The impact of fintech on the profitability of Chinese commercial banks

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Abstract

This study assesses the transformative impact of financial technology (fintech) on the profitability of Chinese commercial banks, with a focus on addressing the challenge of endogeneity in financial data analysis. The study uses the systematic generalized method of moments (GMM) to compare the results with those from fixed-effects models in order to make the findings more reliable. The results reveal that fintech significantly impacts bank profitability, predominantly in a negative manner. This underscores the pressing need for banks to adapt and innovate, responding proactively to the fintech disruption. The practical implications of this study suggest that banks should not only invest in research and development within fintech but also tailor strategic responses according to bank types and establish a comprehensive financial services ecosystem to bolster their competitive edge and profitability. The findings are critical for bank executives and policymakers aiming to navigate the challenges posed by fintech innovations.

1. Introduction

In recent years, "Fintech" has emerged along with the advancement of internet technology. The term "Fintech," composed of "Finance," and "Technology" (Ferdiana & Darma, 2019; Schueffel, 2016; Treu, 2022), has become a buzzword in finance in recent years, but there has never been a unified definition due to the inconsistency in the scope of discussion among scholars. The earliest can be traced back to the 1990s, when Citigroup issued a report called "Financial Services Technology Consortium," which aims to promote technological cooperation so that the financial and technological co-development. This report can be seen as a prototype for the emergence of Fintech (Douglas & Grinberg, 2016; Jose, 2020). The rapid development of Fintech has brought brand new opportunities and challenges for commercial banks (Hu, Zhao, & Yang, 2022). Fintech has become an essential driving force of financial change, profoundly affecting the financial industry, products, and services. At the same time, the development of Fintech has also impacted the profitability level of commercial banks (Yao & Song, 2021).

China's banking industry needs to meet the strict requirements of financial regulation on the sustainability and safety of bank profitability through more effective measures in a changing external

environment (Podpiera, 2006) while at the same time, the traditional profitability model is facing the challenge of transformation due to the impact of factors such as the marketization of interest rates and financial disintermediation (Gomber, Kauffman, Parker, & Weber, 2018) and the interest rate marketization continuously diverts bank deposits (Cui, 2016; Rathnayake, Bai, Louembé, & Qi, 2022). On the micro level, with the development of information technology, customers prefer to wait for convenient colleges and universities and more personalized financial services (Lee & Shin, 2018; Siano, Raimi, Palazzo, & Panait, 2020). Breakthroughs and innovative applications of the technology are reshaping the global economy and driving profound changes in the financial sector (Gomber et al., 2018) and the emergence of Fintech may provide an opportunity for business transformation of commercial banks (Li, He, Tian, Sun, & Ning, 2022; Vasiljeva & Lukanova, 2016).

The rapid progress of fintech has facilitated the pace of technological innovation in commercial banks and brought new challenges to them (Dong et al., 2020). On the positive side, new technologies have aided commercial banks, significantly improving the efficiency and mode of their traditional business, simplifying the operation process, and facilitating the digital transformation of the banking business (Varga, 2017). While absorbing and applying these new technologies, commercial banks have also optimized their original business models (Li, Elahi, & Zhao, 2022) and introduced innovative financial products and services to meet diversified customer needs. However, on the negative side, the rise of fintech has, to a certain extent, competed and conflicted with banks' traditional business, which has exacerbated the volatility of banks' market share (Anagnostopoulos, 2018; Moran, 2020; Van Loo, 2018). Therefore, facing the reality of the "double-edged sword" of fintech (Deakin, Chen, Johnston, & Wang, 2022) it has become particularly urgent for China's commercial banks to respond to it, and learn how to utilize the development dividend of fintech to expand their customer bases, improve profitability, and realize transformation and upgrading (Katsiampa, McGuinness, Serbera, & Zhao, 2022).

The research aims to explore the nuanced impact of Fintech on the profitability of Chinese commercial banks, delving into the effects of technological advancements and competitive pressures introduced by Fintech within the banking sector. Employing a systematic analysis through the lens of System GMM to address potential endogeneity issues, the study seeks to unravel the dynamics between Fintech's innovative disruption and traditional banking profitability, further segmented by bank types, to understand the heterogeneity in response to Fintech's growth across different banking institutions in China.

