OLS Regression Analysis Based on Fintech Industry Development and Bank Credit Risk

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Abstract. This paper aims to study the impact of fintech technology on banking finance. The purpose of this paper is to examine the impact of fintech technology on banking finance and what factors have affected the effectiveness of the traditional banking industry. Based on the strengths of data science and big data in my field of study, a linear regression model of OLS was applied to summarize and analyze the data. Data from the fintech database and the banking finance database were collected through the CSMAR website for the period 2015 to 2020. According to the results, it is shown that the development of the fintech industry increases the credit risk of banks. This impact is presented in different regions of China, but is more pronounced in the non-Big 4 bank types. Overall, the results suggest that fintech banks replace traditional banking services.

Keywords: Fintech technology, Traditional banks, Credit risk

1 Introduction

This paper aims to study the impact of fintech technology on banking finance. I collected data from the fintech database and the banking finance database through the CSMAR website for the period 2015 to 2020. The available data is used to construct panel regression model with fixed effects to study the impact of fintech on the traditional banking industry. Existing literature study the benefits of fintech development for borrowers, as fintech development contribute to a more solid banking and credit environment. This paper, on the other hand, focuses more on the impact of fintech on banks internally.

With the continuous development of fintech, the traditional banking industry has been greatly impacted by fintech, and its impact has both advantages and disadvantages. On the one hand, fintech can reduce banks' credit risk and consolidate their information efficiency. But fintech can also increase the credit risk of banks because of the regulatory risk involved therefore. The definition of fintech for banks can be briefly understood as the application of emerging technologies in the banking industry, including artificial intelligence technology, block chain technology, cloud computing technology, big data technology, Internet technology. In recent years, a increasing number of banks have adopted fintech technologies to accelerate the its development, and the development of banking fintech will be a great trend at present and even in the future [1]. Although more and more banks have adopted fintech technology in recent years, there are few regulations on fintech, which is the main reason why it poses regulatory risk and technology risk ground. In this article, I examine the impact of fintech technology on the traditional banking industry, and these findings can provide some reference for policy and law makers.

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In addition, several studies in recent years have led to my interest in the field of fintech and thus prompted this research on the development of fintech in banks. While some studies have investigated the impact of fintech on bank credit [2][3], the focus of the literature is on what impact fintech has on external borrowers, those outside of traditional bank credit, who can access a better borrowing platform through the use of fintech. We find that fintech industry development would increase bank credit risk. This effect presents across different regions in China, but is more pronounced in non-Big-Four type of banks. Overall, the results suggest fintech banks substitutes traditional banking services.

The remainder of the article follows. Section 2 provides a literature review. Section 3 expresses the data sources, and presents the definitions of the variables. Section 4 describes the methodology used. Section 5 presents the results and discussion. Finally, section 7 draws conclusions.

2 Literature Review

The impact of fintech development on banking and finance can be summarized in two aspects. On the one hand, banks employ fintech technology can reduce model risk and improve information efficiency, and hence reduce credit risk. On the other hand, banking fintech may increase bank credit risk due to the technology risk and regulatory risk it brings.

Various studies the impact of fintech industry development on credit supply and shows that fintech platform development can improve the market assessment to credit, but also squeeze the market share of traditional banking sector. [4] use data from Ant Financial Services. Ant Finance is China's largest online credit provider to small business owners and retailers of Taobao. The authors find that fintech credit can provide credit opportunities to a group of borrowers who are excluded from traditional bank credit, which create a better financial system and improve social welfare. Fintech Credit has a nationwide distribution, which has the benefit of consolidating many of China's fragmented credit markets for small companies, and it could also provide a better platform for China's large rural population to get more access to loans. [5] exam a comprehensive dataset of monthly credit offers made by Anthem to a large number of Taobao sellers, and study the acceptance rate and percentage usage of fintech credit lines by all seller groups. The personal information provided by borrowers enables them to infer local credit market supply and describe how fintech credit offers changes with borrower characteristics and market conditions. The authors find that fintech credit can provide borrowers who are excluded from traditional bank credit with greater access to a better borrowing platform. Fintech credit can thus create a better financial system. [6] compare performance of fintech technology and traditional banking technologies in the credit assessment of different businesses, based on the MYbank dataset. The authors find that fintech approach has a positive impact on SMEs in small cities and has the greatest improvement in loan default prediction for small firms. The results demonstrate that fintech lending is highly inclusive and has important implications for enhancing credit risk assessment and increasing financial inclusion. [7] investigate whether fintech-based crowdfunding are complements or substitutes to banks. The ease of originating loans online appears to allow fintech lenders to charge higher rates, especially among highly creditworthy, time-sensitive and least price-sensitive borrowers. [8] discuss the development of fintech credit, and outline how fintech credit platforms work and compares them to the traditional banking sector. They find that fintech offers an alternative source of funding. Fintech can

