Asset management efficiency (AM) is usually measured by the ratio of operating income to total assets. Most studies suggest that effective asset management can increase bank revenue, thereby enhancing profitability (Athanasoglou, Brissimis, & Delis, 2008; García-Herrero, Gavilá, & Santabárbara, 2009; Curak, Poposki, & Pepur, 2012; Petria, Capraru, & Ihnatov, 2015; Menicucci & Paolucci, 2016). However, Goddard et al. (2013) found that the impact of asset management efficiency might vary in different market environments, particularly during financial crises when its effect on profitability becomes more pronounced. Conversely, Said and Tumin (2011) found no significant impact of asset management efficiency on the profitability of Malaysian banks, possibly due to varying asset portfolios and management strategies in the region.

Operational efficiency (TOE), measured as the ratio of total operating costs to total assets, is an important indicator of bank management efficiency. Most studies suggest that lower operating costs usually indicate higher profitability (Abreu & Mendes, 2002; Micco, Panizza, & Yanez, 2007; Sufian & Chong, 2021). However, Menicucci and Paolucci (2016) found that the impact of operational efficiency might be minor in some market environments, indicating that the effect of operating costs might vary based on market structure and competition. Bashir (2003) claimed that operational efficiency had no significant impact on the profitability of Islamic banks, possibly due to differences in operational strategies and cost structures across banks.

Leverage (LR), measured as the ratio of total liabilities to total assets, is an important indicator of bank risk. Most studies suggest that higher leverage can lead to increased risk and non-performing loans, thereby reducing profitability (Demirguc-Kunt & Huizinga, 1999; Micco, Panizza, & Yanez, 2007; Athanasoglou et al., 2008; García-Herrero, Gavilá, & Santabárbara, 2009; Saona, 2016). Conversely, Kosmidou, Tanna, and Pasiouras (2008)

found no significant impact of leverage on the profitability of UK banks, possibly because UK banks have more mature and cautious risk management practices.

The number of branches (BRNCH) is an indicator of a bank's market coverage and customer contact points. Most studies suggest a positive relationship between the number of branches and bank profitability (Al-Homaidi et al., 2018; Islam & Rana, 2017; Goddard et al., 2013). Goddard et al. (2013) also noted that an increase in the number of branches helps banks serve customers better, thereby enhancing profitability. However, Athanasoglou et al. (2008) found that an increase in the number of branches could lead to higher management costs in some cases, thereby negatively impacting profitability. Naceur and Kandil (2009) found no significant impact of the number of branches on the profitability of banks in the Middle East and North Africa, possibly due to intense market competition where the marginal benefits of additional branches are lower.

In summary, bank-specific factors largely determine bank profitability. Understanding the role of these factors is crucial for formulating effective bank management strategies and improving profitability.

2.2. Influence of external factors on profitability

Macroeconomic factors are determinants related to the economic, industrial, and legal environment, over which banks have no control (Ongore & Kusa, 2013). Despite various approaches to data handling in numerous studies on bank profitability, macroeconomic determinants typically focus on GDP (such as annual GDP growth rate and per capita GDP), inflation, interest rates (long-term interest rates), and exchange rates (exchange rate against the dollar) (Acaravci & Çalim, 2013; Chowdhury & Rasid, 2017; Jara-Bertin et al., 2014; Marijana et al., 2012; Masood & Ashraf, 2012; Menicucci & Paolucci, 2016; Saona, 2016;

Pasiouras & Kosmidou, 2007). However, the impact of macroeconomic factors on bank profitability remains inconclusive.

Bourke's (1989) study aimed to test the Edwards-Heggestad-Mingo theory by analyzing the financial statements of 90 banks across twelve countries or regions from 1972 to 1981. Using a regression analysis model, Bourke examined the influence of external factors, including GDP growth rate, inflation rate, and interest rate, alongside internal factors, on bank profitability (the dependent variable). The study did not find any substantial evidence to prove that growth rate of GDP and the rate of inflation have an impact on the profitability of banks. Tan (2016) supports this finding. His study explored how competition and risk affect the profitability of Chinese commercial banks with different ownership structures. He conducted a detailed analysis of state-owned commercial banks (SOCBs), joint-stock commercial banks (JSCBs), and city commercial banks (CCBs) by Generalised Method of Moments (GMM) dynamic panel model. The study included independent variables such as bank characteristics, industry characteristics, and macroeconomic factors. The macroeconomic factors included the annual GDP growth rate and annual inflation rate. The dependent variables were Return on Assets (ROA), Return on Equity (ROE), Net Interest Margin (NIM), and Profit Before Tax (PBT). The results showed that the inflation rate did not significantly impact the profitability of any of the three types of banks. But the annual GDP growth positively affected the Return on Equity (ROE) and Net Interest Margin (NIM) of joint-stock commercial banks.

In contrast, Asli Demirgüç-Kunt and Harry Huizinga's (1998) study found that the yearly GDP growth rate had no significant impact on bank net interest margins. But the yearly inflation rate had a large positive impact on net interest margins. Other studies generally show that GDP and inflation rates significantly and positively influence bank profitability. Tan and Floros (2015) used a GMM dynamic panel model to investigate the

factors influencing profitability in 101 Chinese banks from 2003 to 2009. Their analysis focused on bank-specific factors, industry-specific factors, and macroeconomic factors. They used the annual inflation rate as a proxy for the latter. They found that the annual inflation rate positively affected banks' return on assets (ROA) and net interest margin (NIM), indicating that higher inflation rates resulted in higher loan returns for banks.

Athanasoglou, Brissimis, and Delis (2005) used a one-way error component regression model to examine Greek bank performance from 1985 to 2001. They discovered that the Consumer Price Index (CPI), as a proxy for expected inflation, had a significant positive impact on bank profitability. This suggests that banks could accurately predict future inflation and adjust interest rates to increase profits. Surprisingly, Abreu (2001), who used a linear regression model to study the profitability of commercial banks in four EU countries—Portugal, Spain, France, and Germany—from 1986 to 1999, found that the annual inflation rate had no significant impact on ROA but had a significant negative effect on interest margins.

In summary, the impact of GDP and inflation rates on different types of commercial banks varies by country and region and is marked by complex dynamics.

2.3. Impact of the COVID-19 pandemic on profitability

The global economy has been significantly affected by the outbreak of COVID-19. Financial industry and commercial banks' profitability are particularly impacted. Feyen et al. (2020) highlighted the significant influence of COVID-19 on global financial markets and banking stability, which results in increased loan loss provisions and a decline in profitability. Goodell (2020) explored the extensive ramifications of the pandemic on the financial sector, including aspects such as bank profitability, capital adequacy, and liquidity. Beck (2020)

discussed various effects on global banks, such as declining profits, reduced capital buffers, and upcoming regulatory challenges.

Based on an extensive analysis of data from over 1,090 banks across 116 countries, Elnahass, Trinh, and Li (2021) found that the global banking sector experienced a substantial decline in stability and financial performance due to the pandemic. Their analysis indicated significant decreases in bank profitability, cost efficiency, stock market valuations, and overall financial stability. Throughout the pandemic, the impacts of capital adequacy, liquidity, leverage, and non-performing loan ratios were particularly notable (Elnahass et al., 2021). The study also examined variations among different regions and types of banks, including traditional and Islamic banks, and found these effects to be widespread regardless of the region or type of bank.

