

The impact of internet finance on bank profitability. Evidence from the Chinese commercial banks

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Abstract

Research Question: Does internet finance, measured by P2P lending and third-party payment, affect bank profitability?

Motivation: Prior studies have focused on the adoption, development, determinants, acceptance, risks and customer satisfaction using data from developed markets, while the impact of internet finance on bank profitability remains understudied. Our study aims to fill this research gap by investigating the impact of internet finance on the profitability of Chinese banks.

Idea: Employing static panel data regression analysis and this study explores whether internet finance, measured by P2P lending and third-party payment, affects bank profitability.

Data: We use data from 51 Chinese listed commercial banks during the period 2012-2019. Data were culled from CSMAR database and iResearch website.

Findings: The results show that internet finance exerts a positive effect on bank profitability for state-owned and joint-stock commercial banks, but adversely affects the profitability of regional commercial banks

Contribution: This is the first study that investigates the effect of internet finance on the profitability of state-owned, joint-stock and regional commercial banks separately. In addition to bank-specific variables, this study also considers macroeconomic variables that have been alleged to affect bank profitability.

Keywords: Internet finance; bank profitability; commercial banks

JEL codes: G15, G21

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1. Introduction

As internet creeps into every corner of society, the penetration rate of online payment in China from 2008 to the first half of 2022 reached a record high. In particular, by the June of 2021, around 86 percent of internet users in China had used online payment services². Moreover, it is estimated that by the end of 2022, the cumulated digital payment value in China will amount to 3.5 trillion USD, making the country a clear global leader for digital payments, followed by the United States with 1.8 trillion USD³. Taking advantage of the financial innovation evolution over the past decade and the widespread use of online payments throughout the population, Chinese banks have introduced internet finance to their customers as an alternative lending and payment system. Since its introduction in 2007 in China, internet finance, represented by peer-to-peer (P2P) lending and third-party payment, has grown and diversified at a dizzying rate. Today, hundreds of millions of people use third-party online payment services to carry out financial transactions, turn to peer-to-peer (P2P) lending platforms or online banks to borrow money, and sidestep brick-and-mortar financial institutions to invest their savings in online investment funds (Guo *et al.*, 2016). Moreover, third-party payment systems have been well integrated into Chinese commercial banks for several years and currently have a pivotal role in the bank payment and settlement system. The third-party payment platforms are fairly high-credit, serving as an intermediate for businesses and banks, including cross-border e-commerce, online to offline, and mobile payments (Wang *et al.*, 2021).

The role of internet finance in the global economy has been largely uncritical and depicted in positive terms. In particular, many scholars, media, and policymakers have pinpointed the rapid expansion of digital financial services as providing much-needed access to credit and pushing traditional banks to improve their services through competition—both of which are seen as contributing positively to the country's development (Arner *et al.*, 2015). Kolodinsky *et al.* (2004) and Alsajjan and Dennis (2010) among others, have highlighted the positive role of internet finance in enhancing the relationship between banks and customers. Likewise, Chen *et al.* (2021) proved that a large number of customers are willing to use internet finance as an effective and efficient way to interact with banks since the transaction cost is much lower than that of traditional retail banks. Moreover, internet finance allows banks to have more access to investing and financing which can result in higher profitability. However, the rapid growth of internet finance has initiated strong competition between traditional banks and alternative sources of financing provided through internet finance.

² <https://www.statista.com/statistics/248962/penetration-rate-of-online-payment-in-china/>

³ <https://daxueconsulting.com/payment-methods-in-china/>

Prior studies have focused on the adoption, development, determinants, acceptance, risks and customer satisfaction using data from developed markets, while the impact of internet finance on bank profitability remains understudied. Moreover, Chen *et al.* (2020) advocated that the empirical research on the impact of internet finance on bank profitability is limited because of the short period of development and prosperity of both P2P lending and third-party payment in China. This study aims to fill this research gap by investigating the impact of internet finance on bank profitability for the period from 2012 to 2019 using data from the Chinese banking industry which has undergone significant regulatory changes in the last decade. Another research objective of the current study is to test the effect of internet finance on the profitability of different types of commercial banks that operate in China. In particular, this study explores the effect of internet finance on the profitability of state-owned, joint-stock and regional commercial banks separately. In addition to bank-specific variables, this study also considers macroeconomic variables that have been alleged to affect bank profitability.

