

The Impact of Developing Fintech on Banks

-- From the Perspective of Net Interest Margin and Non-performing Ratio

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Abstract: In recent years, the rapid development of financial technology (fintech) has greatly impacted the traditional banking industry, posing both challenges and opportunities for banks. In this study, we investigate the influence of fintech on the net interest margin and non-performing loan ratio of banks in China. To measure the level of fintech development in banks, we construct a Bank Fintech Development Index (BFDI) based on text analysis of annual reports. We then use a panel data regression model to analyze the impact of fintech development on the net interest margin and non-performing loan ratio of banks, controlling for other factors such as bank size, capital adequacy, and macroeconomic conditions. Our empirical results show that the development of fintech has a significant positive impact on the net interest margin of banks, indicating that banks that have adopted fintech are able to generate higher profits from their interest-bearing assets. We also find that the development of fintech has a significant negative impact on the non-performing loan ratio of banks, suggesting that fintech can help banks improve their risk management and reduce their credit losses. Therefore, banks should continue to embrace fintech and invest in new technologies to remain competitive in the rapidly evolving financial landscape.

Keywords: Financial technology, Net interest margin, Non-performing loan ratio.

1. Introduction

In recent years, technology represented by big data, artificial intelligence, and cloud computing has brought great changes to the banking industry. In the face of fintech challenges and opportunities, commercial banks have undergone different types of strategic transformation, such as channel innovation, business (product) innovation, and collaborative innovation [1]. Banks are the lifeline of the real economy and an important foundation for the steady and healthy development of the economy. The development of the real economy cannot be separated from banks. High-quality economic development under the new development pattern requires a high-quality banking system to provide support.

In the face of rapid fintech innovation, the People's Bank of China issued the Fintech Development Plan twice in 2019 and 2022, and the State Council also issued the 14th Five-Year Digital Economy Development Plan in 2022, emphasizing the deepening application of big data, artificial intelligence, and other technologies in banking and other fields. CBI Insights recently released its 2022 Global Fintech Industry Report, which states that fintech activity raised \$75.2 billion globally in 2022, down 46% from the previous year, but up 52% from 2020. For example, China Merchants Bank will invest 13.291 billion yuan in fintech in 2021, an increase of 11.58% compared with 2020, and Industrial and Commercial Bank of China will invest 25.987 billion yuan in fintech in 2021, a year-on-year increase of 9.1%. Relying on fintech and centering on online, digital, intelligent, platform, and ecological, comprehensive promotion of the digital reshaping of financial infrastructure and capability system, customers and channels, business and products, management, and decision-making. So, what is the impact of banks' development of fintech on banks? What is the mechanism of action for banks?

Academic studies on the impact of fintech on banks are

mainly divided into two camps. One is from the external aspect, for example, Internet finance will push up the capital cost of commercial banks, thus decreasing profitability and increasing the bankruptcy risk of banks [2]. The second is from the internal aspects, such as the operation performance of banks [3], the risk-bearing level of small and medium-sized banks [4], and other aspects. To sum up, the current research on banks' development of fintech is not comprehensive enough and is still in the initial stage. The internal perspective also mainly uses the intermediary effect to study, and research on the single index of banks is less.

Therefore, the incremental contribution of this paper is mainly reflected in the study and explanation of the influence of banks' development of fintech from the micro perspective of the non-performing ratio and net interest margin. Second, it is reflected in the measurement of the fintech index. In the process of constructing the fintech index, this paper analyzes the text of the annual report and considers the expenditure of banking business and management fees, so as to more accurately and comprehensively reflect the level of the bank's fintech index.

2. Literature Review

From Internet finance in the past few years to fintech now, its rapid development has exerted a significant influence not only on the academic community but also on the business community, particularly on commercial banks. According to the definition of Baidu Baike, FinTech can be simply understood as Finance + Technology. This means to innovate the products and services provided by the traditional financial industry through various technological means to improve efficiency and effectively reduce operating costs. In the first edition of Fintech Development Plan issued by the People's Bank of China, Fintech is defined as technology-driven financial innovation, aiming to use modern scientific and technological achievements to transform or innovate financial

products, business models and business processes, so as to improve the quality and efficiency of financial development. We will fully leverage the enabling role of fintech and enhance the capacity and efficiency of financial services to serve the real economy. The FSB (Global Financial Stability Board) defines financial technology (FinTech) as technology-based innovation in financial services that can result in new business models, applications, processes or products that have a significant impact on the provision of financial services. In short, fintech is a form of technology that incorporates financial and technological aspects into financial service delivery. Through the above definition of fintech, it is not difficult to find that fintech is a kind of innovation, which has brought certain impact on the real economy and financial services.