improve financial services for companies while providing more options for individuals. But evidence of increasing credit losses suggest that these innovations need a longer period to be further validated.

Meanwhile, several studies show that fintech industry tends to increase the overall market credit. [9] investigate the impact of fintech on household and non-financial business credit, based on data about technology usage in the financial industry. They find that fintech credit has grown more in affluent areas and where there is less bank competition, and that fintech industry development has improved borrowers' access to finance. In addition, they find that those who borrow using fintech are riskier than those who borrow at banks.

Another branch of studies focus on the impact of fintech technology adoption in banks on banks' credit risk. For example, [10] investigates the impact of fintech on the performance of Chinese banks using fintech development techniques and generalized moment model to address the endogenous problem. They find that fintech has a significant impact on all aspects of bank performance. In general, it reduces banks' earnings and assets, but improves their capital adequacy and management efficiency. They conclude with the recommendation that banks should focus on the increasing capabilities of fintech rather than the resulting competition and challenges. [11] construct a banking FinTech index by using web crawling techniques and text mining on the Baidu search word frequency, and use it to study the impact of bank Fintech on credit risk. They find that state-owned banks are developing banking fintech faster than other banks. They find that bank fintech level significantly reduces credit risk. Further research shows that the negative impact of bank fintech on credit risk is relatively weak among large banks, state-owned banks, and listed banks. [12] research examines the impact of financial technology innovation on Chinese bank performance, using both patent data and FinTech development index. The authors apply a generalized method of moments model to resolve potential endogeneity. While the results show that FinTech innovation reduces banks' profitability and asset quality in the aggregate, it improves banks' capital adequacy and management efficiency. They find the negative effect of fintech is more pronounced for large state-owned commercial banks, while the positive effect is to a smaller degree for policy banks and state-owned commercial banks. Moreover, banks' own specific FinTech capabilities, measured by patent applications and claims, have similar effects on bank performance.

Finally, [13] develop questionnaires and conduct interviews, the find that digital innovation and technology-based business models can provide new business opportunities for companies. And they can disrupt existing outcomes in the financial sector. By providing new avenues for entrepreneurship, fintech can facilitate the gold-positive of new players. The final conclusion is that FinTech is an important evolution in financial markets and disruption is inevitable. [14] analyze fintech and banks using descriptive analysis in Indonesia. The results reveal what has happened in the past, present, and future with fintech and banks, provide practical implications for the banking industry, and suggest how to create innovation through fintech in the future. [15] writes a review of the literature on fintech and banking interactions, examining some statistics as well as typical examples. The final conclusion on the eventual replacement of cash by digital money is tentative and that P2P lenders would not immediately replace banks, and they will simply take away some of their market share. All of these conclusions are tentative because research on these topics is still in its early stages.

3 Data and Variables

We obtain the data from CSMAR. In particular, there are two main sources of data, the Bank Financial Database and the FinTech Database. The sample period ranges from 2015 to 2020. The data provides information on firm financial condition, loan credit condition, liquidity risk, market risk and credit risk.