The results reveal that internet finance has a positive impact on the profitability of state-owned and joint-stock commercial banks, while the impact turns negative when regional banks are considered. These results provide evidence that regional banks encounter difficulties in reaping benefits from internet finance, while state-owned and joint-stock commercial banks tap into internet finance.

The rest of the article is organized as follows: Section two presents the pertinent literature. Section three describes the research design, while section four presents and discusses the empirical results. Section five provides concluding remarks and discusses managerial implications.

2. Literature review

2.1 Internet finance variable

Hou *et al.* (2016) were the first who tested the internet finance-bank profitability relationship by employing data from 56 Chinese commercial banks over the period of 2003-2014. Taking a wide range of control variables into account, they concluded that internet finance can enhance bank profitability by attracting more bank deposits and offering some conveniences in lending. Chen *et al.* (2020) explored whether internet finance affects the profitability of banks using data from 200 Chinese commercial banks over the period from 2011 to 2016. The findings showed that internet finance has a negative impact on bank profitability proxied by six ratios. These results suggest that as the use of internet banking increases, the interest income of loans decline and the interest expense of deposits rise. Moreover, internet finance leads to a lower growth rate of deposits and loans and a higher level of risk. Therefore, the empirical evidence from China so far is inconclusive and the

fundamental question of whether the development of internet finance benefits traditional banks remains open. Therefore, our first hypothesis conjectures that:

H1. The impact of internet finance on bank profitability can be either positive or negative.

2.2 Bank-specific variables

The pertinent literature has employed a gamut of bank-specific variables to construe bank profitability. Below we discuss the impact of following variables: bank size, the ratio of liquid assets to total assets (LIA), operating cost ratio (OPC), the ratio of loan loss provisions to total loans (LLP), the ratio of equity to total assets (EQASS) and the interest income to total loans (ININ).

The size of a bank can be deemed as an essential determinant of bank profitability as it is closely related to economies of scale (Athanasoglou *et al.*, 2008). As Boyd and Runkle (1993) assert, the large size is generally accompanied by economies of scale. Hence, compared with small banks, a significant advantage of large banks is that they have more ability to lower the cost of collecting and processing information. Such cost reduction subsequently enhances banks' profit levels. In terms of technical knowledge and technical potential related to cost and profit management, large banks compare favorably with small banks (Lee, 2009). Following Gropp and Heider (2010) and Chen *et al.* (2020), we use the natural logarithm of total assets to proxy bank size. Therefore, our second hypothesis conjectures that:

H2. Bank size positively affects bank profitability.

The ratio of liquid assets to total assets (LIA) is concerned with the liquidity management of banks, which is a crucial function in banks' operations. To date, the empirical evidence suggests that the LIA is expected to affect bank profitability, however, the direction of the effect is ambiguous. On the one hand, it is believed that banks with higher levels of liquidity are inclined to pursue more profit, which in turn motivates banks to intensify their intermediary business to expand their revenue sources (Ozili, 2017). On the other hand, liquid assets, which can be easily converted to cash, are often connected with lower expected returns. Consequently, high liquidity is likely to threaten bank profitability (Guru *et al.*, 2002). Sufian (2009) and Al-Homaidi *et al.* (2018) also find a negative association between liquidity and bank profitability in China's banking sector. Therefore, the effect of the liquid assets to total assets (LIA) on bank profitability is inconclusive.

H3. The impact of liquid assets to total assets (LIA) on bank profitability can be either positive or negative.

To proxy the expenses management, we employ the operating cost ratio (OPC) calculated as the operating cost scaled by total assets. A lower OPC indicates healthier cost management. Prior literature provides mixed evidence on the influence

of the OPC ratio on bank profitability. In particular, Pasiouras and Kosmidou (2007) found a negative impact of the OPC ratio on bank profitability, suggesting that professional and highly qualified expenses management is a prerequisite for the enhanced profitability of the banking industry in EU countries. Contrarily, Molyneux and Thornton (1992) found a positive impact of the OPC ratio on bank profitability, pointing out that paying higher payroll expenses to more productive staff can result in higher bank profits. Therefore, the impact of the operating cost ratio (OPC) on bank profitability is uncertain.