In addition, many scholars at home and abroad also attempt to define fintech when studying the influence of fintech on banks. Based on a series of technological innovations such as big data, cloud computing, artificial intelligence and blockchain, Fintech is fully applied to face recognition, speech semantic recognition, payment and clearing, lending and financing, risk control, wealth management, retail banking, transaction settlement and other financial fields, achieving a high degree of integration of finance and technology. In short, fintech is a technical means to apply science and technology to the financial industry, expand the service group of the financial industry, reduce transaction costs, and improve industry efficiency [5].

With research on fintech, the influence of external fintech, such as Internet finance, on commercial banks has been studied at the early stage. Wang Sheng et al. showed that the influence of Internet finance on the risk taking of Chinese commercial banks presents an inverted U-shaped distribution, that is, the risk taking of commercial banks rises first and then falls [6]. Now scholars are beginning to focus on the micro-level of banks. The existing literature shows that the influence of fintech on commercial banks can be roughly classified from the positive and negative aspects.

In terms of positive influence, Zhao Qingbo et al. (2022) pointed out that the development of fintech can significantly improve the operating performance of banks by reducing the non-performing loan ratio and cost-income ratio [3]. Sheng (2021) showed that fintech has changed the way banks overcome information asymmetry and helped them obtain more information [7]. Lapavitsas and Santos (2008) analyzed the positive effects of technological progress on bank operation from the perspective of risk, and believed that the development of fintech could enable commercial banks to understand their credit customers more comprehensively and reduce credit risks [8].

In terms of negative impact, Li Hongquan et al. (2022) pointed out that the development of fintech raises the potential risk bearing level of commercial banks on the whole [9]. Yang Wang et al. (2020) pointed out that fintech can improve the total factor productivity of banks, while intensifying competition and increasing the debt cost of banks [10]. This is mainly due to the increasing dependence on inter-bank borrowing funds, and the change in the structure of the debt end, which leads to the decline of the bank's net interest margin [11].

3. Models and Variables

3.1. Sample Selection and Data Sources

To ensure the credibility of the data, 42 A-share listed commercial banks were selected as research samples in this paper, including 6 large state-owned commercial banks, 9 joint-stock banks, 17 city commercial banks and 10 rural commercial banks, covering a comprehensive range of types. The sample period is 2010-2021. The bank financial data used in this paper was mainly obtained from the annual reports of the banks and partly from the CNRDS database. The original data were processed in the following ways: (1) the observed values missing in the data of the main variables were deleted; (2) bank samples with observed values less than 4 years in the sample period were deleted; (3) double-tailed 1% Winsor was applied to continuous variables at the bank level with the main purpose of eliminating the interference of outliers on the results of this paper. Finally, the unbalanced panel data of 37 banks, including 5 state-owned large commercial banks, 8 joint-stock banks, 15 city commercial banks, and 9 rural commercial banks, are obtained.

3.2. Variable Selection

This paper involves three kinds of variables: first, bank risk and management index; second, bank fintech development indicators; third, control variables. The definition of variables is given below.

3.2.1. Explained Variables

The explained variables involved in this paper mainly involve two aspects: one is the level of bank risk control, the other is the level of bank profitability.

Bank Risk Control Level: This paper first uses non-performing loan ratio (NPL) as a proxy variable to measure the bank's risk control level and then uses risk-weighted return on assets (RORWA) as a proxy for the bank's risk control level. Risk-weighted return on assets refers to the classification of assets by banks and the determination of different risk coefficients according to the risk nature of different asset classes, which includes more types of assets and reflects more types of risks. In the following paper, the amount of non-performing loans/risk-weighted assets (RENPL) will be used as a substitute variable for the robustness test.