Haider and Mohammad (2020) further supported these findings. They found a decrease in the profitability of banks in both developed and developing economies during the pandemic (Haider and Mohammad, 2020). In developed economies, banks faced problem of substantial declines in capital adequacy and liquidity, increased regulatory scrutiny. In developing economies, banks experienced significant increases in loan default rates and a decline in economic activity, leading to a significant drop in profitability. Carletti et al. (2020) found similar outcomes when examining EU banks. They observed a decrease in profitability, increased balance sheet pressures, and the need for business restructuring. Sufian and Chong (2021) reported that the pandemic negatively impacted the profitability of banks in Gulf Cooperation Council (GCC) countries, especially those heavily dependent on oil revenues.

In their study, Duan, El Ghoul, Guedhami, Li, and Li (2021) analysed data from 1,584 listed banks across 64 countries. They conducted an ordinary least squares (OLS) analysis over the period from February 6 to December 10, 2020 (Duan, El Ghoul, Guedhami, Li, &Li,

2021). Their research focused on evaluating the effects of the pandemic on the level of risk present in banking systems. The explanatory variables included bank size, bank leverage, loan-to-asset ratio (LTA), and bank capital ratio (Duan, El Ghoul, Guedhami, Li, & Li, 2021). The results showed that the negative impacts on systemic stability were more pronounced for large, highly leveraged, high-risk, high LTA, inadequately capitalized, and less centrally connected banks (Duan, El Ghoul, Guedhami, Li, & Li, 2021). However, these effects can be mitigated by formal banking laws (such as deposit insurance), ownership arrangements (like foreign and government ownership), and informal institutions (like culture and trust) (Duan, El Ghoul, Guedhami, Li, & Li, 2021). For example, banking systems in countries with stronger collectivist cultures showed greater resilience during the pandemic (Duan, El Ghoul, Guedhami, Li, & Li, 2021).

Studies focused on individual countries have also indicated similar trends. Zhu and Xie (2021) used data from Chinese city commercial banks and found that the pandemic led to a significant decline in bank profitability, with smaller banks being more severely affected. Gao, Li, and Wen (2021) examined changes in funding costs for Chinese banks during the pandemic, finding that funding costs increased significantly, especially in the initial stages. Market panic over the pandemic led to a sharp rise in funding costs, but government interventions through monetary and fiscal policies helped stabilize these costs, although the effects varied among different banks. Ozili (2020) studied Nigeria and pointed out that bank profitability was severely impacted during the pandemic due to reduced economic activity, increased loan default rates, and changes in the interest rate environment. Barua et al. (2020) assessed the impact on the banking sector in Bangladesh, noting decreased profitability, increased credit risk, and rising operational costs. Katusiime (2021) found that the pandemic significantly reduced bank profitability in Uganda, mainly due to decreased economic activity and increased loan default rates. Pandey, Sharma, and Kant (2020) found that the pandemic

led to a significant decline in loan demand in India, with increased defaults among small and medium enterprises (SMEs) and individual borrowers, leading to a rise in non-performing assets. However, the pandemic also accelerated the digital transformation of Indian banks to reduce physical contact and improve operational efficiency (Pandey, Sharma, and Kant, 2020). Mugo, Wanjiru, and Mwangi (2020) confirmed similar negative impacts on bank profitability in Kenya due to the pandemic, including decreased economic activity and increased non-performing loans.

All the studies mentioned above provide valuable insights into the impact of the pandemic on the banking sector.

2.4. Hypothesis and Contribution

Therefore, based on the reviewed literature, the following hypotheses are proposed to guide this study:

Hypothesis 1 (H1): During the COVID-19 pandemic, the liquidity levels of Chinese commercial banks have a significant positive impact on their profitability.

Hypothesis 2 (H2): During the COVID-19 pandemic, the deposit ratios of Chinese commercial banks have a significant positive impact on their profitability.

Hypothesis 3 (H3): The positive impact of liquidity levels on the profitability of Chinese commercial banks has weakened during the COVID-19 pandemic.

Hypothesis 4 (H4): The positive impact of deposit ratios on the profitability of Chinese commercial banks has weakened during the COVID-19 pandemic.

The empirical evidence presented in this study will demonstrate the influence of the COVID-19 pandemic on the relationship between liquidity, deposit ratios, and profitability in

Chinese commercial banks. By focusing this crisis, it will enhance comprehension of bank performance in extreme circumstances and provide unique perspectives on China's substantial banking sector. The results will provide policymakers and regulators with information regarding the effectiveness of liquidity and deposit management strategies during economic disruptions. This research will address a literature gaps by examining the behaviour of internal bank factors under pandemic-induced stress, thereby providing valuable implications for future financial stability and bank profitability strategies.

3. Methodology and Data

3.1. Research design

The research question of this study is to examine whether and how selected bank-specific factors, macroeconomic factors, and the COVID-19 pandemic affect the profitability of Chinese commercial banks. This paper uses certain bank-specific factors, several macroeconomic factors, and pandemic dummy variable as explanatory variables. The dependent variables, which reflect the profitability of the banks, are the Return on Average Assets (ROAA), Return on Average Equity (ROOE), and Net Interest Margin (NIM). Each explanatory variable's impact on the three dependent variables is analysed to determine the direction of the influence, whether positive or negative.

This study employs a quantitative research method, selecting annual macroeconomic data of China and relevant data from 64 Chinese commercial banks, including five state-owned commercial banks and other general commercial banks, for the period from 2012 to 2022. The analysis is conducted using Stata16.0. Initially, descriptive statistics are used to determine the mean, standard deviation, minimum, and maximum values for each variable. Then, correlation analysis and Variance Inflation Factor (VIF) analysis are performed to

check for multicollinearity among the variables, and autocorrelation tests confirm whether the variables exhibit first-order autocorrelation. Subsequently, the Hausman test is employed to identify the optimal regression model. According to its result, a fixed-effects model is selected for the regression analysis. To visually compare the impact of the pandemic, LIQ*COV, and DEP*COV, each dependent variable will undergo three fixed-effects model regressions. The three regressions will include the following sets of explanatory variables: other variables and the pandemic dummy variable, other variables and LIQ*COV, and other variables and DEP*COV.