2. Literature Review

Ong and Chong (2023) identified the spread of digital payments and mobile banking services as a key factor in improving their efficiency of bank operations and reducing transaction costs. Meanwhile, Mishra and Kaushik (2023) showed that the introduction of blockchain technology in asset management and cross-border payments brought banks greater efficiency and security than traditional banks. Fang, Wang, Wang, and Zhao (2023) observation further demonstrated that the application of AI and big data analytics to risk management and customer service not only improves the efficiency of banks' credit decision-making but also optimizes their products and services, bringing positive impacts on banks' profitability.

Although FinTech has brought many benefits to the banking industry, its development is not without challenges. Cumming, Johan, and Reardon (2023) point out that fintech has increased the ease of doing business, but it also increases cybersecurity risks, which may harm the long-term profitability of banks. Teichmann, Boticiu, and Sergi (2023) mention that RegTech has helped banks comply with the regulatory requirements effectively, but it also imposes high initial investment and maintenance costs. Mainardes and De Freitas (2023) explore the competition between fintech companies and traditional banks and argue that this competition forces banks to lower their service fees to keep customers, which in turn leads to a certain degree of competition. Boot, Hoffmann, Laeven, and Ratnovski (2021) explored the competition between fintech companies and traditional banks and argued that such competition forces banks to lower their service fees to retain customers, which in turn undermines their profitability to a certain extent. The study by Murinde, Rizopoulos, and Zachariadis (2022) further revealed the impact of fintech on consumer behaviour. As consumer reliance on fintech services increases, the demand for traditional banking services decreases, this may affect the market share of banks. The decrease in demand for traditional banking services could potentially impact the market share and profitability of banks.

Despite the challenges posed by fintech, we expect commercial banks to grow profitability by strategically adapting to these changes. Elsaid (2023) study suggests that banks have been able to expand into new business areas such as P2P lending and crowdfunding by partnering with fintech firms, which opens up a new source of revenue for the banks. Broby (2021) suggests that the fintech applications have increased financial inclusion and attracted a wider customer base not covered by the traditional financial system, thus increasing profit opportunities for banks. Zhou, Sun, Luo, and Liao (2021) observations emphasize the rise of digital currencies and the role of fintechs in improving sustainability by providing banks with access to high-growth market opportunities, while attracting environmentally and socially responsible investments through green finance and sustainable investments, further enhancing banks' profitability.

These research findings, taken together, suggest a close relationship between Fintech and cost reduction, service quality enhancement, strengthening of financial institutions risk-bearing capacity, promotion of urban

ecological efficiency, and loan growth and profitability in the commercial banking sector. However, further research is warranted to delve deeper into the specific mechanisms through which Fintech influences the profitability of commercial banks and to devise strategies for addressing the challenges and opportunities presented by Fintech.

3. Research Methodology

3.1. Data Collection

This study mainly involves manually obtaining secondary data, mainly from China's financial yearbook, Wind financial database, Cathay Pacific database, and annual reports of listed commercial banks. There are 54 listed banks in China as the end of 2022, including six large commercial banks, and ten rural commercial banks. Based on the completeness and continuity of the data, excluding some samples of banks with incomplete data, the main research scope of this bit is 40 commercial banks in China, including six large Chinese state-owned banks, ten joint-stock banks, and 24 relatively large urban commercial banks, with the panel data from 2011 to 2021 as the main research sample.

3.2. Model Design

This paper presents a study that analyzes the impact of fintech on the profitability of Chinese commercial banks using the System Generalized Method of Moments (System GMM), which is more robust than the fixed effects model. This approach effectively addresses the endogeneity issue and provides a dynamic analysis of profitability while taking into account the persistence of financial performance. The novelty of the study lies in its methodological rigour and the contemporary context of the impact of fintech on bank profitability, which distinguishes it from previous studies that may have used more static or less comprehensive analytical techniques.