H4. The impact of the operating cost ratio (OPC) on bank profitability can be either positive or negative.

The ratio of loan loss provisions to total loans (LLP) is used to measure credit risk and is expected to have a negative impact on bank performance. Dietrich and Wanzenried (2011) contend that the higher the LLP, the poorer the quality of the loan portfolio and consequently the higher the risk that banks face. Therefore, a negative relationship between LLP and bank profitability is expected.

H5. The ratio of loan loss provisions to total loans (LLP) negatively affects bank profitability.

Capital adequacy defined as the ratio of equity to total assets (EQASS), representing the equity structure, is also taken into account in our model. According to Boubakri *et al.* (2017), higher capital-to-assets ratio is related to a lower cost of funding and bankruptcy risk. Sufian (2009) found a positive relationship between the EQASS and bank profitability using data from the Chinese banking sector, suggesting that a higher level of capital adequacy enables banks to survive in financial crises and secure the safety of deposits in the case of an unstable macroeconomic environment. Therefore, a positive relationship between EQASS and bank profitability is expected.

H6. The ratio of equity to total assets (EQASS) positively affects bank profitability.

Another variable that is considered in our model is the ratio of interest income to total loans (ININ). A higher ININ implies more interest earnings, eventually contributing to improved bank profits (Chen *et al.*, 2020). Therefore, a positive association between ININ and bank profitability is conjectured.

H7. The ratio of interest income to total loans (ININ) positively affects bank profitability.

2.3 Macroeconomic variables

Bhaumik *et al.* (2011) contended that inflation has a direct impact on banks' economic activities and the composition of banks' portfolios, which in turn affects bank profitability. Trujillo-Ponce (2013) showed that the extent to which inflation (INF) affects bank performance depends on whether the bank is able to accurately

predict future changes in inflation. If the extent of inflation can be fully estimated, then the bank can accordingly adjust the interest rate to ensure its income exceeding cost to enhance profits. Following Karimzadeh and Reza (2013), inflation is calculated by the change in the consumer price index (CPI) and is expected to have a positive impact on bank profitability.

H8. Inflation (INF) positively affects bank profitability.

Monetary policy is another macroeconomic variable that might affect bank performance. Qiao *et al.* (2018) asserted that a looser monetary policy results in a higher money supply. Under tight monetary regimes, banks are constrained in establishing proper prices for their deposits and loans which results in exerting pressure on the operating margin and adversely impacting bank profitability (Trujillo-Ponce, 2013). Furthermore, Bhaumik *et al.* (2011) opined that different types of banks respond rather differently to monetary policy. Following Hou *et al.* (2016), we employ the growth rate of the broad measure of money supply (M2GROWTH) to reflect changes in China's monetary policy and we expect a negative effect on bank profitability.

H9. Money supply (M2GROWTH) negatively affects bank profitability.

3. Research design

3.1 Sample

To form the final sample, this study considers all Chinese listed commercial banks that had been active between January 1, 2012 and December 31, 2019. In particular, the final sample consists of 6 state-owned commercial banks, 9 joint-stock commercial banks and 36 regional commercial banks (including city and rural commercial banks). Based on the data available, we constructed an unbalanced panel dataset of 51 Chinese commercial banks with a total of 351 observations. Accounting data for all banks were culled from CSMAR database. Data on internet finance such as P2P and third-party payment were obtained from the database on the iResearch website (www.iresearch.com.cn).