3.2. Models and Variables

According to research on profitability of Indian commercial banks by Al-Homaidi et al. (2018), this study utilizes panel data estimation, the formulas are as followed (using ROOA as an example):

$$ROOA_{it} = \partial_i + \beta_1 CAD_{it} + \beta_2 AQ_{it} + \beta_3 LIQ_{it} + \beta_4 DEP_{it} + \beta_5 AM_{it} + \beta_6 TOE_{it} + \beta_7 \log(AS_{it}) + \beta_8 LR_{it} + \beta_9 BRNCH_{it} + \beta_{10} GDP_t + \beta_{11} INF_t + \beta_{12} COV_t + \in_{it}$$

$$ROOA_{it} = \partial_i + \beta_1 CAD_{it} + \beta_2 AQ_{it} + \beta_3 LIQ_{it} + \beta_4 DEP_{it} + \beta_5 AM_{it} + \beta_6 TOE_{it} + \beta_7 \log(AS_{it}) + \beta_8 LR_{it} + \beta_9 BRNCH_{it} + \beta_{10} GDP_t + \beta_{11} INF_t + \beta_{12} LIQ_{it} * COV_t + \in_{it}$$

$$ROOA_{it} = \partial_i + \beta_1 CAD_{it} + \beta_2 AQ_{it} + \beta_3 LIQ_{it} + \beta_4 DEP_{it} + \beta_5 AM_{it} + \beta_6 TOE_{it} + \beta_7 \log(AS_{it}) + \beta_8 LR_{it} + \beta_9 BRNCH_{it} + \beta_{10} GDP_t + \beta_{11} INF_t + \beta_{12} DEP_{it} * COV_t + \in_{it}$$

In which i represents individual banks; t denotes the year; $\beta 1$ to $\beta 15$ are the coefficients of determinant variables; ϵ is the error term.

This study utilizes an annual dataset spanning from 2012 to 2022, covering a total of 11 years, to analyze the determinants of profitability for Chinese commercial banks. The dataset integrates both macroeconomic factors and bank-specific factors to comprehensively assess their impacts on the profitability of these banks, measured through three key financial metrics: Return on Average Assets (ROOA), Return on Average Equity (ROOE), and Net Interest Margin (NIM).

The sample of this study is comprised of annual data for 64 Chinese commercial banks, including 5 state-owned commercial banks (Industrial and Commercial Bank of China (ICBC), China Construction Bank (CCB), Agricultural Bank of China (ABC), Bank of China (BOC), and Bank of Communications (BoCom)) and 59 ordinary commercial banks. The performance and challenges of the sector over the specified period are comprehensively examined in this dataset. The dataset is an unbalanced panel dataset because of the absence of data for specific institutions in specific years. In order to guarantee the accuracy and reliability of the research findings, mean imputation is used to deal with missing values.

The macroeconomic indicators included in the analysis are the GDP growth rate and inflation rate, as these factors typically have a significant impact on bank profitability, as indicated by a series of previous studies (Al-Homaidi et al., 2018; Dietrich & Wanzenried, 2014; Elnahass, Trinh, & Li, 2021; Lemma & Negash, 2013; Masood & Ashraf, 2012; Tan & Floros, 2015; Tan, 2016). The National Bureau of Statistics of China is the source of the data for the GDP growth rate and inflation rate. It guarantees the reliability and accuracy of Chinese macroeconomic data. This study calculates the annual inflation rate by using the

Consumer Price Index (CPI) inflation rate. It represents the change in the price level of a basket of consumer products and services purchased by households.

Al-Homaidi et al. (2018) also include a number of bank-specific factors, such as Bank Size, Capital Adequacy, Asset Quality, Liquidity, Deposit Ratio, Assets Management Efficiency, Operational Efficiency, Leverage, and Number of Branches. Higher levels of capital adequacy, asset quality, liquidity, deposit ratio, and asset management have a significant positive impact on bank profitability; conversely, a greater leverage ratio and operational expenses have a significant negative effect on bank profitability (Al-Homaidi et al., 2018). These data are obtained from the Bankscope database, a trusted source of global banking information.

This study intends to examine how the COVID-19 pandemic has affected the profitability of Chinese commercial banks. To do this, a pandemic dummy variable is included. Value 0 is represents the pre-pandemic period (2012-2019), while value 1 represents the pandemic period (2020-2022). Duan, El Ghoul, Guedhami, Li, and Li (2021) found that ownership structure affects the impact of the pandemic on systemic stability, particularly for banks that are large, highly leveraged, high-risk, have high loan-to-asset ratios, are inadequately capitalized, and have poor connectivity. Therefore, a state-owned bank dummy variable is included in the model, with 0 representing ordinary commercial banks and 1 representing state-owned commercial banks. Additionally, studies by Funke and Tsang (2020) and Gao, Li, and Wen (2023) confirmed that the liquidity and deposit ratios of Chinese commercial banks increased during the pandemic. Therefore, this study includes two interaction terms: the liquidity asset ratio multiplied by the pandemic dummy variable and the deposit ratio multiplied by the pandemic dummy variable, to explore whether the influence of these factors changes during the pandemic.

Based on previous research (Al-Homaidi et al., 2018; Dietrich & Wanzenried, 2014; Elnahass, Trinh, & Li, 2021; Lemma & Negash, 2013; Masood & Ashraf, 2012; Tan & Floros, 2015; Tan, 2016), ROOA, ROOE, and NIM are selected as dependent variables. The definitions of ROA and ROOA differ. ROA is calculated as net profit divided by total assets. In contrast, ROOA uses the average total assets instead of the end-of-period total assets. This approach helps to smooth out fluctuations in assets caused by seasonal or other short-term factors, providing a more stable and accurate measure of profitability. Despite the difference in their calculation methods, both metrics are used to assess a company's asset profitability. Consequently, ROA and ROOA are widely chosen in numerous studies. The same applies to ROE and ROOE. Net Interest Margin (NIM) is calculated as net interest income divided by total assets and similarly reflects the income a bank earns through interest rate spreads. The data for ROOA and ROOE are directly obtained from Bankscope, while the data for the dependent variable NIM are derived through calculation.

The calculation methods for all variables, as well as the definitions of the pandemic dummy variable and the state-owned bank dummy variable, are illustrated in Table 1.

Table 1: Variables

Variable Category	Variable Name	Description/Calculation Method	Source
Macroeconomic Factors	GDP Growth Rate (GDP)	Annual percentage growth rate of GDP	National Bureau of Statistics of China
Macroeconomic Factors	Inflation Rate (IF)	Annual Inflation Rate = [(Current Year CPI - Previous Year CPI) / Previous Year CPI] * 100%	National Bureau of Statistics of China
Bank-Specific Factors	Bank Size (LnAS)	Logarithm of total assets	BankScope Database
Bank-Specific Factors	Capital Adequacy (CAD)	Equity to total assets ratio	BankScope Database
Bank-Specific Factors	Asset Quality (AQ)	Loan to total assets ratio	BankScope Database

Bank-Specific Factors	Liquidity (LIQ)_	Liquid assets to total assets ratio	BankScope Database
Bank-Specific Factors	Deposits Ratio (DEP)	Deposits to total assets ratio	BankScope Database
Bank-Specific Factors	Assets Management Efficiency (AM)	Operational income to total assets ratio	BankScope Database
Bank-Specific Factors	Operational Efficiency (TOE)	Total operational cost to total assets ratio	BankScope Database
Bank-Specific Factors	Leverage (LR)	Total liability to total assets ratio	BankScope Database
Bank-Specific Factors	Number of Branches (BRNCH)	Count of physical bank branches	BankScope Database
Covid-19 Factor	Pandemic dummy variable (COV)	"1" for Covid-19 pandemic period "0" for other periods	Definition
Interaction Variable	Interact 1	LIQ*COV	Definition
Interaction Variable	Interact 2	DEP*COV	Definition
Outcome Variables	ROOA (Return on Average Assets)	Net profit to total assets ratio	BankScope Database
Outcome Variables	ROOE (Return on Average Equity)	Net profit to total equity ratio	BankScope Database
Outcome Variables	NIM (Net Interest Margin)	Net interest income to total assets ratio	BankScope Database