The model's regression equation can be expressed as:

$$ROA_{it} = \alpha_0 + \alpha_1 ROA_{it-1} + \alpha_2 Fintech_{it} + \alpha_3 ASSET_{it} + \alpha_4 CIR_{it} + \alpha_5 CAR_{it} + \alpha_6 LDR_{it} + \alpha_7 GDP_{it} + \mu_{it} \quad (1)$$

From Equation 1, ROA denotes the profitability of commercial banks, i denotes each bank in China, and t denotes the year, where Fintech denotes the development of Fintech in China, ASSET denotes the asset size, CIR denotes the cost-to-income ratio, CAR denotes the capital adequacy ratio, LDR denotes the deposit-to-loan ratio, GDP denotes the growth rate of GDP, which α_0 denotes a constant term, and α_1、α_2、α_3、α_4、α_5、α_6、α_7 asks the coefficients of explanatory variables and control variables, respectively, which μ are constant terms.

3.3. Selection of Explained Variables, Explanatory Variables and Control Variables

3.3.1. Explained Variables

As for the core profitability indicators of banks, the key leading indicators used to evaluate the profitability of city commercial banks include return on total assets (ROA) and return on equity (ROE). When ROA is high, it indicates that the profit per unit of total assets of city commercial banks is higher, showing strong profitability. And a higher ROE means that the bank generates a higher return for its shareholders. In contrast, ROA more intuitively shows the profitability of city commercial banks. Based on this, this study chooses the return on total assets (ROA) as the main explanatory variable of this empirical regression analysis.

3.3.2. Explanatory Variables

In analyzing the impact of Fintech on the profitability of urban commercial banks, this study adopts the Digital Inclusive Finance Index released by the Digital Finance Research Centre of Peking University as a representative indicator of the level of Fintech development. The logic behind this choice lies in the fact that the index comprehensively synthesizes the impact of Fintech on multiple dimensions, such as increasing the accessibility of financial services, reducing the cost of services, and enhancing the end-user experience (Liu & Huang, 2020). In addition, the index reflects the important role of Fintech in promoting financial service innovation and improving the overall efficiency of financial operations (Zhao, Tsai, & Wang, 2019). Therefore, the index is used as a proxy variable for the development of Fintech, which can effectively capture the comprehensive impact of Fintech on the profitability of commercial banks and provide an in-depth and accurate analytical perspective for related research.

3.3.3. Control Variables

In the comprehensive profitability performance evaluation system of urban commercial banks, return on total assets (ROA) and return on net assets (ROE) constitute the core indicators for measuring their profitability level. An increase in ROA implies an increase in the earnings generated per unit of the bank's total assets, which shows stronger profitability, while an increase in ROE reflects a rise in the rate of return that each shareholder receives from within the bank. In contrast, ROA is more direct for assessing the profitability performance of urban commercial banks, therefore, this study will adopt ROA as the core explanatory variable to carry out empirical regression studies.

Firstly, the capital adequacy ratio is defined as the ratio between a bank's capital and risk-weighted assets, and is often viewed as the ratio of equity to assets. As for the non-performing loan ratio, it describes the proportion of non-performing loans in the total loans of city commercial banks, an indicator that reflects the operating status of banks to some extent.

Then, as for the loan-to-deposit ratio, this index measures the ratio between the total deposits and the total loans of urban commercial banks. It is well known that one of the main sources of profit for banks is interest income, which is the difference between the interest rate on deposits and loans. Therefore, to a certain extent, the loan-to-deposit ratio characterizes the profit potential of city commercial banks.

Thirdly, the cost-income ratio (CIR), i.e., bank operating expenses divided by operating income, can reflect the operating conditions of commercial banks. Strictly speaking, it is a reverse indicator; that is, the larger the cost-income ratio is, the more unfavourable it is to the development of commercial banks, at which time the profitability of commercial banks will become worse. Therefore, this paper selects the cost-income ratio as an operating indicator to reflect the commercial banks.

Fourth, the total asset size refers to assets that urban commercial banks hold, encompassing their loans to residents, among other things. This indicator reflects, to some extent, the scale and operating conditions of urban commercial banks.

Fifth, the economic growth rate is mainly used to measure the level of economic development of a country's macroeconomic indicators, mainly reflecting the overall situation of China's economic development and the bank as the pillar industry of China's financial system so that the economic growth will have a specific impact on the profitability of the listed banks; macro-level economic growth will lead to the development of the financial industry, with commercial banks as an essential part of the financial industry. When the economy is booming, more funds are available to commercial banks, which increases the total amount of loan funds available to the bank, thus increasing the operating efficiency of commercial banks. When the economy is in recession, the resistance of commercial banks to carrying out their various businesses and services increases, and the narrowing of the banks' revenue margins inevitably leads to a decline in efficiency.