3.2 Methodology

Following prior studies that empirically tested the impact of internet finance or internet banking on bank profitability (Hernando & Nieto, 2007; Athanoglou *et al.*, 2008; Siddik *et al.*, 2016; Chen *et al.*, 2020), we employ panel data regression analysis which provides superior estimates compared to the cross-sectional models. In specific, panel data regression models (i) are less likely to suffer from multicollinearity among the explanatory variables, (ii) control for the presence of bank-specific effects, and (iii) better detect and measure effects that cannot be

observed in pure cross-section or pure time-series data (Wooldridge, 2010). The static regression model has the following form:

$$Y_{i,t} = \alpha + \beta_1 \text{Internet}_t + \sum_{i=2}^n \beta_i \text{Control}_{i,t} + \sum_{i=2}^n \theta_i \text{Macro}_{i,t} + v_i + \varepsilon_{i,t}$$

where the subscripts *i* and *t* refer to an individual bank and in a particular year, respectively. $Y_{i,t}$ denotes the dependent variable, that is, the performance of commercial banks. α is a bank fixed effect term that captures time-invariant influences specific to bank. v_i is the unobserved bank-specific effect, and $\varepsilon_{i,t}$ is the error term. We estimate the baseline Equation (1) using a fixed effect (FE) model with robust standard errors clustered at the firm level to control for heteroscedasticity and serial correlation among the observations of the same firm in different years. The Hausman test was employed to check for fixed-effects versus random-effects.

Following prior relevant studies (Pasiouras & Kosmidou, 2007; Athanasoglou *et al.*, 2008; Singh *et al.*, 2016; Al-Homaidi *et al.*, 2018; Chen *et al.*, 2020), we proxy bank performance using return on assets (ROA) which measures how efficiently banks achieve earnings on specific assets, calculated as net income divided by total assets. We also employ return on equity (ROE), computed as net income scaled by shareholders' equity, as an alternative bank profitability metric. The variable of interest in the model specification is internet finance (INTERNET). Following prior studies (Chen *et al.*, 2020; Tobing & Wijaya, 2020), we proxy internet finance as the sum of the trading volume of third-party payment and peer-to-peer lending scaled by total assets. Chen *et al.* (2020) claim that given that internet finance is not limited by time and space, it is reasonable to apply country-level data in the regression analysis.

In addition to the impact of internet finance, we use a gamut of bank-specific (control) and macroeconomic variables that have been alleged to affect bank profitability. Following prior literature (Maudos & De Guevara, 2004; Athanasoglou *et al.*, 2008; Naifer, 2010; Adusei, 2015; Siddik *et al.*, 2016), we include bank-specific factors such as size, liquidity (LIA), credit risk (LLP), expenses management (OPC and OEASS), capital adequacy (EQASS) and loan interest (ININ). Macroeconomic variables include inflation (INF) and money supply (M2GROWTH). Table 1 summarizes all variables and definitions.

Table 1. Definition of variables

Acronym	Variable	Definition	Prior studies
ROA	Return on assets	Net income / total assets	Chen <i>et al.</i> (2020)
ROE	Return on equity	Net income / equity	Athanasoglou <i>et al.</i> (2008)
INTERNET	Developmental scale of Internet finance	Trading volume of third-party payment	Chen <i>et al.</i> (2020)

Acronym	Variable	Definition	Prior studies
		and P2P lending / total assets	
SIZE	Total assets	Natural logarithm of total assets	Chen <i>et al.</i> (2020)
LIA	Liquidity ratio	Liquid assets / total assets	Sufian (2009)
LLP	Loan loss provisions ratio	Loan loss provisions / total loans	Trujillo-Ponce (2013)
OPC	Operating cost ratio	Operating cost / total assets	Athanasoglou et al. (2008)
EQASS	Equity-to-assets ratio	Equity / total assets	Chen <i>et al.</i> (2020)
OEASS	Overhead expenses ratio	Overhead expenses / total assets	Sufian (2009)
ININ	Ratio of interest income to total loans ratio	Interest income / total loans	Chen <i>et al.</i> (2020)
INF	Annual inflation rate	Consumer Price Index (CPI)	Karimzadeh and Reza (2013)
M2GROWTH	Monetary policy	The growth rate of the broad measure of money supply (M2)	Hou <i>et al.</i> (2016)
CGDP	Economic growth	The growth of the gross domestic product	Trujillo-Ponce (2013)

Table 2 displays the descriptive statistics of all variables for the full sample. The mean (median) of ROA is 1% (0.9%). The mean of the internet finance index is 188.488 and its median is 26.29. The mean (median) size of banks is 27.451 (1.717). On average, liquid assets (LIA) account for 79.4% of total assets.