3.3. Descriptive Statistics

Table 2: Summary Statistics

VarName	Obs	Mean	SD	Min	Median	Max
ROOA	704	0.846	0.456	-0.828	0.845	4.966
ROOE	704	11.545	6.154	-7.763	11.374	33.506
NIM	704	1.821	0.671	-0.168	1.793	4.342
CAD	693	8.046	4.140	1.194	7.272	51.442
AQ	704	47.967	12.660	5.592	48.808	95.425
LIQ	704	27.899	12.123	1.173	26.193	77.254
DEP	671	64.450	15.371	2.877	66.539	91.566
AM	704	2.566	0.916	0.182	2.451	9.108
TOE	704	1.044	0.600	0.096	0.906	5.288
LnAS	704	8.782	0.762	7.400	8.591	10.598
LR	704	3.345	3.719	0.000	0.000	14.560
BRANCH	704	1262.339	4152.887	0.000	46.000	23682.000
GDP	704	0.064	0.019	0.022	0.069	0.084
IF	704	0.021	0.006	0.009	0.020	0.029

Table 2 displays the descriptive statistics for the variables corresponding to the data of 64 Chinese commercial banks over the period from 2012 to 2022. This analysis includes annual macroeconomic data and various financial indicators relevant to the study. Due to missing values in the branch number data, mean imputation was used to handle these missing values.

Dependent Variables

Among the profitability indicators, the mean Return on Operating Assets (ROOA) is 0.846% with a standard deviation of 0.456. The minimum ROOA is -0.828%, while the maximum is 4.966%, indicating a wide range of profitability among the banks. The mean Return on Operating Equity (ROOE) is 11.545%, with a standard deviation of 6.154. The minimum ROOE is -7.763%, and the maximum is 33.506%, suggesting significant variability in equity returns. The Net Interest Margin (NIM) has a mean of 1.821% and a standard deviation of 0.671, with values ranging from -0.168% to 4.342%. This spread indicates differences in banks' abilities to manage their interest income and expenses effectively.

Bank-Specific Explanatory Variables

CAD has a mean of 8.046% and a standard deviation of 4.140, ranging from 1.194% to 51.442%, suggesting discrepancies in bank capital strength. Asset Quality (AQ) ranges from 5.592% to 95.425% and averages 47.967% with a standard deviation of 12.660, demonstrating significant loan portfolio quality disparities across institutions. The Liquidity Ratio (LIQ) ranges from 1.173% to 77.254% with a mean of 27.899% and a standard deviation of 12.123. These numbers show that certain banks have high liquidity, while others may have liquidity constraints that affect short-term obligations.

A standard deviation of 15.371 and a mean Deposit Ratio (DEP) of 64.450% indicate banks' variable reliance on deposits for funding. Asset Management (AM) has a mean of

2.566% and a standard deviation of 0.916, with values between 0.182% and 9.108%, suggesting varied bank asset management and efficiency strategies. The mean Total Operating Expense (TOE) is 1.044%, the standard deviation is 0.600, the minimum is 0.096%, and the maximum is 5.288%, demonstrating operational efficiency. In the sample, bank sizes range from 7.400 to 10.598, according to the logarithm of Asset Size (LnAS) mean of 8.782 and standard deviation of 0.762.

Leverage Ratio (LR) ranges from 0.000 to 14.560%, with a mean of 3.345 and a standard deviation of 3.719. This shows banks' financial leverage and risk-taking vary. BRANCH has an average of 1262.339, a standard deviation of 4152.887, a minimum of 0.000, and a high of 23682.000, indicating a wide range in branch network sizes, which can affect customer reach and service delivery.

Macroeconomic Explanatory Variables

The mean GDP growth rate was 0.064% with a standard deviation of 1.9%, ranging from 2.2% to 8.4%, suggesting varied economic conditions across the years investigated. Average inflation (INF) is 2.1% with a standard deviation of 0.6%, ranging from 0.9% to 2.9%. These results imply that banks functioned in a stable macroeconomic climate with modest inflation, which could affect loan demand and interest rates.

4. Result Analysis

Multicollinearity refers to a situation where there is a high correlation between explanatory variables, which affects the accuracy of coefficient estimates in regression models. The Pearson correlation coefficient matrix analysis is used as a preliminary test for multicollinearity issues. Typically, a correlation coefficient absolute value greater than 0.7 may indicate the presence of multicollinearity. The analysis results, as shown in Table 3,

indicate that the majority of the explanatory variables do not exhibit multicollinearity issues. However, the correlation coefficients between ROOA and ROOE (0.849***), and NIM and AM (0.790***) show high correlations, which may lead to multicollinearity problems.

To further examine the multicollinearity issue, this study employs Variance Inflation Factor (VIF) and tolerance analysis. The VIF and Tolerance values are used to assess the extent of multicollinearity among the explanatory variables in a regression model. A VIF value greater than 10 typically indicates high multicollinearity, which can distort the estimated coefficients. Conversely, the tolerance value, which is the inverse of VIF (1/VIF), indicates the proportion of variance in an explanatory variable that is not explained by other explanatory variables. A tolerance value below 0.1 suggests high multicollinearity. Results are shown in Table 4. The mean VIF value is 2.36, which is well below the critical threshold of 10, suggesting that the model does not suffer from severe multicollinearity. All individual VIF values are also below 10, further indicating that there are no serious multicollinearity problems among the explanatory variables.

The Wooldridge test is used to detect first-order autocorrelation in panel data. The null hypothesis (H0) of the test is the absence of first-order autocorrelation. If the null hypothesis is rejected, it indicates the presence of autocorrelation. The test results are shown in Figures 1, 2, and 3.

Figures. 1 The autocorrelation test with ROOA as the dependent variable

```
Wooldridge test for autocorrelation in panel data
H0: no first order autocorrelation
    F(  1,      61) =    130.366
           Prob > F =      0.0000
```

Figures.2 The autocorrelation test with ROOE as the dependent variable

```
Wooldridge test for autocorrelation in panel data
H0: no first order autocorrelation
    F(  1,      61) =    116.307
           Prob > F =      0.0000

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Figures.3 The autocorrelation test with NIM as the dependent variable

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Wooldridge test for autocorrelation in panel data
H0: no first order autocorrelation
    F(  1,      61) =     62.721
           Prob > F =      0.0000
```

In all three tests, the F-statistics (130.366, 116.307, and 62.717) are very high, and the p-values are all 0.0000, well below the conventional significance level of 0.05. The null hypothesis is rejected, indicating strong evidence of first-order autocorrelation in the panel data. The results of correcting the autocorrelation issue using a first-order autoregressive process (AR(1)) to adjust the covariance matrix are shown in Table 5.