Table 1 is a brief summary of the above variables, the specific forms of which are in the paragraphs above.

Table 1. Variables.

Variable type	Variable name	Variable symbol	Variable definition
Dependent variable	Return on total assets	ROA	(Net profit/Average total assets) ×100%
Independent variable	Fintech index	Fintech	The weighted average of Peking University's total digital financial inclusion index takes the natural logarithm.
Control variables	Asset size	ASSET	Total bank assets take natural logarithm
	Cost to income ratio	CIR	(Bank operating expenses / Operating income) ×100%
	Capital adequacy ratio	CAR	(Total bank assets / Risk-weighted assets)×100%
	Deposit-to-loan ratio	LDR	(Total loans / Total deposits) ×100%
	GDP growth rate	GDP	GDP growth rate

3.4. Descriptive Statistics

Table 2 gives the statistics of the total return on assets and fintech index of the sample banks. The sample period of this paper is 11 years, in which the mean value of the total return on assets is 0.951231, the maximum value is 1.796351, and the minimum value is 0.3891689. The mean value of the level of fintech development is 2.455747, the maximum value is 3.72719, and the minimum value is 0.4000419.

Table 2. Descriptive statistics.

Variable	N	Mean	Std.	Min.	Max.
ROA	440	0.951231	0.2630239	0.3891689	1.796351
Fintech	440	2.455747	1.189474	0.4000419	3.72719
LnASSET	440	4.86957	7.454877	0.0105535	35.17138
LnCIR	440	0.3167524	0.0908479	0.1600485	0.7771336
LnCAR	440	13.29242	1.895484	8.84	25.87
LnLDR	440	0.6953303	0.1611829	0.31206	1.176344
GDP	440	6.999545	1.816038	2.2	9.6

3.5. Smoothness Test

Regarding the reliability of the data, to ensure that the data is a smooth sequence, before the relevant analysis, the data of each variable indicator needs to be tested for unit root to determine whether the data is smooth or not. This paper adopts the LLC test and the ADF-Fisher method to test the unit root of the panel data. The data testing process in this paper is as follows: First, the unit root test is performed directly on the original data. Rejecting the null hypothesis at a certain significance level indicates the absence of a unit root in data, signifying its stability. Otherwise, it is unstable. The first step is to differentiate the variables. In the test, before the data are stabilized, the results of the unit root test are shown in Table 3.

Table 3. Unit root test results.

Variables	LLC-test	Stationarity	ADF-test	Stationarity
ROA	-11.0060***	Smooth	-4.894***	Smooth
Fintech	-14.7856***	Smooth	-6.603***	Smooth
ASSET	-7.0916***	Smooth	-2.733***	Smooth
CIR	-7.0771***	Smooth	-4.698***	Smooth
CAR	-13.0631**	Smooth	-3.323***	Smooth
LDR	-10.5749***	Smooth	-3.071***	Smooth
GDP	-21.6804***	Smooth	-7.933***	Smooth

Note: **, *** represent that the test results are significant at 5%, and 1%, respectively.

3.6. Diagnostic Checking

An economic model uses the heteroskedasticity test to test for heteroskedasticity, or a non-constant variance, in the model's error terms. Heteroskedasticity indicates that the variance of the error term may vary over a range of values, which may violate one of the basic assumptions of the econometric model, i.e., homoskedasticity. The presence of heteroskedasticity, i.e., a non-constant variance of the error term, can have an impact on the estimation results of the econometric model and may lead to bias and invalid statistical inference. Therefore, the heteroskedasticity test can identify the presence of heteroskedasticity problems in the model so that appropriate corrective measures can be taken to ensure the reliability and accuracy of the model. Since this paper employs the GMM method for analysis, the heteroskedasticity problems does not impact the GMM result. But for the heteroskedasticity problem, we can use the robust command to solve it if we want to do regression analysis. Table 4 displays the results of the heteroskedasticity test in this paper.

Table 4. Heteroscedasticity test results.