The mean and median of the loan loss provisions ratio (LLP) is 3.3% and 2.9%, respectively. Equity-to-assets ratio (EQASS) has a mean (median) value of 6.9% (6.8%), while the mean (median) operating cost-to-assets (OPC) ratio is 2.6% (2.7%).

Table 2. Descriptive Statistics

Variable	Obs.	Mean	Median	Std. Dev	Min	Max
ROA	351	0.010	0.009	0.002	0.003	0.021
INTERNET	351	188.488	26.290	405.993	0.044	2,929.736

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Variable	Obs.	Mean	Median	Std. Dev	Min	Max
SIZE (Ln)	351	27.451	27.151	1.717	23.136	31.036
LIA	351	0.794	0.799	0.091	0.536	0.987
LLP	351	0.033	0.029	0.034	0.014	0.625
EQASS	351	0.069	0.068	0.012	0.025	0.116
OPC	351	0.026	0.027	0.010	0.002	0.056
ININ	351	0.103	0.099	0.028	0.057	0.245
INF	351	102.130	102.000	0.485	101.400	102.900
M2GROWTH	351	0.110	0.113	0.025	0.070	0.144

Note: This table presents a summary of descriptive statistics for all variables. INTERNET is the ratio of the trading volume of third-party payment and P2P lending to total assets. SIZE is the natural logarithm of total assets. LIA is the ratio of liquid assets to total assets. LLP is the ratio of loan loss provisions to total loans. EQASS is the ratio of equity to total assets. OPC is the ratio of operating cost to total assets. ININ is the ratio of interest income to total loans. INF is the consumer price index. M2GROWTH is the growth rate of the broad measure of monetary supply.

Table 3 presents the correlation coefficients between the dependent and independent variables. There is a negative correlation between ROA and internet finance variable. Size, liquidity ratio (LIA) and loan loss provisions ratio (LLP) are also negatively correlated with ROA. In contrast, equity-to-assets (EQASS), operating cost-to-total assets (OPC), interest income to total loans (ININ) and the two macroeconomic variables are positively related to ROA. Overall, the coefficients between independent variables are relatively low, therefore, the data does not suffer from multicollinearity problems.

Table 3. Correlation Analysis

	ROA	INTERNET	SIZE	LIA	LLP	CAPITAL	OPC	ININ	INF	M2GROWTH
ROA	1									
INTERNET	-0.298	1								
SIZE	-0.099	-0.375	1							
LIA	-0.071	-0.040	0.077	1						
LLP	-0.026	0.033	-0.003	-0.079	1					
EQASS	0.113	0.308	-0.131	-0.181	0.079	1				
OPC	0.019	-0.022	-0.060	0.069	-0.008	0.021	1			
ININ	0.222	-0.110	-0.415	0.006	-0.071	-0.309	-0.107	1		
INF	0.212	0.091	-0.023	0.133	0.005	0.061	-0.232	-0.101	1	
M2GROWTH	0.475	-0.421	-0.177	0.202	-0.118	-0.267	0.180	0.293	0.123	1

Note: This table presents a summary of descriptive statistics for all variables. ROA is the ratio of net income to total assets. INTERNET is the ratio of the trading volume of party payment and P2P lending to total assets. SIZE is the natural logarithm of total assets. LIA is the ratio of liquid assets to total assets. LLP is the ratio of loan loss provision to total loans. EQASS is the ratio of equity to total assets. OPC is the ratio of operating cost to total assets. ININ is the ratio of interest income to total loans. INF is the consumer price index. M2GROWTH is the growth rate of the broad measure of monetary supply.