Given that the directions of the impacts of GDP and the pandemic differ from most studies, the Hausman test is used to determine whether the fixed effects model or the random effects model is more appropriate for this panel data. The Hausman test compares the fixed effects and random effects estimators to see if the difference between them is systematic or random. If the difference is systematic, the fixed effects model is preferred because it accounts for the potential correlation between the regressors and the unobserved individual effects. If the difference is random, the random effects model is preferred because it is more efficient. The null hypothesis is that the preferred model is random effects. And the alternative Hypothesis is that the preferred model is fixed effects. The results of the Hausman test are shown in Tables 6, 7, and 8. Since the p-values for all tests are 0, which is

significantly less than the confidence level of 0.05, the null hypothesis is rejected. Therefore, the fixed effects model is more appropriate for all dependent variables.

This study employs a fixed effects model with fixed individual effects. The regression results are presented in Table 9,10 and 11. In the first regression model, DEP, AM, GDP growth rate, and IF have a significant positive impact on ROOA, while LIQ has a marginally significant positive impact (i.e., statistically close to the significance level but not fully reaching the usual threshold). AQ and TOE have a significant negative impact on ROOA, and LR has a marginally significant negative impact. The results align with the conclusions drawn in the majority of research conducted by Acaravcı and Çalım (2013), Athanasoglou et al. (2008), Demirgüç-Kunt and Huizinga (1999), Bourke (1989), Tan and Floros (2012), and Menicucci and Paolucci (2016). Indeed, certain studies have identified varying effects of these variables on the profitability of banks. For example, García-Herrero et al. (2009) found that liquidity had no significant impact on the profitability of Chinese banks, possibly due to different operating environments and management strategies; Goddard et al. (2013) found different results as well. BRANCH has no significant impact on ROOA, which is consistent with the findings of Masood and Ashraf (2012). CAD has no significant impact on ROOA. This result is inconsistent with the study by Abreu and Mendes (2001), who found a significant positive impact of capital adequacy on profitability, but consistent with Al-Homaidi et al. (2018), who found no significant impact of capital adequacy on the profitability of Indian commercial banks. LnAS has a significant negative impact on ROOA, which is inconsistent with the findings of Goddard et al. (2013), who found a significant positive impact of bank size on profitability. One potential reason is that the profitability of banks may differ based on their size and the geographies they operate in. Remarkably, COV has a significant, albeit small, positive impact on ROOA, which contradicts the general view that the pandemic has a negative impact on bank profitability. One potential reason is that

Chinese commercial banks have received government assistance and financial rescue measures during the pandemic, may resulting in improved profitability and stability for the banks. The second regression model demonstrates that the interaction between LIQ and COV has a statistically significant and positive effect on ROOA. This suggests that during the pandemic, the influence of liquidity on bank profitability is enhanced. In the third regression model, the interaction term of DEP and COV has a significant positive impact on ROOA, similarly indicating that the positive impact of the deposit ratio on bank profitability is stronger during the pandemic. These findings are consistent with the results of Barua et al. (2020).

The regression results for ROOE and NIM are generally consistent with those for ROOA, with the key difference being that CAD has a significant negative impact on ROOE. Pasiouras, F., & Kosmidou, K. (2007) in their study on banks in certain European countries, and Berger, A. N. (1995) in his study on the profitability of U.S. banks, found similar results, indicating that in some cases, capital adequacy ratios have a negative impact on bank profitability, but this impact is usually small. A possible explanation is that greater capital adequacy ratios necessitate banks to maintain larger capital reserves, which in turn reduces the amount of money available for investment and lending. Consequently, this decrease in available funds leads to a decline in the bank's profitability. Another distinction is that TOE has a significant positive impact on NIM. Although similar conclusions are relatively rare, some studies indicate that appropriate operational investments can lead to efficiency improvements, thereby enhancing profitability. For instance, Dietrich and Wanzenried (2011) found that during the financial crisis, high operational expenses of Swiss banks were associated with higher net interest margins. Pasiouras and Kosmidou (2007) also pointed out that a bank's operational expenses can indirectly impact profitability by improving service quality and customer satisfaction. Increased operating expenses may result from investments

in technology and efficiency improvements, such as spending on digital infrastructure. These investments can enhance operational efficiency and service quality, leading to a better customer experience. As a result, these expenditures might lead to higher interest income and lower funding costs, thereby increasing overall profitability. Besides, the positive impact of the liquity ratio and deposit ratio on ROOE and NIM are also both stronger during the pandemic.

5. Discussion and Conclusion

5.1. Discussion

This study uses data from 64 Chinese commercial banks over the period 2012-2022 to analyze the impact of various factors on bank performance (ROOA, ROOE, NIM) using fixed-effects models. The effects of most explanatory variables are consistent with previous literature, and the different impacts of a few variables have been explained above. This section aims to provide policy recommendations for China and other countries, drawing on China's experience, to enable the banking industry to effectively cope with future major shocks similar to the pandemic.

China's savings rate has long been at a high level (Kraay, 2000; Modigliani & Cao, 2004; Horioka & Wan, 2007; Chamon & Prasad, 2010; Wei & Zhang, 2011; Yang, Zhang, & Zhou, 2011). Chinese banks have traditionally relied on deposits as their primary source of funding, which helps stabilize profitability (Demirgüç-Kunt & Huizinga, 1999; Islam & Rana, 2017; Petria et al., 2015). Deposits, as a stable and relatively low-cost source of funds, provide banks with sufficient capital support to sustain their lending and investment activities. Compared to banks that rely on short-term market financing, those relying on deposits are more stable in the face of market fluctuations because deposits are typically more

stable and have lower interest rates. Furthermore, a high deposit ratio can increase the net interest margin (NIM), then increase profitability. Notably, during the COVID-19 pandemic, the positive impact of high deposit ratios on profitability was significantly strengthened, providing a crucial buffer against economic disruptions.

In recent years, Chinese banks have strengthened liquidity management to cope with market fluctuations, thereby improving their profitability (Menicucci & Paolucci, 2016; Acaravcı & Çalım, 2013; Masood & Ashraf, 2012). This improvement in liquidity management generally includes increasing the proportion of high-liquidity assets to ensure that assets can be quickly liquidated under unfavorable market conditions to meet liquidity demands. For example, banks may increase their holdings of government bonds and other high-liquidity, low-risk assets, or enhance their monitoring and management strategies for liquidity risk. These measures not only improve banks' risk resilience but also stabilize their earnings to some extent. During the pandemic, effective liquidity management proved even more critical, with its positive impact on profitability being notably enhanced as banks navigated the economic uncertainty.

Additionally, Chinese banks have recently accelerated branch expansion, but excessive branches may increase operating costs, thereby affecting profitability (Bourke, 1989; Molyneux & Thornton, 1992; Augeraud-Véron & Boungou, 2023). Branch expansion can increase banks' market coverage and customer base, enhancing market share and brand influence. However, excessive branches can bring significant fixed and operating costs, including personnel, rent, and equipment maintenance. If these costs cannot be effectively covered by business growth, they will pressure banks' profitability. Especially in the current context of rapidly spreading digital financial services, the marginal benefits of physical branches may be diminishing, and excessive branch layouts need to be carefully evaluated for their cost-effectiveness.