Chi-sq. statistic	Chi-sq. d.f.	Prob.
151.08	35	0.0000

As an important indicator of the degree of multicollinearity of predictor variables in regression analysis, the core role of the variance inflation factor (VIF) is to assess the inter-correlation among predictor variables in the model. Strong correlation between the predictor variables within the model manifests the phenomenon of multicollinearity, and the application of VIF can clarify degree of increase in the variance of the regression coefficients, effectively revealing the existence of multiciollinearity and its scope of influence. The VIF test was adopted in this study, and the results were obtained as shown in Table 5, where the VIF values of the predictor variables did not exceed 5, with an average value of 2.07, indicating that there is no significant multicollinearity between the explanatory variables in the model, and therefore it is appropriate to continue with the subsequent regression analysis process.

Table 5. VIF test results.

Variables	VIF	1/VIF
Fintech	1.65	0.6069
ASSET	1.27	0.7871
CIR	1.17	0.8549
CAR	1.09	0.9140
LDR	1.51	0.6616
GDP	1.23	0.8126
Mean VIF	1.31	

In this paper, the model was first subjected to the Hausman test in FE and RE, and the p-value was 0.000, which indicates the rejection of the original hypothesis (original hypothesis: use of random effects); therefore, this paper will use the fixed effects for regression analysis, and the results are shown in Table 6.

Table 6. Regression analysis results.

Chi-sq. statistic	Chi-sq. d.f.	Prob.
66.87	8	0.000

3.7. Analysis of Empirical Results

Given that factors such as total assets, cost-to-income ratio, and non-interest income of commercial banks may be causally linked to their profitability levels, this may raise endogeneity issues. Considering the dynamic nature and persistence of bank profitability, this study uses the GMM method for panel data. Differential GMM can address the endogeneity problem inherent in the model but may face the challenge of weak instrumental variables. System GMM overcomes the serial correlation and heteroskedasticity problems by combining level and difference equations and effectively reducing the bias of estimated coefficients. This study selects system GMM as the instrument for regression analysis. Table 7 displays the detailed analysis results.

Table 7. Specific analysis results.

Variables	FE	SYS-GMM
ROAit-1		0.2597***
		(4.99)
Fintech	-0.0258***	-0.3063***
	(-3.29)	(-3.35)
ASSET	-0.0052**	0.0016
	(-2.11)	(0.86)
CIR	0.2276**	-0.1653
	(2.28)	(-0.62)
CAR	0.0297***	0.0236***
	(6.98)	(2.71)
LDR	-0.0018**	-0.0040***
	(-2.40)	(-3.47)
GDP	0.0118***	0.0200***
	(3.16)	(4.43)
CONS	0.1287	0.68101***
	(1.51)	(4.83)
N	440	440
R-square	0.647	
Adj. R-square	0.61	
Hansen test		0.572
AR（1）		0.037
AR（2）		0.180

Note: **, *** represent that the test results are significant at 5%, and 1%, respectively.

Table 7 shows the results of the regression analysis obtained using the fixed effects model and the systematic GMM approach. You must perform the appropriate tests when applying the GMM method. The regression analysis shows that the second-order autocorrelation test AR (2) has a value of 0.180, which exceeds the criterion of 0.05, which indicates that there is no second-order serial correlation in the model. Meanwhile, the result of Hansen's test is 0.572, exceeding the threshold of 0.1, which proves that all selected instrumental variables are valid, thus verifying the rationality and validity of the constructed empirical model. Specifically, the prior period's TFP has a positive and at 1% significance level effect on the current period's TFP, a result that reveals a significant cumulative effect of banks in enhancing firepower. This phenomenon may be attributed to the following factors: first, banks with high ROA tend to build a good brand image and win the widespread trust of their customers, which in turn leads to deposit growth and expansion of their customer base; second, banks with higher ROA usually maintain better capital adequacy ratios and liquidity levels, which not only help to support lending operations but also effectively absorb potential losses and ensure the smoothness of the bank's operations as well as meeting customers' funding needs.

