Fintech, Inclusive Finance, and Bank's Risk-Taking

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Abstract. In this paper, we use web crawler technology and principal component analysis to measure the FinTech index and estimate the Lerner index by constructing a transcendental logarithmic cost function and SFA model to empirically investigate the moderating effect of fintech concerning the relationship of financial inclusion and bank's risk-taking. The results show that (1) financial inclusion motivates banks to take risks proactively, leading to an increase in the level of risk-taking, and (2) the positive impact of financial inclusion on risk-taking is weakened as fintech empowers financial inclusion. The innovation of the paper is to detect the moderation effect of fintech on the association between financial inclusion and bank's risk-taking and to provide theoretical support for further preventing financial risks, holding the bottom line of no systemic financial risks, and maintaining financial stability, while differing from previous literature that explores the impact of financial inclusion and fintech on bank's risk-taking separately.

Keywords: Fintech, Bank's Risk-taking, Financial inclusion.

1   Introduction

Promoting inclusive finance, aimed at providing convenient and effective financial services to all social groups, particularly the disadvantaged, is an essential requirement for promoting the sustainability of China's financial sector, enhancing social equity, and achieving common prosperity. In recent years, China's inclusive finance has developed well and provided a solid foundation for the real economy and employment situation. At the end of 2021, the loan balance of China's inclusive SMEs was 19.23 trillion yuan, up 27.3%, and as many as 44.56 million households were granted credit. While inclusive finance can reduce banks' reliance on wholesale financing and lower financing costs, the potential risk issues arising should also be of concern. Preventing excessive bank's risk-taking is an important part of maintaining financial stability, and preventing financial risks and holding the bottom line of no systemic financial risks is particularly important for the high-quality development of China's economy and promoting the financial economy to serve the real economy.

    With the application and popularity of Internet finance, big data finance, and blockchain technology, the application and development of fintech have made it easier for more people, especially the poor, to access financial services and experience the

benefits of financial inclusion. By utilizing big data and other fintech to craft customer profiles, banks are directly increasing the availability and expansion of financial services by taking advantage of features such as high coverage and high efficiency .And the possibility that fintech can reduce the elevated risk-taking due to the provision of inclusive financial services is a question that deserves in-depth study. Therefore, based on the panel data of 55 banks from 2011-2021, this paper empirically analyzes the moderation impact of fintech on the r nexus between financial inclusion and risk-taking.

2   Theoretical analyses

Inclusive finance is committed to building a new system that is more financially inclusive and distinct from the traditional financial system of existential financial exclusion. The traditional financial system excluded low-income people from financial services because they could not afford the expensive intermediary services due to the "wealth threshold"[1]. Financial inclusion has a strong contribution to addressing financial exclusion and poverty, promoting equality of opportunity, and achieving an inclusive society, but it must be confronted with the paradoxical problem of financial inclusion. Inclusive services tend to benefit disadvantaged groups, which may sacrifice the interests of some people, which in turn leads to the unsustainability of inclusion[2]. Inclusive finance requires banks to serve a large retail customer base, yet this requirement not only imposes a corresponding burden on operating costs but also indiscriminately expands the audience for inclusive finance and promotes excessive credit expansion, which affects the quality of banks' asset portfolios, leads to excessive risk-taking and ultimately affects financial stability.

Fintech-enabled inclusive finance has broadened the scope of inclusive financial services, effectively helping banks to identify the credit needs of long-tail customers and alleviating the "hyper-normal" financial rationing caused by financial exclusion. Fintech empowers banks to better predict the credit value of borrowers and reduce credit risk caused by information asymmetry with the help of machine learning algorithms, improve risk management capabilities through ex-ante verification, post-event supervision, and accurate customer profiling, control the level of bad debt rates, reduce bank transaction time and costs, and improve bank resource allocation efficiency, which in turn reduces bank risk concentration and bank's risk-taking levels[3]. Specifically, based on big data and other fintech, banks can make more accurate panoramic relationship network mapping and customer profiles, accurately target service objects, so as to screen out micro and small customers with financing needs, understand more about the characteristics of financing needs of micro and small customers, and realize the accurate drip irrigation of financial services. In addition, fintech also effectively solves the critical technical problems in risk prevention and control, helping banks to make more accurate evaluation of business risks and improve their ability to make credit decisions.