Bank profitability: Net interest margin is an important indicator to evaluate a bank's profitability. The higher the net interest margin, the stronger its profitability, which is mainly affected by net interest income and interest-bearing assets. In the revenue of Chinese banking industry, net interest income occupies an absolutely dominant position, and basically, the ratio of net interest income to the total operating income is as high as 60%-80%. Therefore, net interest margin is the index used in this paper to investigate bank profitability.

3.2.2. Core Explanatory Variables

Bank Fintech Development Index: The Financial Technology Development Index (Fintech) is constructed by textual analysis of bank annual reports. The detailed steps are as follows:

Firstly, build the original keyword database of fintech. By referring to relevant reports of Basel Committee and the development process of fintech, fintech can be summarized into five categories: payment and settlement, business channels, resource allocation, risk management and technology basis. Based on the above classification methods,

further read the "Financial Technology (FinTech) Development Plan (2019-2021)" and other materials as well as some bank annual reports. Finally, after referring to Zhao

Qingbo et al. (2022) [3] and Li Hongquan et al. (2022) [9], the fintech keyword database was finally improved, and the results are shown in Table 1

Table 1. Fintech keyword database of banks

| Application scenario | | | | technology | |
|---------------------------------|--------------------|--------------------------------|---------------------------|-------------------------|---------|
| Payment and settlement | Business channel | Resource allocation | Risk management | Underlying technology | |
| Online payment | e-banking | Online banking | Big data risk control | Big data | fintech |
| Mobile payment | Electronic banking | Electronic transaction | Intelligent risk control | Cloud computing | FinTech |
| Online payment | Fortune Bank | Intelligent investment manager | Quantitative risk control | Artificial intelligence | Fintech |
| Computer payment | Mobile banking | Network communication | Intelligent risk control | blockchain | |
| two-dimensional barcode payment | Online banking | Net loan | Digital risk control | Internet of things | |
| Network payment | Light bank | Online transaction | Risk control system | Internet | |
| mobile payment | Investment bank | Online financing | Risk control intelligence | | |
| Electronic payment | Private bank | Network loan | Intelligent risk control | | |
| Internet payment | Wholesale bank | Network financing | Credit evaluation | | |
| Digital RMB payment | | Modern risk control | Data mining | | |
| Cloud payment | | | | | |
| Quick payment | | | | | |

Secondly, we calculated the frequency of each keyword in the annual report. To do this, we first downloaded the PDF annual reports of listed companies and then used Python for text analysis: (i) we used the pdfminer library to convert the annual reports from PDF format to TXT format. For traditional annual reports that were in Word format, we converted them to simplified annual reports. (ii) We then segmented the words using jieba and calculated the frequency of each keyword in each annual report.

Finally, we obtained the total amount of search results through a Python network crawler in the form of "keyword + bank name." However, we couldn't eliminate the interference from irrelevant information such as advertisements. Moreover, the search results might contain some news with weak relevance to the fintech development of banks. These two

points may overestimate the fintech development level of banks. Therefore, we referred to the research of Li Chuntao et al. (2020) [13] and used the index built based on Baidu search as the stability test variable.

3.2.3. Control Variables

We controlled for individual factors at the bank level, including the capital adequacy ratio (CAR), which is expressed as the bank net capital divided by total assets. We also controlled for the bank size index (SIZE), which is expressed by the logarithm of the bank's total assets. Another control variable is a measure of operating efficiency (CIR), which is expressed as a cost-to-income ratio. This ratio is calculated by dividing the total cost by operating revenue. Finally, we included a liquidity indicator (LDR), which is measured as the ratio of total loans to total deposits.

Table 2. Main variable meaning and descriptive statistics

| Variable type | Variable | symbol | Meaning description | Mean | Std.Dev |
|----------------------|------------------------------|---------|--|-------|---------|
| Explained variable | Non-performing loan ratio | NPL | Non-performing loans/total loans | 2.710 | 0.426 |
| | Net interest margin | NII | (Interest income-interest expense)/all interest-bearing assets | 2.349 | 0.432 |
| | Risk-weighted rate of return | RORWA | Net profit/risk-weighted assets | 3.132 | 10.38 |
| Explanatory variable | fintech | FinTech | self-calculation | 59.46 | 40.75 |
| Control variable | Capital adequacy ratio | CAR | Net capital/total assets of a bank | 13.38 | 1.744 |
| | Bank size | SIZE | The logarithm of a bank's total assets | 27.96 | 1.683 |
| | Operating efficiency | CIR | Total cost divided by revenue | 30.40 | 4.580 |
| | Liquidity indicator | LDR | Ratio of total loans to total deposits | 73.05 | 13.49 |