The regression coefficient of FinTech shows -0.3063 with a 1% significance level, a result that reinforces Hypothesis 1, which states that the rise of FinTech harms the profitability of commercial banks. First, by adopting advanced technologies and digital platforms, FinTech firms can provide more efficient and cost-effective services compared to traditional banks. This has led to increased competition between fintech firms and commercial banks, which in turn has eroded the latter's market share and customer base and weakened their profitability. Second, FinTech is characterized by the pursuit of user-centric service experience and convenience, and as consumer preference for FinTech solutions grows, expectations for seamless digital banking services have risen accordingly. Traditional banks may face difficulties in adapting to these ever-changing consumer demands, leading to a loss of customers and thus negatively impacting their profitability. Third, fintechs are in a new and evolving regulatory environment, and regulatory frameworks are often difficult to update in tandem with technological developments, posing regulatory challenges for both fintechs and traditional banks. Traditional banks, which may have higher compliance costs in response to regulatory

demands, may be at a disadvantage compared to nimble fintechs, which may increase operating costs and affect profitability.

At a 10% level of significance, the regression coefficients of 0.0016 for asset size (ASSET) and -0.1653 for cost-to-income ratio (CIR) for control variables are not significant. this may the reason for this may be that the relationship between asset size, the cost-to-income ratio, and profitability may be affected by various other factors, such as market conditions, interest rates, risk management practices, cost structure, and competition. If these factors are not adequately considered or controlled for in the regression model, then the coefficient on asset size may not appear significant. The regression coefficient of the Capital Adequacy Ratio (CAR) is 0.0236 and is significant at a 1% level, indicating that CAR will have a positive effect on the profitability of commercial banks. The reason for this may be an Adequate level of capital contributes to the overall solvency and stability of the bank. It provides a safety net against unexpected losses and helps maintain investor and depositor confidence. A stable and solvent bank is more likely to attract funds at favourable interest rates, enabling it to generate profits through lending and investment activities. The regression coefficient of Loan to Deposit Ratio (LDR) is -0.0040 and is significant at a 1% level, indicating that LDR harms the profitability of commercial banks. A high loan-to-deposit ratio indicates that the bank derives a large portion of its funds from customer deposits, while loans account for a large portion of its assets. Banks may be exposed to interest rate risk if the interest rate on loans is fixed or has a longer term than the interest rate on deposits. In a rising interest rate environment, a bank's interest expense may increase faster than its interest income, leading to net interest margin compression and a decline in profitability.

3.8. Robustness Test

Given that factors such as total assets, cost-to-income ratio, and non-interest income of commercial banks may be causally linked to their profitability levels, this may raise endogeneity issues. Considering the dynamic nature and persistence of bank profitability, this study uses the GMM method for panel data. Differential GMM can address the endogeneity problem inherent in the model but may face the challenge of weak instrumental variables. System GMM overcomes the serial correlation and heteroskedasticity problems by combining level and difference equations and effectively reducing the bias of estimated coefficients. This study selects system GMM as the instrument for regression analysis. The detailed analysis results are displayed in Table 7.

Table 8. Robustness test results.

Variables	Total sample	Sub-sample I	Sub-sample 2	Sub-sample 3
ROAit-1	0.2597***	0.2354***	0.2298***	0.2289***
	(4.99)	(4.47)	(4.50)	(4.17)
Fintech	-0.3063***	-0.0265***	-0.0395***	-0.0453***
	(-3.35)	(-3.01)	(-4.33)	(-5.66)
ASSET	0.0016	0.0088***	0.0009	0.0409*
	(0.86)	(3.54)	(0.45)	(1.73)
CIR	-0.1653	0.1752	-0.1805	0.2288
	(-0.62)	(1.06)	(-0.66)	(1.52)
CAR	0.0236***	0.0242**	0.0238**	0.0219*
	(2.71)	(2.50)	(2.37)	(1.94)
LDR	-0.0040***	-0.0047***	-0.0038**	-0.0049**
	(-3.47)	(-3.86)	(-1.97)	(-2.08)
GDP	0.0200***	0.0178***	0.0220***	0.0206***
	(4.43)	(3.71)	(4.21)	(3.79)
CONS	0.68101***	0.6273***	0.7028***	0.6674***
	(4.83)	(3.84)	(4.18)	(2.96)
N	440	374	330	264
Hansen test	0.572	0.860	0.976	0.995
AR（1）	0.037	0.034	0.039	0.040
AR（2）	0.180	0.148	0.138	0.126

Note: *, **, *** represent that the test results are significant at 10%, 5%, and 1%, respectively.