3   Research design

3.1   Model specification

A model to detect the relationship between fintech impact on financial inclusion and risk-taking is constructed as follows:

$$Risk_{i,t} = b_0 + b_1 Fic_t + b_2 Fintech_t + b_3 Fic_t \times Fintech_t + b_4 Control_{i,t} + \varepsilon_i + m_{i,t} \tag{1}$$

Where $Risk_{i,t}$ is the risk-taking on bank i in year t, Fic_t is the level of financial inclusion in year t, $Control_{i,t}$ is the bank-level and macro-level control variables, $Fintech_t$ is the level of fintech in year t, $Fic_t \times Fintech_t$ is the interaction term between financial inclusion and fintech, ε_i represents individual fixed effect, and represents the random error term.

3.2   Variable measurement

Independent variable.
     Considering the data availability of expected default rate, the strong endogeneity of Z-values and the tendency of fluctuations to be skewed, and the fact that the Risk-weighted assets as a percentage of total assets can reflect the comprehensive risk-taking level of banks more comprehensively, this paper selects the risk-weighted asset ratio as a proxy variable for bank's risk-taking.

Dependent variable.
     Drawing on the ideas of Chen et al.(2022)[4], this paper uses web crawler technology to extract the annual average daily search values of 34 keywords from 2011-2021 from the Baidu index search engine based on constructing a thesaurus, which will be used as the basis for constructing a fintech index. Then, using principal component analysis to construct a fintech index. Drawing on the methodology of Hasanul Banna (2020)[5], the amount of mobile cellular subscriptions per 100 people and the number of ATMs per 100 thousand adults were used as surrogate variables for financial inclusion.

Control variable.
     (1)The unemployment rate (ur), year-on-year GDP growth rate (gdp), and year-on-year CPI growth rate (cpi) are selected to control for the employment status, economic environment, inflation level, and the total bank assets (size), liquidity ratio (liq), capital adequacy ratio (car) and Lerner index (ler) are selected to control for the effects of bank size, liquidity level, capital status and the degree of bank competition. Among them, referring to Beck et al.(2012)[6], the Lerner index, which can directly

reflect banks' ability to adjust after changes in supply and demand, is selected as a proxy variable for the level of bank's competition, and the formula is calculated as :

$$LER_{i,t} = (p_{i,t} - mc_{i,t})/p_{i,t} \qquad (2)$$

Drawing on the methods of Joaquin et al. (2004)[7] and Chen et al. (2022)[8], the "three inputs and one output" model is used to measure the marginal cost and Lerner index. The derivation process is as follows:

$$lnTC_{i,t} = \alpha_0 + \alpha_1 lnTA_{i,t} + \frac{1}{2}\alpha_2(lnTA_{i,t})^2 + \sum_{j=1}^{3}\beta_j lnW_{j,it} +$$
$$\frac{1}{2}\sum_{j=1}^{3}\sum_{k=1}^{3}\theta_{jk} lnW_{j,it} lnW_{j,it} + \sum_{j=1}^{3}\gamma_j lnTA_{it} lnW_{j,it} + \lambda_1 Trend + \lambda_2 \frac{1}{2}Trend^2 +$$
$$\sum_{j=1}^{3}\phi_j TrendlnW_{j,it} + \varepsilon_{i,t} \qquad (3)$$

Where TC is the total cost and TA is the total output, which is expressed in terms of total assets; $W_1, W_2 and W_3$ are input prices, representing labor price, capital price, and fixed asset price respectively, see table 1 for variable descriptions; Trend represents technological change, measured by time trend, Trend=1, 2, ..., 11, representing 2011-2021, respectively; ε_{it} denotes the random error.