The pandemic shock has led to an increase in non-performing loans in China, a phenomenon that is very common worldwide (Athanasoglou et al., 2008; Curak et al., 2012; Pasiouras & Kosmidou, 2007). An increase in non-performing loans typically means that banks need to set aside more provisions to cover potential bad debts, directly reducing profits. Furthermore, high levels of non-performing loans may cause banks to be more cautious in future credit extensions, impacting the expansion of lending businesses and further suppressing profitability.

Given all the findings and the special case of China, this paper proposes several policy recommendations. Firstly, for banks, they should enhance asset quality management by implementing better and more effective credit risk management to reduce non-performing loans and improve asset quality. Also, they should adopt effective liquidity management strategies, which can maximize short-term debt servicing, especially in times of economic downturn. Moreover, banks should improve operational efficiency by investing in technology and decreasing operational processes, therefore to reduce operating costs and improve profitability. Large banks should also try to achieve economies of scale. Secondly, for policymakers and governments, macroeconomic indicators such as GDP growth and inflation rates should be closely monitor. Furthermore, given China's high savings rate, policymakers should consider how to more effectively convert household savings into productive investments. For example, by offering more financial products and investment opportunities, encouraging households to invest their savings in capital markets, thus supporting economic growth and bank profitability (Kraay, 2000; Modigliani & Cao, 2004). During times of crisis, coordinated government support and rescue measures can stabilize the banking industry. Policymakers should design timely and effective policy to ensure banks remain resilient. Finally, for regulatory authorities, they should strengthen capital adequacy regulation to ensure banks maintain sufficient capital reserves to absorb negative shocks during crises. By

implementing these recommendations, it is more likely that banks, policymakers, and regulatory authorities can enhance the stability and profitability of the banking.

5.2. Limitation

Despite providing valuable insights into the factors affecting the profitability of Chinese commercial banks, this study has several limitations that need to be addressed in future research. Firstly, this study is based on data from 64 Chinese commercial banks between 2012 and 2022. Although the sample covers a wide range of time and banks, there may still be issues with sample representativeness. As the structure and policy environment of the Chinese banking industry continue to evolve, future research should consider including more samples and updated data to enhance the generalizability and reliability of the findings.

Secondly, while the fixed-effects models used in this study have advantages in controlling for individual heterogeneity, they still have limitations in explaining the causal relationships between explanatory and dependent variables. Although this study did not encounter multicollinearity issues between key variables, the models may still have limitations. For instance, the impact of capital adequacy (CAD) on bank profitability shows different results in various studies. This inconsistency may stem from model limitations, the failure to consider other potential influencing factors, or the overlapping information among variables, making it difficult for the model to accurately isolate the independent effects of each variable. Therefore, future research could employ more complex and comprehensive econometric methods, such as dynamic panel data models, structural equation models, ridge regression, or principal component analysis, to more accurately reveal the causal relationships between variables.

Thirdly, this study mainly focuses on the impact of internal management factors and macroeconomic factors on bank profitability, with relatively little consideration given to the policy environment and regulatory framework. The regulatory policies and market environment of the Chinese banking industry are highly dynamic and unique. Different policy adjustments may significantly impact bank profitability. Thus, future research should pay more attention to the effects of policy changes on the banking industry, exploring how regulatory environments, financial innovation, and market competition collectively influence bank performance.

Furthermore, some conclusions of this study differ from international research results, potentially reflecting the unique characteristics of the Chinese banking industry. However, whether these differences are solely due to regional and institutional variations or are influenced by different data processing methods or model settings requires further validation and comparative studies. Future research could employ cross-country comparisons or regional studies to deeply analyze the differences in bank profitability under various institutional environments and their underlying causes.

Finally, while this study includes major factors affecting bank profitability, it may still overlook some important variables. The comprehensive analysis lacked a full consideration of the impact of technological investments, advancements in financial technology, and changes in customer behavior on overall bank profitability. To thoroughly evaluate the factors affecting bank profitability, future research should incorporate more variables that reflect the ongoing developments in the banking industry, particularly as fintech progresses and the market environment changes.

In summary, this research has constraints related to sample representativeness, model setting, and insufficient policy environment evaluation. In order to conduct a more thorough

analysis of the factors influencing bank profitability, future studies can broaden the scope of their research by involving a larger range of participants, utilizing more advanced statistical techniques, and incorporating policy modifications and emergent variables.

5.3. Conclusion

This research examines the factors influencing the financial success of Chinese commercial banks by analyzing data from 64 institutions between 2012 and 2022. A fixed-effects model is used to analyze the impact of bank-specific and macroeconomic factors on three key profitability measures: Return on Average Assets (ROAA), Return on Average Equity (ROAE), and Net Interest Margin (NIM).

The findings show the complex determinants of Chinese commercial banks' profitability. Traditional characteristics such as asset quality and deposit ratios significantly impact bank profitability. The study also reveals that deposit ratios and liquidity levels had a significantly strengthened positive impact on profitability during the COVID-19 pandemic. It indicates their crucial role in maintaining financial stability. Additionally, the research highlights the significant impact of COVID-19 on bank profitability, which is confirmed by various paper before.

To gain a better understanding of the determinants of bank profitability in China, future research should expand its sample size, use advanced econometric models, and consider the changing financial and regulation policy. This approach will help implement better measures to improve the stability and profitability of Chinese commercial banks when facing future's economic challenges and opportunities.

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Appendix

Table 1: Variables

Variable Category	Variable Name	Description/Calculation Method	Source
Macroeconomic Factors	GDP Growth Rate (GDP)	Annual percentage growth rate of GDP	National Bureau of Statistics of China
Macroeconomic Factors	Inflation Rate (IF)	Annual Inflation Rate = [(Current Year CPI - Previous Year CPI) / Previous Year CPI] * 100%	National Bureau of Statistics of China
Bank-Specific Factors	Bank Size (LnAS)	Logarithm of total assets	BankScope Database
Bank-Specific Factors	Capital Adequacy (CAD)	Equity to total assets ratio	BankScope Database
Bank-Specific Factors	Asset Quality (AQ)	Loan to total assets ratio	BankScope Database
Bank-Specific Factors	Liquidity (LIQ)_	Liquid assets to total assets ratio	BankScope Database
Bank-Specific Factors	Deposits Ratio (DEP)	Deposits to total assets ratio	BankScope Database
Bank-Specific Factors	Assets Management Efficiency (AM)	Operational income to total assets ratio	BankScope Database
Bank-Specific Factors	Operational Efficiency (TOE)	Total operational cost to total assets ratio	BankScope Database
Bank-Specific Factors	Leverage (LR)	Total liability to total assets ratio	BankScope Database
Bank-Specific Factors	Number of Branches (BRNCH)	Count of physical bank branches	BankScope Database
Covid-19 Factor	Pandemic dummy variable (COV)	"1" for Covid-19 pandemic period "0" for other periods	Definition
Interaction Variable	Interact 1	LIQ*COV	Definition
Interaction Variable	Interact 2	DEP*COV	Definition
Outcome Variables	ROOA (Return on Average Assets)	Net profit to total assets ratio	BankScope Database
Outcome Variables	ROOE (Return on Average Equity)	Net profit to total equity ratio	BankScope Database
Outcome Variables	NIM (Net Interest Margin)	Net interest income to total assets ratio	BankScope Database