4. Empirical results

4.1 Regression analysis

Table 4 presents the results of the baseline model employing static panel data regressions using ordinary least squares (OLS). Column 1 reports the regression results for the full sample, column 2 for the state-owned commercial banks, column 3 for the joint-stock commercial banks and column 4 for the regional commercial banks. The regression results show that the internet finance (INTERNET) variable measured by P2P and third-party payment has a negative effect on ROA at the 1% significance level ($\beta = -0.001$, $p < 0.001$). This result is in line with that of Onay and Ozsoz (2013) and Chen *et al.* (2020) who also found that internet finance negatively affects the profitability of Chinese commercial banks.

However, the impact of internet finance on profitability is heterogeneous among different types of banks. Specifically, the impact of internet finance is positive and statistically significant for state-owned commercial banks ($\beta = 0.001$, $p < 0.001$) and for joint-stock commercial banks ($\beta = 0.001$, $p < 0.001$), while it is negative and statistically significant for regional commercial banks ($\beta = -0.001$, $p < 0.001$). The reason behind the negative effect of internet finance on regional banks' profitability can be explained by their limited capital, personnel and risk management mechanisms, which are indispensable to the provision of alternative online bank services to customers. In contrast to the regional commercial banks, the state-owned commercial banks have sufficient financial resources and strong government support.

Moreover, state-owned commercial banks possess state-of-the-art online platforms and IT technology, which enable them to better control risks related to internet finance. Therefore, internet finance is properly utilized by state-owned commercial banks to expand the scope of their business and enhance their profitability. Similarly, internet finance seems to enhance the profitability of joint-stock commercial banks through technological advancements that allow them to offer innovative products or services to their customers.

The coefficient of bank size is positive and statistically significant in all regression models corroborating our second hypothesis. This result accords with that of Athanasoglou *et al.* (2008) who found that larger banks have higher profitability than smaller banks due to their easy access to raise funds with lower costs. Pasiouras and Kosmidou (2007) also found a positive correlation between bank size and bank performance using data from fifteen EU countries. The coefficient of LIA is positive in all regressions, but statistically significant for the full sample ($\beta = 0.003$, $p < 0.001$), and that of regional commercial banks ($\beta = 0.002$, $p < 0.05$). This result is in line with Adusei (2015) who also found that the ratio of liquid assets to total assets has a

positive and statistically significant effect on the profitability of regional commercial banks. Abbas *et al.* (2019) argued that smaller and rural commercial banks usually have limited access to capital markets for short-term funding. Consequently, small and rural banks must keep sufficient liquid assets vis-a-vis large banks.

The coefficient of loan loss provisions (LLP) is positive in all regression models, but statistically significant for the joint-stock and regional commercial banks. According to the skimping hypothesis put forward by Berger and Udell (1997), a bank might reduce its short-term cost for the sake of long-term profits. To do that, a bank may choose to shrink the expenses associated with monitoring loans and at the same time, it bears the higher credit risk and more relevant loan performance problems.

Given China's national conditions, the insignificant effect of the LLP on the performance of state-owned commercial banks could be attributed to their competitive advantages in the Chinese credit market and their strong ability to resist risk. Consequently, state-owned commercial banks are definitely less affected by credit risk (Chen *et al.*, 2020). In accord with Abbas *et al.* (2019) and Chen *et al.* (2020), the equity to assets ratio (EQASS) is positively associated with bank profitability, thus verifying our sixth hypothesis. In particular, our results show that EQASS has a statistically significant effect on the profitability of state-owned and regional commercial banks, whereas this effect is non-significant for joint-stock commercial banks.

The coefficient of the operating cost ratio (OPC) is negative and statistically significant for the full sample ($\beta = -0.023$, $p < 0.05$) and for the sample of regional banks ($\beta = -0.049$, $p < 0.001$). This result is in line with Athanasoglou *et al.* (2008) and Al-Homaidi *et al.* (2018) who found that a lower operating cost ratio is associated with higher bank profitability. Consistent with prior evidence, the ratio of interest income to total loans (ININ) is positively related to bank profitability across all types of banks. This result is congruent with our seventh hypothesis.