Also, to ensure that the input factor prices satisfy the first-order chi-squared condition, the following linear constraint is placed on equation (3):

$$\sum_j \beta_j = 1, \sum_j \theta_{jk} = 0, \sum_j \gamma_j = 0, \sum_j \phi_j = 0 \qquad (4)$$

Table 1. Description of input price variables

	Input prices	Variable Description
W1	Labor price	Ratio of personnel costs to total assets
W2	Capital price	Interest cost divided by the sum of deposits and short-term funds
W3	Fixed asset price	Ratio of other operating expenses to fixed assets

The resulting coefficients α_1, α_2 and γ_j are taken into the following equation to solve for the bank's marginal cost mc:

$$mc_{it} = \frac{\partial TC_{it}}{\partial TA_{it}} = \frac{TC_{it}}{TA_{it}} \times \frac{\partial lnTC_{it}}{\partial lnTA_{ti}} = \frac{TC_{it}}{TA_{ti}} \times (\alpha_1 + \alpha_2 lnTA_{it} + \sum_{j=1}^{3}\gamma_j lnW_{j,it}) \qquad (5)$$

The Lerner index for each bank for each year is obtained by taking mc_{it} into equation.

(2) The magnitude of the Lerner index ranges from 0 to 1, with 0 indicating perfect competition and 1 indicating perfect monopoly. In general, the Lerner index shows a negative correlation with the degree of bank competition, the higher the Lerner index, the less competitive the bank is; the lower the Lerner index, the more competitive the bank is.

3.3   Data source.

Considering data availability, this paper takes 55 commercial banks in China from 2011-2021, including 5 state-owned banks, 13 joint-stock banks, 30 urban commercial banks, as well as 7 rural commercial banks. Financial inclusion data are obtained from the World Bank Global Findex database, bank-level data sourced from the Wind database, Bankscope database and the annual reports of each bank, and macro-level data from national statistical offices and IMF.

4   Empirical analysis

Table 2 reports the regression results of the model, specifically, the estimated coefficients of mcs, atm, and ft all pass the significance test and are significantly positive at the 10% level, meaning that increased financial inclusion and fintech leads to an increase in the level of risk-taking. However, the estimated coefficient of the interaction between financial inclusion and fintech is significantly negative at least at the 10% level, suggesting that the contribution of financial inclusion to risk-taking is weakened with the addition of fintech. The estimated coefficients of the bank-level control variables were significant and negative at least at the 10% level, indicating that asset size, liquidity level, capital adequacy ratio, and the degree of competition are important characteristic variables that affect bank's risk-taking. Banks with larger assets, higher levels of liquidity, higher capital adequacy ratios, and lower levels of competition have lower levels of risk-taking or, conversely, higher levels of risk-taking.

Table 2. Impact of fintech on the relationship between financial inclusion and risk-taking

rwa	(1)			rwa	（2）		
mcs	0.597***	size	-6.550**	atm	0.111**	size	-2.179*
	(5.974)		(-2.611)		(2.201)		(-1.794)
ft	10.366***	liq	-0.194***	ft	5.574*	liq	-0.220***
	(2.320)		(-3.165)		(1.782)		(-6.734)
c.mcs#c.ft	-0.082*	car	-0.378	c.atm#c.ft	-0.079**	car	-0.250
	(-1.855)		(-1.214)		(-2.012)		(-1.362)
ler	-7.428*			ler	-6.893***		
	(-1.798)				(-3.118)		
Individual effects	YES		YES	Individual effects	YES		YES
Macro environment	YES		YES	Macro environment	YES		YES

t statistics in parentheses	* p<0.1 ** p<0.05 ***p<0.01

5   Conclusion

This paper analyzes the moderating effect of fintech on the relationship between financial inclusion and risk-taking with data from 55 commercial banks in China from 2011-2021. The paper found that (1) Inclusive finance and bank's risk-taking show a significant positive correlation, with the expansion of inclusive financial services, the level of bank's risk-taking rises; (2) fintech can effectively weaken the facilitation impact of inclusive finance on bank's risk-taking, and the level of risk-taking decreases in the process of fintech promoting the deeper development of inclusive finance.

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