From the results of the analysis in Table 8, both the AR (2) test and Hansen test confirm the important role of instrumental variables in the dynamic model. In the overall sample analysis, the coefficient value for the fintech is -0.3063. For sub-sample 1, sub-sample 2 and sub-sample 3, the regression coefficients of the fintech indicator are recorded as -0.0265, -0.0395 and -0.0453, respectively. This result indicates that the negative impact of fintech on profitability is attenuated by the removal of the sample of large commercial banks and joint-stock banks, and in particular, the negative impact of fintech on profitability is attenuated by the removal of the sample of large commercial banks and joint-stock banks. The reduction of its impact is more pronounced

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in the case of removing large commercial banks and joint-stock banks. In the case of sub-sample 3, the coefficient value of the FinTech indicator is -0.0453, implying that the negative effect of FinTech on profitability slows down and the downward trend of profitability of urban commercial banks slows down in the case of considering only the urban commercial bank sample. This finding supports the second hypothesis of the study.

4. Conclusions and Recommendations

4.1. Conclusion

This study reviews the relevant literature and conducts an empirical analysis based on panel data from 40 banks in China from 2011 to 2021. The results show that there is a significant positive correlation between the growth level of China's banking industry and the intensity of market competition. By constructing a panel regression model and a dynamic GMM model, this paper further confirms how the progress of fintech affects the profitability of Chinese commercial banks. At the same time, this study also examines the differences in operating efficiency, management style, organizational structure, and scale of different types of commercial banks in detail, and analyzes how these differences show the heterogeneity of profitability in the face of the development of fintech. The main findings of the study are as follows:

Fintech has impacted the profitability of commercial banks in several ways, with fintech companies bringing stiff competition to the financial industry with their flexible and technology-driven business models. These companies often offer innovative products and services such as digital banking, peer-to-peer lending, and robo-advice platforms, which can attract customers away from traditional banks. Increased competition can lead to a decline in market share and profitability for commercial banks. Fintech disruptors tend to operate with lower overhead costs compared to traditional banks, enabling them to offer competitive pricing and lower fees. This puts pressure on commercial banks' spreads and fee income, leading to margin compression. As customers turn to fintech alternatives for cheaper and more convenient services, banks may face declining margins on traditional revenue streams. Fintech platforms, such as peer-to-peer lending and crowdfunding platforms, have bypassed traditional bank intermediaries. These platforms connect borrowers directly with lenders, eliminating the need for bank lending services. As a result, commercial banks may experience reduced demand for loans, leading to lower interest income and profit margins.

Through empirical analysis, Fintech has a significant negative effect on the profitability of commercial banks. The rise of Fintech has impacted the intermediary function of commercial banks to a certain extent, which has greatly affected the asset business, liability service, and intermediary businesses of banks, and changed the profit source channels and methods of commercial banks. In this situation, commercial banks should actively lay out the development strategy of financial technology and fully utilize the emerging technology of financial technology to empower their own businesses and improve their competitiveness. Secondly, compared with large banks and joint-stock banks, Fintech has a more inhibiting effect on urban commercial banks, which may be because large commercial banks usually have a long-accumulated brand reputation and a broad customer base. These banks have a high level of trust and reliability in the financial market, and customers are more inclined to do business with these institutions, especially when large sums of money are involved, complex transactions are involved, or risks are high. Fintechs, while innovative and flexible, are relatively weak in this area, so large commercial banks retain a competitive advantage in these areas.

4.2. Recommendations

The impact of FinTech on commercial banks is a trend that cannot be ignored, and the following are some suggestions to help commercial banks better cope with and utilize the impact of FinTech.

4.2.1. Increase Original R&D Application of FinTech

In the current situation, commercial banks play more of a follower role in fintech than a navigator role. Therefore, it is imperative to focus on the research and development of core fintech technologies. First of all, banks should place the development of fintech at its core, set up a fintech leading group supported by high-level decision-making, and build fintech research and application departments in the head office and each branch. At the same time, they should prioritize the recruitment of technical talents with interdisciplinary backgrounds and set up fintech R&D inputs according to their scale, to stimulate the team's sense of urgency for independent innovation and catch up with the development speed of fintech enterprises. In addition, the frequency of application of fintech in the daily operation of the bank should be increased to ensure that it serves the bank.