3.3. Descriptive Statistics

As depicted in the figure, the time trend graph for the growth rate of net interest income (NII) of different banks is roughly the same. In general, it remains relatively flat with a slight upward trend that is not particularly obvious. In contrast, the time trend chart for the non-performing loan ratio (NPL) of different banks has undergone significant changes, with most peaks appearing in 2015, followed by a gradual decline.

This phenomenon may be related to the 15-year structural bull market. On one hand, inter-bank liquidity is abundant, while on the other hand, financing difficulties for the real economy have resulted in more bad loans, causing the defect rate to reach a peak. The trend chart for the non-performing loan ratio of individual banks shows a gradual decline, indicating that factors determining NPL differ among banks. This difference in non-performing loan ratio among banks can be helpful in estimating these factors.

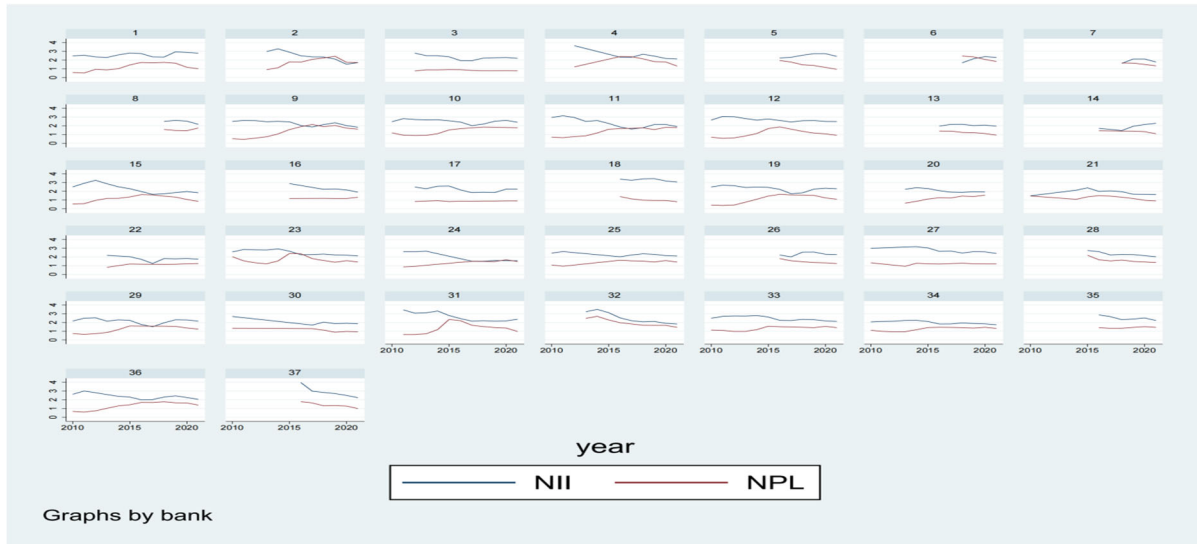


Figure 1. Time trend chart (NPL and NII)

As demonstrated by the correlation coefficient matrix below, FinTech is positively correlated with net interest margin (NII), and negatively correlated with non-performing loan ratio (NPL) and weighted risk-return (RORWA). In other words, it can be concluded that FinTech has a positive impact

on net interest margin, while having a negative impact on non-performing loan ratio and risk-weighted rate of return. However, it is important to note that correlation coefficients do not necessarily indicate causation, and a regression analysis will be conducted to verify causality.