Turning our attention to macroeconomic variables, we observe that inflation (INF) positively impacts bank profitability, a result that echoes the empirical research of Sufian (2009) who also found that inflation positively affects ROA. This result is in accord with our eighth hypothesis. In contrast, no significant impact is observed between M2GROWTH and bank profitability for the state-owned commercial banks and joint-stock commercial banks. However, M2GROWTH turns out to be a significantly negative determinant of the bank profitability of regional commercial banks. This finding is in line with our ninth hypothesis.

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Table 4. Regression results of Chinese listed commercial banks

	Full sample	State-owned commercial banks	Joint-stock commercial banks	Regional commercial banks
INTERNET	-0.001*** (-6.82)	0.001*** (2.66)	0.001* (1.89)	-0.001*** (-6.65)
SIZE	0.003*** (9.10)	0.003*** (8.34)	0.004*** (4.51)	0.003*** (8.26)
LIA	0.003*** (3.65)	0.003 (0.62)	0.003 (1.32)	0.002** (2.22)
LLP	0.001 (0.82)	0.001 (0.73)	0.059** (2.44)	0.018** (2.52)
EQASS	0.034*** (3.45)	0.063** (2.52)	0.019 (1.07)	0.031*** (2.83)
OPC	-0.023** (-2.33)	-0.009 (-0.62)	-0.008 (-0.42)	-0.049*** (-3.56)
ININ	0.037*** (9.32)	0.026*** (2.76)	0.021** (2.10)	0.043*** (9.21)
INF	0.001*** (4.45)	0.001 (0.47)	0.001 (0.92)	0.001*** (4.47)
M2GROWTH	-0.007* (-1.68)	-0.001 (-0.09)	-0.001 (-0.15)	-0.016*** (-2.65)
Constant	0.009 (0.56)	0.321*** (6.68)	0.083* (1.77)	-0.006 (-0.28)
Year FE	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes
No. of Obs.	351	47	72	232
Adjusted-R²	0.645	0.683	0.689	0.685
F-statistic	23.45***	27.69***	19.17***	29.15***

Note: This table presents the estimation of basic model using panel data regression with year and bank fixed effects. The dependent variable is return on assets (ROA). All explanatory variables are defined in Table 1. The standard errors are adjusted for heteroscedasticity and within-firm clustering. P-values are in parentheses. *, **, *** indicate statistical significance at the 10%, 5% and 1% level, respectively.

4.2 Robustness tests

We carry out a further layer of regression analysis as robustness tests. In particular, we replace the dependent variable ROA with an alternative measure of performance, that is, return on equity (ROE) which is commonly used by prior studies (Hernando & Nieto, 2007; Athanoglou *et al.*, 2008; Al-Homaidi *et al.*, 2018). Following Sufian (2009), we replace the OPC ratio with the ratio of overhead expenses to total assets (OEASS). We also add the growth of gross domestic product (GGDP) to capture how the economy affects bank profitability as suggested by previous scholars (García-Herrero *et al.*, 2009; Trujillo-Ponce, 2013; Siddik *et al.*, 2016; Hou *et al.*, 2016; Al-Homaidi *et al.*, 2018). Al-Homaidi *et al.* (2018) found that a lower level of profitability is linked with higher GGDP, while Trujillo-Ponce (2009) reported that bank profits increase during the upturn of the economic cycle.

The results of the robustness tests are presented in Table 5. The coefficient of internet finance (INTERNET) remains negative and statistically significant for the full sample as well as for the sample of regional commercial banks. The impact of the overhead expenses ratio (OEASS) on profitability is negative and statistically significant for the full sample and the sample of regional commercial banks corroborating earlier evidence reported in Table 4 for the impact of the OPC ratio on bank profitability. CGDP exerts a positive effect on the profitability of all types of banks. The coefficients of the rest of the variables remain qualitatively the same as those reported in Table 4.