For the construction of the variables, we use non-performing loan ration as a measure of credit risk, which is calculated as the total value of non-performing loans divided by the bank's total assets. To measure the level of fintech industry performance, we use the logarithm of sum of asset values of all firms reported in this industry. For control variables, we construct leverage as the debt divided by assets, Tier2 capital as the bank tier2 asset value, which is measured in billions. Asset turnover ratio is also used. And EBIT to asset is also used to control for firm's profitability. Finally, intangible asset value, bank's credit rating are also used, wherein the rating value starts from 0 to 12, with 12 being the best rated and lowest risk, 1 being the worst rated and highest risk, and 0 being no rating.

4 Methodology

To analyze the impact of fintech on the traditional banking industry, we estimate the following basic regression model.

$$NPL\_Ratio_{it} = \alpha + \beta * Fintech\_Asset_t + \sum_{i=1}^{K} \eta^k * X_{it}^k + \delta_i + \epsilon_{it}$$

NPL_Ratio_{it} stands for the non-performing loan ratio of bank i at year t. $Fintech\_Asset_t$ represents the average fintech industry asset value at year t. The impact of the fintech industry on bank credit risk can be studied by calculating the coefficient of β before $Fintech\_Asset_t$. A positive β has an impact on bank risk, and a negative one if there is no impact. X_{it}^k denotes the control variable, including bank's leverage, tier2 capital ratio, asset turnover rate, EBIT to asset ratio, intangible asset over total asset ratio, bank's credit rating and number of employees that with Master degree. δ_i represents bank-fixed effect. ϵ_{it} stands for the residual term. It is performed as a panel regression with bank fixed effect. Standard errors clustered at the bank level.

5 Empirical Results

Table 1 represents the summary statistics of the variables used in this paper, including number of observation (N), average (mean), standard deviation (S.D), skewness and kurtosis. The table shows that the mean value of NPL ratio is 1.76 and its standard deviation is 1.56, which is less than the mean level. The variation in this variable is considerably reasonable, given its minimum and maximum values are 0 and 26.76 respectively, which indicates some banks do not have non-performing loans. The mean value and standard deviation of Fintech asset is much larger than NPL ratio, at 14.4 and 15.6 respectively. The difference between the minimum and maxi-

mum values of Fintech_asset is larger, thus leading to a more significant S.D. Referring to control variables, Tier2cap has the largest variation, the difference is large as can be seen from its maximum and minimum values, thus leading to a large and unstable standard deviation value of 127, which is six times its mean value. In addition to a mean value of 21.27.

Table 1. Summary statistics

variable	N	Mean	S.D	Skew	Kurt	Min	Median	Max
NPL_ratio	3307	1.76	1.56	6.25	72.59	0	1.48	26.76
Fintech_asset	3506	14.40	15.16	0.57	1.39	0.90	6.49	36.60
Fintech_num	3506	34.86	10.85	0.08	2.51	12	35	54
Leverage	1036	8.96	11.24	10.15	154.27	0.15	6.94	226.75
Tier2cap	1708	21.27	127.02	27.95	982.99	0	1.18	4589.16
Turnover	3467	0.03	0.01	0.96	4.68	0	0.02	0.08
Ebit2asset	3466	0.03	0.01	18.78	756.24	-0.05	0.03	0.55
Intangible	3218	0.49	2.40	8.18	75.50	0.00	0.04	27
Rating	3506	0.23	1.30	6.34	44.19	0	0	12
MscWorker	1363	1132.07	3698.14	5.77	41.62	1	160	36182

Table 2. Baseline Regression: Non-Performing Loan Ratio

	(1)	(2)	(3)	(4)
	NPL_ratio	NPL_ratio	NPL_ratio	NPL_ratio
Fintech_asset	0.00553***	0.00552***	0.0107***	0.0146***
	(3.58)	(3.48)	(2.87)	(3.12)
Leverage			-0.179***	-0.266***
			(-3.53)	(-4.09)
Tier2cap			-0.0000461	-0.0000253
			(-0.20)	(-0.14)
Turnover			22.96	66.32***
			(1.64)	(3.85)
Ebit2asset			-56.73***	-41.81**
			(-3.98)	(-2.51)
Intangible				-0.0105
				(-0.18)
Rating				-0.0193
				(-0.56)
LnMscWorker				0.0398
				(0.14)
Constant	1.846***	1.675***	3.838***	2.708
	(22.40)	(52.72)	(6.60)	(1.39)
Bank Fixed Effect	No	Yes	Yes	Yes