Table 3. Correlation coefficient matrix

| | NPL | NII | RORWA | FinTech | SIZE | CIR | LDR |
|---------|-----------|-----------|----------|-----------|-----------|-----------|---------|
| NPL | 1 | | | | | | |
| NII | -0.176*** | 1 | | | | | |
| RORWA | -0.0590 | 0.101* | 1 | | | | |
| FinTech | 0.00900 | -0.257*** | 0.096* | 1 | | | |
| SIZE | -0.0440 | -0.239*** | 0.251*** | 0.753*** | 1 | | |
| CIR | -0.126** | 0.328*** | -0.0490 | -0.336*** | -0.332*** | 1 | |
| LDR | 0.142** | -0.223*** | -0.0590 | 0.434*** | 0.353*** | -0.253*** | 1 |
| CAR | 0.152*** | -0.196*** | 0.106* | 0.142** | -0.0170 | -0.134** | 0.138** |

3.4. Model Construction

This main focus of this paper is to examine the impact of fintech development level on both bank risk control and bank profitability level. To address potential endogenous issues stemming from individual and time-based factors, the paper employs a two-way fixed utility model for estimation.

$$Y_{i,t} = \alpha + \beta FinTech_{i,t} + \varphi Controls_{i,t} + \mu_i + \lambda_t + \varepsilon_{i,t}$$

In the following table, i represents the bank and t represents the year. $Y_{i,t}$ represents the explanatory variable, which is composed of non-performing loan ratio, risk-weighted return

rate and net interest margin. $FinTech_{i,t}$ refers to the level of fintech development of different banks in different years. $Controls_{i,t}$ represents control variables at the bank level, including bank size (SIZE), operation efficiency (CIR), Capital adequacy ratio (CAR) and liquidity measure (LDR). μ_i solid effect for individual level, λ_t solid effect of time, $\varepsilon_{i,t}$ said random error term.

4. Empirical Tests

4.1. Baseline Regression Results

Successive estimations using the in-group estimator, LSDV test, and Hausman test were performed for the regression

model, with the final regression estimation conducted using the bidirectional fixed effect model. The table below presents the regression results for non-performing loan ratio (NPL), risk-weighted return rate (RORWA), and net interest margin (NII), respectively.

Table 4. Regression Results

| Explained \ Explanatory | NPL | RORWA | NII |
|--------------------------------|--------------------------|-----------------------|-------------------------|
| FinTech | -0.00209** (0.000917) | -0.0446** (0.0193) | 0.00237** (0.000898) |
| Control variable | | | |
| size | 0.0142 (0.130) | 2.417*** (0.465) | -0.238 (0.211) |
| cir | -0.00743 (0.0120) | -0.0648 (0.124) | -0.0256** (0.0116) |
| ldr | -0.000232 (0.00551) | -0.0872** (0.0408) | 0.00515* (0.00275) |
| car | -0.0137 (0.0253) | 1.154*** (0.295) | 0.0189 (0.0178) |
| gdp | -0.0378*** (0.0102) | 0.482* (0.275) | 0.0399 (0.0263) |
| cpi | -0.119*** (0.0218) | 0.798 (0.523) | 0.195* (0.107) |
| Constant | -73.01*** (13.89) | -73.14*** (13.97) | 8.166 (6.478) |
| Bank FE | control | control | control |
| Year FE | control | control | control |
| N | 322 | 322 | 322 |
| Adjust R^2 | 0.271 | 0.153 | 0.643 |

The regression model for non-performing loan ratio (NPL) showed a statistically significant negative correlation with the fintech development coefficient at the 5% significance level. Specifically, when the fintech level increases by 1%, the non-performing loan ratio decreases by 0.0142%, indicating a significant effect. Additionally, the inclusion of control variables revealed that aside from the negative correlation between fintech level and NPL, both GDP and consumer price index have significant impacts. This may be due to the fact that a healthier real economy, with faster growth rates, generates fewer bad debts for banks, thereby effectively reducing their non-performing loan ratio.

The regression model for risk-weighted return rate (RORWA) also revealed a statistically significant negative correlation with the fintech development level index at the 5% significance level. Specifically, when the fintech level increases by 1%, the non-performing loan ratio decreases by 0.0446%, which has a significant effect. The control variable SIZE was found to have a significant impact on the non-performing loan ratio, likely due to the close relationship between weighted risk assets and total assets of banks.

However, the regression analysis of net interest margin (NII) showed a significant negative relationship with the fintech coefficient at the 5% level. This suggests that a bank's development of fintech has a negative impact on its net interest margin, with every 10% increase in fintech level leading to a 0.0237% increase in net interest margin. Despite this negative correlation, the development of fintech can significantly improve a bank's profitability.