Next, commercial banks need to actively analyze the behavioural patterns and promotional methods of Internet companies in the financial field, and explore the potential market demand for the services they provide, which are still in their early stages. Based on these findings, banks can develop fintech solutions with innovative features, thus shaping their competitive advantages.

Third, banks hold a large amount of data on customer resources. Fintech companies can optimize the potential of this data by combining it with big data technology. In terms of marketing strategy, banks should

establish a set of exclusive data analysis frameworks to explore in depth the complex connections between the various dimensions of data, and then customize more personalized financial service solutions for customers. In the process of product management, advanced data mining technology is used to analyze customer behaviour patterns and preferences and distil deep insights, accordingly optimizing the distribution of service outlets, creating unique customer experiences, and enhancing customer loyalty.

4.2.2. Assigning Differentiated Strategies to Different Banks

Large commercial banks and joint-stock banks are larger in scale, have a high degree of operational digitization, and their comprehensive ability to master various resources is higher than that of urban commercial banks. They can inject more funds to develop Fintech, so they can make all-around layouts in the field of Fintech, establish a more specialized fintech platform, and improve the quality of their digitized business. Unlike large banks and joint-stock banks, urban commercial banks face many obstacles in the development of Fintech, such as lack of capital and talent, but they also have the advantages of relatively high depth of regional and local development and relatively short decision-making channels. Therefore, small commercial banks must have a correct and objective understanding of their advantages and disadvantages. Urban commercial banks can cooperate with local fintech companies, use their technology to build their fintech platform, enjoy advanced fintech technology at a low price, and launch innovative products.

4.2.3. Establishing a Complete Financial Service Ecosystem

The rapid development of FinTech has driven many domestic commercial banks to upgrade or build new service platforms, intending to break through the limitations of traditional single-function platforms and bring more diverse service options to consumers. At the international level, the exploration and application of fintech started earlier and have made remarkable achievements. Given this, domestic commercial banks should take the initiative to learn from advanced international practices and gradually develop and pilot innovative programs. By integrating cloud computing, big data, and other fintech tools, but they can not only refresh their platforms and products but also expand their business scope from traditional financial services to frequent non-financial activities involving fewer financial transactions. For example, in the retail services sector, banks can offer services around education, travel, entertainment, healthcare, and dining, enabling consumers to utilize bank points for diverse payment activities such as ticketing. This shift allows banks to transform their marketing strategies from product-oriented to customer-centred, creating an intelligent and integrated financial services ecosystem. In summary, by combining fragmented businesses with the power of fintech, banks can more comprehensively meet the needs of their customers while creating additional revenue streams. Such an integrated financial service ecosystem can creatively expand the boundaries of banking services, integrate into customers' scenario-based applications, deeply integrate into customers' daily lives, strengthen banks' ability to retain existing customers and attract new customers, and thus optimize the profitability of commercial banks.

4.3. Limitations and Suggestions for Future Research

This paper describes several limitations inherent in the study of the impact of fintech on the profitability of Chinese commercial banks, particularly the study's reliance on data selected from a limited number of 40 banks, spanning the period from 2011 to 2021. This sample size, although large, may not capture all the variables in the diversification landscape of the Chinese banking sector. In addition, dynamic GMM models, while adept at addressing certain statistical challenges, may not be able to fully account for the intricate interplay between external economic factors, regulatory changes, or rapid technological innovation in the fintech sector. The inherent dynamism and complexity of FinTech developments pose a significant challenge in capturing their full impact within the constraints of the models used.

With future research advocates, a multifaceted approach was advocated to deepen the understanding of the impact of fintech on the banking sector. It has been suggested that subsequent surveys might extend the analysis to a wider range of banks, including smaller institutions and banks located in economically underdeveloped regions, to provide a more comprehensive panorama of the impact of fintech. The use of qualitative methods, such as case studies or interviews with bank executives, may yield subtle insights into the strategic adjustments banks are making in response to the rise of fintech. Exploring the intersection of fintech with emerging regulatory frameworks and their impact on financial stability can provide valuable insights into how banks are responding to the changing environment. As a result, the research path in this area is characterized by an interdisciplinary approach that includes the complexity and rapid innovation inherent in the interplay between fintech and traditional banks.

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