Table 2: Summary Statistics

VarName	Obs	Mean	SD	Min	Median	Max
ROOA	704	0.846	0.456	-0.828	0.845	4.966
ROOE	704	11.545	6.154	-7.763	11.374	33.506
NIM	704	1.821	0.671	-0.168	1.793	4.342
CAD	693	8.046	4.140	1.194	7.272	51.442
AQ	704	47.967	12.660	5.592	48.808	95.425
LIQ	704	27.899	12.123	1.173	26.193	77.254
DEP	671	64.450	15.371	2.877	66.539	91.566
AM	704	2.566	0.916	0.182	2.451	9.108
TOE	704	1.044	0.600	0.096	0.906	5.288
LnAS	704	8.782	0.762	7.400	8.591	10.598
LR	704	3.345	3.719	0.000	0.000	14.560
BRANCH	704	1262.339	4152.887	0.000	46.000	23682.000
GDP	704	0.064	0.019	0.022	0.069	0.084
IF	704	0.021	0.006	0.009	0.020	0.029

Table 3: Correlation Analysis

	ROOA	ROOE	NIM	CAD	AQ	LIQ	DEP	AM	TOE	LnAS	LR	BRANCH	GDP	IF	COV
ROOA	1														
ROOE	0.849***	1													
NIM	0.576***	0.503***	1												
CAD	-0.065*	-0.491***	-0.094**	1											
AQ	-0.206***	-0.156***	-0.010	-0.112***	1										
LIQ	0.179***	0.053	-0.022	0.354***	-0.503***	1									
DEP	0.316***	0.113***	0.367***	0.204***	-0.317***	0.165***	1								
AM	0.671***	0.504***	0.790***	0.081**	-0.085**	0.157***	0.417***	1							
TOE	0.227***	0.073*	0.500***	0.297***	-0.197***	0.384***	0.462***	0.692***	1						
LnAS	0.116***	0.185***	-0.067*	-0.239***	0.405***	-0.255***	-0.365***	-0.043	-0.388***	1					
LR	-0.183***	-0.368***	-0.237***	0.507***	-0.119***	0.042	0.047	-0.132***	-0.100***	0.091***	1				
BRANCH	0.202***	0.147***	0.108***	-0.005	0.149***	0.004	0.164***	0.142***	0.010	0.572***	0.005	1			
GDP	0.270***	0.331***	0.263***	-0.114***	-0.137***	0.178***	0.021	0.267***	0.261***	-0.110***	-0.299***	-0.005	1		
IF	0.156***	0.173***	0.137***	-0.031	0.011	0.118***	0.073*	0.132***	0.104***	-0.063	-0.148***	-0.010	-0.288***	1	
COV	-0.292***	-0.359***	-0.245***	0.133***	0.251***	-0.300***	0.008	-0.313***	-0.283***	0.131***	0.342***	0.008	-0.597***	-0.275***	1

Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Table 4: Variance Inflation Factor (VIF) and Tolerance (1/VIF)

Variable	VIF	1/VIF
LnAS	3.40	0.293734
TOE	3.13	0.319146
COV	2.73	0.366269
AM	2.65	0.377125
GDP	2.58	0.387960
BRANCH	2.19	0.457665
DEP	2.09	0.478618
CAD	2.01	0.498092
AQ	1.92	0.520280
LIQ	1.89	0.530174
LR	1.87	0.533717
IF	1.80	0.555024
Mean VIF	2.36	

Figures. 1 The autocorrelation test with ROOA as the dependent variable

```
Wooldridge test for autocorrelation in panel data
H0: no first order autocorrelation
    F(  1,      61) =    130.366
           Prob > F =      0.0000
```

Figures.2 The autocorrelation test with ROOE as the dependent variable

```
Wooldridge test for autocorrelation in panel data
H0: no first order autocorrelation
    F(  1,      61) =    116.307
           Prob > F =      0.0000

.
```

Figures.3 The autocorrelation test with NIM as the dependent variable

```
Wooldridge test for autocorrelation in panel data
H0: no first order autocorrelation
    F(  1,      61) =     62.721
           Prob > F =      0.0000
```

Table 5: Model Adjusted for Autocorrelation

	(1) ROOA	(2) ROOE	(3) NIM
CAD	-0.0005	-1.1390***	-0.0407***
	(-0.09)	(-6.66)	(-3.17)
AQ	-0.0051***	-0.0881***	0.0028
	(-3.49)	(-3.19)	(0.84)
LIQ	0.0040***	0.0540**	-0.0038
	(3.20)	(2.48)	(-1.32)
DEP	0.0040***	0.0111	0.0024
	(3.42)	(0.53)	(1.48)
AM	0.4500***	6.0012***	0.7582***
	(9.47)	(8.99)	(12.55)
TOE	-0.4191***	-5.1630***	0.0398
	(-4.58)	(-3.74)	(0.35)
LnAS	0.0577**	0.6382	-0.0980**
	(2.52)	(1.52)	(-2.18)
LR	-0.0098***	-0.1328**	-0.0102*
	(-2.73)	(-2.28)	(-1.80)
BRANCH	0.0000	0.0000	0.0000*
	(0.71)	(1.02)	(1.79)
GDP	1.9675*	41.9156*	1.8417
	(1.67)	(1.75)	(1.31)
IF	5.8027	127.0745	5.1754
	(1.49)	(1.61)	(1.09)
COV	0.0322	0.6976	0.1264
	(0.43)	(0.47)	(1.51)
_cons	-0.7052**	2.3452	0.7128
	(-2.45)	(0.45)	(1.41)
N	671	671	671
R^2	0.6904	0.7092	0.7769
Adjusted R^2			

Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Table 6: Hausman Test for ROOA as the Dependent Variable

Column (1) represents Random Effects, Column (2) represents Fixed Effects

	(1)	(2)
VARIABLES	RE	FE
CAD	-0.007	-0.009
	(0.006)	(0.007)
AQ	-0.009***	-0.011***
	(0.001)	(0.001)
LIQ	0.003***	0.002*
	(0.001)	(0.001)
DEP	0.005***	0.009***
	(0.001)	(0.001)
AM	0.531***	0.513***
	(0.023)	(0.026)
TOE	-0.396***	-0.424***
	(0.052)	(0.065)
LnAS	0.059*	-0.236***
	(0.035)	(0.080)
LR	-0.012***	-0.005*
	(0.003)	(0.003)
BRANCH	0.000	0.000
	(0.000)	(0.000)
GDP	3.541***	2.489***
	(0.577)	(0.591)
IF	9.338***	6.441***
	(1.623)	(1.689)
COV	0.120***	0.130***
	(0.025)	(0.025)
Constant	-0.892***	1.725**
	(0.343)	(0.741)
Observations	671	671
R-squared		0.676
Number of id	62	62
Hausman		75.01
p-value		0.000

Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Table 7: Hausman Test for ROOE as the Dependent Variable