4.2. Endogeneity Test

There may be a positive causal relationship between the development level of fintech in banks, the number of employees, and the average salary, leading to endogenous problems. Therefore, the contribution of changes in the number of employees and salary level to the explained variables is also included in the contribution of fintech level, which can overestimate the contribution level of fintech.

To alleviate the influence of this endogenous problem on the research conclusion, the instrumental variable method was used for testing. Since there may be a measurement error in the variable Fintech, per capita salary and total staff were considered as instrumental variables of Fintech to perform 2sls regression, and robust standard error was used.

The results showed that all variables in the three regression equations satisfied exogeneity, and the fintech level of banks still had significant negative, negative, and positive influences on NPL, RORWA, and NII, respectively. Therefore, the above conclusion is robust.

4.3. Robustness Test

In order to ensure the stability and reliability of the above conclusions, the following robustness tests will be conducted:

4.3.1. Substitute Explained Variables

"Profit front, risk back" is a major feature of banking. The non-performing loan ratio is a variable that represents the stock of non-performing assets at a certain point in time. Inspired by Delis and Kouretas(2011)[14] and Jin Penghui et al. (2014)[12], this paper chooses the ratio of risk-

weighted assets to total assets as an indicator of bank risk taking. Additionally, the non-performing loan ratio (NPL) = (non-performing loans/total loan balance) is further optimized to the non-performing loan ratio (RENPL) = (non-performing loans/risk-weighted assets) to conduct a robustness test. The results indicate that the development of fintech by banks still has a significant negative impact on NPL under different measures, supporting the previous conclusion.

4.3.2. Substitute Core Explanatory Variables

In order to eliminate the right-bias of data, the bank's business and management fee are logarithmic. Following the research of Li Chuntao et al. (2020) [13], an index constructed based on Baidu search is summed up with the logarithmic data to obtain a more comprehensive level of fintech index.

The results show that the development of fintech by banks has a significant impact on the risk suppression and profitability of banks. This finding indicates that the previous conclusions remain valid after replacing the core explanatory variables.

5. Conclusions and Suggestions

The rapid development of fintech not only optimizes the allocation of financial factor markets, but also positively impacts the development of banks. It reduces the non-performing loan ratio of banks and improves their profitability. This paper analyzes the influence of banks' development of fintech on their risk level and profitability by using data from 37 A-share listed banks from 2010 to 2021. The bank fintech development level index is constructed using a web crawler and text analysis of annual statements. The study reached the following conclusions:

Firstly, the development of fintech can significantly reduce the non-performing loan ratio and risk level of banks. At the same time, it is also significantly influenced by the GDP growth rate of the current year. The higher the GDP growth rate, the lower the non-performing loan ratio.

Secondly, the development of financial technology can significantly improve the profitability of banks, that is, the level of banks' net interest margin. The conclusion is still valid after a series of robustness tests above.

Based on the above research, the following recommendations are made:

First, commercial banks with large assets and strong profitability can conduct large-scale fintech research and development due to their strong capital advantages. Meanwhile, small and medium-sized banks should reasonably choose the direction of research and development based on the success of large banks. They can leverage the development of fintech to improve profitability and reduce risk-taking, completing the "digital" transformation.

Second, the non-performing loan ratio and net interest margin of banks are greatly affected by the degree of macro prosperity. In good economic years, the non-performing loan ratio and net interest margin of banks will improve significantly. At this time, more capital accumulation can be completed to reduce the impact on fintech investment in bad economic years, so as to achieve capital investment smoothing.

Third, the development of fintech will intensify the competition among banks for financial resources. Compared with small banks, more financial resources flow to large

commercial banks, which compresses and occupies the business space of small banks. Therefore, from the perspective of the healthy development of the entire industry, the focus of the development of fintech should not be the competition for financial resources in the stock market, but should focus on helping banks extend the service boundary, strive to open up incremental markets, and improve the overall level of financial services in the industry.

Forth, relevant departments should formulate policies to guide and support banks in fintech development; The construction of relevant infrastructure can also increase so that banks can better serve the real economy and facilitate the financial supply-side reform with the help of fintech. Commercial banks should strengthen cooperation with fintech enterprises, learn from each other, broaden their development prospects and comprehensively improve their strength.

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