R2	0.00593	0.00419	0.0696	0.132
N	3307	3307	569	321

t statistics in parentheses

* p<0.1, ** p<0.05, *** p<0.01

The first column uses simple panel OLS regression with only the Fintech asset variable. The second column added Bank Fixed Effect. Column 3 adds bank accounting, including information, Leverage, Tier2cap, Turnover and Ebit2asset. Furthermore, the fourth column adds bank intelligence information variables, such as value of intangible asset, corporate rating and the logarithm of number of employees with master degree. The results of Table 2 suggest that Fintech asset has a positive impact on banks' NPL ratio. Such effect is significant at 1% significance level across all four regression settings. Taking column 4 as an example, when Fintech asset increases by one unit, the non-performing loan ratio of banks would increase by 0.0146%. It shows that the development of the fintech industry would have a negative impact on the banking industry because it raises the non-performing loan rate of banks. This result contributes to the findings by Lee, et al (2011), who find that development of the fintech industry has a crowding-out effect on the development of the banking industry.

Table 3. Heterogeneity across Regions

	(1) East	(2) Middle	(3) West
Fintech_asset	0.0132**	0.0274*	0.0145**
	(2.00)	(1.84)	(2.43)
Leverage	-0.404***	-0.104	0.0483
	(-4.41)	(-0.62)	(0.53)
Tier2cap	-0.0000107	-0.00831	-0.0539*
	(-0.06)	(-0.13)	(-1.87)
Turnover	98.35***	2.345	-29.01
	(3.66)	(0.07)	(-1.22)
Ebit2asset	-62.40**	-60.64	-13.43
	(-2.51)	(-1.21)	(-0.70)
Intangible	0.0214	0.653	1.833
	(0.31)	(0.45)	(0.77)
Rating	-0.0308	0	0.0194
	(-0.75)	(.)	(0.36)
LnMscWorker	0.165	-1.203	-0.417
	(0.38)	(-1.32)	(-1.31)
Constant	2.568	10.51*	4.361**
	(0.80)	(1.83)	(2.49)
Bank Fixed Effect	Yes	Yes	Yes
R2	0.200	0.466	0.280
N	214	40	66

t statistics in parentheses

* p<0.1, ** p<0.05, *** p<0.01

The impact of fintech asset on bank non-performing loans is studied by geographic region, divided into eastern, western and central China. The eastern part contains Hebei Province, Beijing, Tianjin, Shandong Province, Shanghai, Zhejiang Province, Fujian Province, Guangdong Province, Liaoning Province. The western part contains Chongqing Sichuan Province, Shaanxi Prov-

ince, Yunnan Province, Guizhou Province, Guangxi Zhuang Autonomous Region, Gansu Province, Qinghai Province, Ningxia Hui Autonomous Region, Xinjiang Uygur Autonomous Region, Inner Mongolia Autonomous Region. The central region includes Shanxi, Jilin, Heilongjiang, Anhui, Jiangxi, Henan, Hubei, Hunan Province. In order to understand whether there are geographical differences in the role of fintech development on the banking industry, the development of local credit and fintech varies from region to region. Through the graph as shown our findings, the values in the first row are all positive, so fintech industry has a positive impact on Fintech asset in both the East and West as well as the Central, and the most significant in the West. At the same time, the impact on Leverage and Turnover is most significant in the east, and the significance of Tier2cap impact in the west is not very significant. In addition, the Ebit2asset significance of banks in the eastern region is relatively significant, but the value is negative, indicating that fintech has a negative impact on the interest and pre-tax profits of banks in the eastern region. Overall, Fintech has a positive impact on the banking and finance industry in these three parts of China.