Column (1) represents Random Effects, Column (2) represents Fixed Effects

	(1)	(2)
VARIABLES	RE	FE
CAD	-1.432***	-1.435***
	(0.095)	(0.097)
AQ	-0.155***	-0.166***
	(0.019)	(0.022)
LIQ	0.039**	0.021
	(0.015)	(0.015)
DEP	0.022	0.097***
	(0.016)	(0.020)
AM	6.927***	6.640***
	(0.360)	(0.372)
TOE	-4.400***	-6.501***
	(0.798)	(0.945)
LnAS	-0.082	-8.652***
	(0.553)	(1.164)
LR	-0.106**	0.014
	(0.045)	(0.044)
BRANCH	0.000	-0.000
	(0.000)	(0.000)
GDP	71.907***	45.084***
	(8.776)	(8.598)
IF	193.310***	113.855***
	(24.678)	(24.555)
COV	2.158***	2.276***
	(0.387)	(0.363)
Constant	6.689	84.008***
	(5.393)	(10.769)
Observations	671	671
R-squared		0.750
Number of id	62	62
Hausman		219.7
p-value		0.000

Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Table 8: Hausman Test for NIM as the Dependent Variable

Column (1) represents Random Effects, Column (2) represents Fixed Effects

	(1)	(2)
VARIABLES	RE	FE
CAD	-0.014	0.008
	(0.010)	(0.011)
AQ	-0.001	-0.003
	(0.002)	(0.002)
LIQ	-0.001	0.001
	(0.002)	(0.002)
DEP	0.003*	0.008***
	(0.002)	(0.002)
AM	0.812***	0.736***
	(0.038)	(0.040)
TOE	0.205**	0.354***
	(0.084)	(0.102)
LnAS	-0.043	-0.308**
	(0.058)	(0.126)
LR	-0.016***	-0.008*
	(0.005)	(0.005)
BRANCH	0.000	-0.000
	(0.000)	(0.000)
GDP	3.081***	1.833**
	(0.927)	(0.930)
IF	7.632***	4.048
	(2.608)	(2.656)
COV	0.223***	0.239***
	(0.041)	(0.039)
Constant	-0.330	1.716
	(0.567)	(1.165)
Observations	671	671
R-squared		0.762
Number of id	62	62
Hausman		49.79
p-value		0.000

Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Table 9: ROOA Fixed Individual Effects Model

	(1) ROOA	(2) ROOA	(3) ROOA
CAD	-0.0092	-0.0090	-0.0074
	(-1.37)	(-1.32)	(-1.09)
AQ	-0.0114***	-0.0094***	-0.0106***
	(-7.69)	(-6.51)	(-7.10)
LIQ	0.0017*	0.0014	0.0018*
	(1.70)	(1.37)	(1.72)
DEP	0.0089***	0.0094***	0.0088***
	(6.43)	(6.62)	(6.16)
AM	0.5132***	0.5008***	0.5094***
	(20.07)	(19.39)	(19.66)
TOE	-0.4235***	-0.4287***	-0.4213***
	(-6.52)	(-6.48)	(-6.39)
LnAS	-0.2359***	-0.2348***	-0.2292***
	(-2.95)	(-2.88)	(-2.83)
LR	-0.0055*	-0.0055*	-0.0057*
	(-1.79)	(-1.76)	(-1.86)
BRANCH	0.0000	0.0000	0.0000
	(0.17)	(0.11)	(0.12)
GDP	2.4885***	1.5561***	1.8781***
	(4.21)	(2.69)	(3.19)
IF	6.4406***	3.8079**	4.9714***
	(3.81)	(2.35)	(2.93)
COV	0.1301***		
	(5.22)		
LIQ*COV		0.0024***	
		(2.75)	
DEP*COV			0.0013***
			(3.55)
Individual fixed effect	Yes	Yes	Yes
_cons	1.7253**	1.7643**	1.7092**
	(2.33)	(2.34)	(2.28)
N	671	671	671
R^2	0.6760	0.6654	0.6682
Adjusted R^2	0.6363	0.6245	0.6276

Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Table 10: ROOE Fixed Individual Effects Model

	(1) ROOE	(2) ROOE	(3) ROOE
CAD	-1.4352***	-1.4465***	-1.4061***
	(-14.77)	(-14.63)	(-14.41)
AQ	-0.1659***	-0.1328***	-0.1606***
	(-7.68)	(-6.34)	(-7.42)
LIQ	0.0212	0.0136	0.0222
	(1.43)	(0.90)	(1.49)
DEP	0.0973***	0.0997***	0.0882***
	(4.82)	(4.84)	(4.25)
AM	6.6404***	6.4500***	6.6409***
	(17.86)	(17.22)	(17.73)
TOE	-6.5008***	-6.4642***	-6.3265***
	(-6.88)	(-6.74)	(-6.64)
LnAS	-8.6516***	-8.5349***	-8.4309***
	(-7.43)	(-7.23)	(-7.19)
LR	0.0141	0.0100	0.0046
	(0.32)	(0.22)	(0.10)
BRANCH	-0.0002	-0.0002	-0.0002
	(-0.60)	(-0.68)	(-0.67)
GDP	45.0836***	35.0620***	40.8928***
	(5.24)	(4.18)	(4.80)
IF	113.8554***	81.5199***	104.8934***
	(4.64)	(3.47)	(4.28)
COV	2.2761***		
	(6.28)		
LIQ*COV		0.0599***	
		(4.75)	
DEP*COV			0.0308***
			(5.67)
Individual fixed effect	Yes	Yes	Yes
_cons	84.0082***	83.5531***	82.5708***
	(7.80)	(7.64)	(7.61)
N	671	671	671
R^2	0.7504	0.7436	0.7475
Adjusted R^2	0.7198	0.7122	0.7166

Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Table 11: NIM Fixed Individual Effects Model

	(1) NIM	(2) NIM	(3) NIM
CAD	0.0077	0.0062	0.0106
	(0.73)	(0.58)	(1.01)
AQ	-0.0027	0.0008	-0.0024
	(-1.14)	(0.34)	(-1.04)
LIQ	0.0010	0.0001	0.0011
	(0.61)	(0.09)	(0.69)
DEP	0.0081***	0.0082***	0.0069***
	(3.71)	(3.71)	(3.07)
AM	0.7364***	0.7169***	0.7391***
	(18.31)	(17.74)	(18.33)
TOE	0.3542***	0.3607***	0.3778***
	(3.47)	(3.49)	(3.68)
LnAS	-0.3085**	-0.2942**	-0.2813**
	(-2.45)	(-2.31)	(-2.23)
LR	-0.0085*	-0.0090*	-0.0097**
	(-1.77)	(-1.86)	(-2.01)
BRANCH	-0.0000	-0.0000	-0.0000
	(-0.26)	(-0.35)	(-0.34)
GDP	1.8329**	0.9095	1.6424*
	(1.97)	(1.01)	(1.79)
IF	4.0479	0.9321	3.7511
	(1.52)	(0.37)	(1.42)
COV	0.2394***		
	(6.10)		
LIQ*COV		0.0067***	
		(4.91)	
DEP*COV			0.0035***
			(6.04)
Individual fixed effect	Yes	Yes	Yes
_cons	1.7162	1.6447	1.5204
	(1.47)	(1.40)	(1.30)
N	671	671	671
R^2	0.7617	0.7567	0.7614
Adjusted R^2	0.7326	0.7270	0.7323

Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1