Table 5. Additional regressions results of Chinese listed commercial banks

	Full sample	State-owned commercial banks	Joint-stock commercial banks	Regional commercial banks
INTERNET	-0.001*** (-2.66)	0.001*** (2.62)	0.000** (2.18)	-0.000*** (-2.78)
SIZE	0.039*** (6.54)	0.076** (2.22)	0.062*** (2.82)	0.055*** (6.42)
LIA	0.038*** (3.45)	0.023 (0.98)	0.039* (1.92)	0.032** (2.28)
LLP	0.008 (0.33)	-0.003 (-0.28)	0.084** (2.35)	0.078* (1.86)
EQASS	1.578*** (9.75)	0.812 (1.46)	1.513*** (4.42)	1.708*** (8.53)
OEASS	-0.246*** (-7.54)	0.055 (0.51)	0.043 (0.51)	-0.314*** (-7.32)
ININ	0.227***	0.312**	0.359**	0.191**

The impact of internet finance on bank profitability. Evidence from the Chinese commercial banks

	Full sample	State-owned commercial banks	Joint-stock commercial banks	Regional commercial banks
	(3.68)	(2.24)	(2.41)	(2.33)
GGDP	0.017***	0.013**	0.005**	0.022***
	(4.12)	(2.33)	(1.99)	(2.75)
INF	0.015***	0.003	0.006*	0.015***
	(6.98)	(1.32)	(1.81)	(3.17)
M2GROWTH	-0.142**	-0.040	-0.042	-0.315***
	(-2.37)	(-0.41)	(-0.48)	(-3.52)
Constant	-0.093	0.965*	0.521	0.050
	(-0.36)	(1.68)	(1.12)	(0.14)
Year FE	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes
No. of Obs.	315	45	70	200
Adjusted-R²	0.637	0.659	0.628	0.623
F-statistic	16.67***	10.47***	10.76***	9.84***

Note: This table presents the estimation of basic model using panel data regression with year and bank fixed effects. The dependent variable is return on equity (ROE). All explanatory variables are defined in Table 1. The standard errors are adjusted for heteroscedasticity and within-firm clustering. P-values are in parentheses. *, **, *** indicate statistical significance at the 10%, 5% and 1% level, respectively.

5. Conclusions and policy implications

The rapid development of internet finance has spurred the interest of some scholars to examine its effects on bank profitability. However, limited attention has been paid to Chinese commercial banks because of the short period of development and prosperity of both P2P lending and third-party payment in China. Using data from 51 Chinese listed commercial banks and employing a gamut of bank-specific and macroeconomic variables, we assess the impact of internet finance on bank profitability from 2012 to 2019. We find that internet finance has a positive effect on the profitability of state-owned and joint-stock commercial banks, whereas internet finance has an inverse impact on the profitability of regional commercial banks. The above results underline the significant role of internet finance in enhancing bank profitability especially for state-owned and joint-stock commercial banks.

In line with prior studies and our theoretical anticipations, we find evidence that bank size, LIA, LLP, EQASS and ININ are positively associated with bank profitability, while OPC is negatively related to all bank profitability measures. The above results suggest that large banks and those with high liquidity and capital adequacy enjoy

higher profits, while high operating costs harm bank profitability. Looking at the macroeconomic variables, inflation was found to positively impact bank profitability, while money supply had a negative effect. Finally, we find that bank profits increase during the upturn of the economic cycle as captured by the growth of gross domestic product (GGDP).

Our study has some valuable managerial implications for banks and policymakers. In particular, these findings are useful to banks that seek to provide online financial services to their customers through third-party online payment and peer-to-peer (P2P) lending. The results demonstrate that internet finance enhances the profitability of state-owned and joint-stock commercial banks. However, the nascent stage of internet finance for regional banks seems to adversely affect their profitability. Consequently, regional banks should be cautious to expand internet finance until bank customers would be willing to adopt the disruptive role of peer-to-peer lending and third-party payment services.

For policymakers, these results suggest that an increase in the money supply results in lower profitability levels especially for regional banks. Consequently, policymakers should assess the impact of an expansionary monetary policy. Moreover, policymakers should establish policies that will facilitate the penetration and convenience of internet finance services across China.

The results of this study highlight interesting avenues in the hope of promoting future research on additional determinants of bank profitability. An interesting expansion of the current study could include data in the aftermath of Covid-19 when the use of internet finance reached unprecedented levels. Moreover, future research could be directed to the investigation of the relationship between internet finance and profitability to both listed and non-listed banks in China. Finally, alternative measures of internet finance could also be considered.

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