Table 4. Heterogeneity across Bank Types

	(1)	(2)
	Big4Bank	Other Banks
Fintech_asset	-0.0168	0.0163***
	(-0.81)	(3.30)
Leverage	0.434	-0.285***
	(0.96)	(-4.16)
Tier2cap	-0.00107	-0.0000178
	(-0.41)	(-0.10)
Turnover	-28.40	67.44***
	(-0.17)	(3.79)
Ebit2asset	-16.00	-38.00**
	(-0.11)	(-2.17)
Intangible	0.0490	-0.0116
	(0.51)	(-0.17)
Rating	0.0126	-0.0179
	(0.11)	(-0.49)
LnMscWorker	-0.457	-0.0191
	(-0.20)	(-0.06)
Constant	4.073	3.042
	(0.18)	(1.55)
Bank Fixed Effect	Yes	Yes
R2	0.541	0.141
N	16	305

t statistics in parentheses

* p<0.1, ** p<0.05, *** p<0.01

The impact of fintech asset on banks' non-performing loans is studied by bank type, divided into the four major state-owned banks and other banks. The four state-owned banks include Bank of China Industrial, Commercial Bank of China, Agricultural Bank of China and China Construction Bank. To understand whether there are differences in the role of fintech development on different nature of banking sector. In the graphs by bank type. we find that the role of fintech asset is not significant, with a negative sign, and fintech does not have a significant impact on the credit risk of the big four banks. But for other banks, the development of the fintech industry still raises the credit risk of banks and the impact can be more significant. For other banks, the significance of both Leverage and Ebit2asset is significant, and fintech has a positive impact on both values. But for turnover the impact is greater and the significance is significant, reaching a value of 67.44. The rest of the values are not significant. So we can see from these results that state-owned banks have guaranteed business volume and a good grasp of risk control.

Table 5. Robustness Check: Fintech Measures

	(1)	(2)	(3)
	Npl_ratio	Npl_ratio	Npl_ratio
Fintech_NetIncome	0.439*		
	(1.93)		
Fintech_Revenue		0.0351***	
		(3.26)	
Fintech_Leverage			3.464*
			(1.94)
Leverage	-0.244***	-0.263***	-0.215***
	(-3.70)	(-4.09)	(-3.41)
Tier2cap	-0.0000251	-0.0000294	-0.0000279
	(-0.14)	(-0.17)	(-0.16)
Turnover	63.76***	65.19***	66.36***
	(3.66)	(3.79)	(3.78)
Ebit2asset	-42.67**	-45.31***	-47.47***
	(-2.53)	(-2.73)	(-2.82)
Intangible	-0.000616	-0.0111	-0.00140
	(-0.01)	(-0.18)	(-0.02)
Rating	-0.0216	-0.0197	-0.0174
	(-0.62)	(-0.58)	(-0.50)
LnMscWorker	0.186	0.0944	0.447*
	(0.63)	(0.35)	(1.81)
Constant	1.781	2.510	-1.003
	(0.89)	(1.32)	(-0.56)
Bank Fixed Effect	Yes	Yes	Yes
R2	0.110	0.135	0.110
N	321	321	321

t statistics in parentheses

* p<0.1, ** p<0.05, *** p<0.01

We again examine the impact of fintech on the development of the banking industry by replacing the industry variables of fintech. Replacing fintech asset with Fintech_Net Income, Fintech_Revenue, Fintech_Leverage. The substitution of the variable Fintech_Revenue has the most significant effect on the NPL ratio of the bank. The rest of the control variables do not change significantly due to the change of the main variable, and the significant are all consistent, among which the significance of leverage, turnover and ebit2asset is the most significant. But the final result is not changed by the replacement of variables.

6 Conclusion

We investigated the impact of fintech on bank finance in recent years through CSMAR website, using bank finance database and fintech database. The final results were obtained by panel regression. The results show that banks' NPL ratio is positively correlated with total assets of fintech. This is, fintech industry development increased banks' NPL ratio, which has a positive impact on banks in the east, central, and west. However, state-owned banks are not very significantly affected by the development of fintech. Changing the control variables did not change the results. However, the data is limited and only observed from 2015 to 2020, future research are needed to explore fintech in depth.

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