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FinTech and Commercial Bank Risk-Taking: Evidence from the Operational Efficiency Channel

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Abstract. Against the backdrop of rapid digital transformation in banking, how fintech affects commercial banks' risk-taking has become an important issue for financial stability. This study uses annual data for Chinese listed commercial banks over 2010–2024 to investigate whether differences in fintech development are associated with banks' risk exposure.Banks with higher fintech development tend to report a larger share of risk-weighted assets. The positive relationship remains statistically significant in the fixed-effects specification. The mechanism analysis further shows that fintech is associated with a lower cost-to-income ratio. When the cost-to-income ratio is introduced into the risk-taking equation, its coefficient is negative and significant, while the fintech coefficient remains positive. Similar results are obtained when the aggregate fintech index is replaced by separate measures of artificial intelligence and digitalization. The evidence therefore points to a possible trade-off. Fintech is associated with greater operating efficiency, but the additional operating capacity may also be accompanied by expansion into assets with higher risk weights. By using bank-level fintech data, the study adds evidence on how digital adoption is related to the risk profile of individual banks.

Keywords: fintech, commercial banks, risk-taking, operational efficiency

1. Introduction

Bank risk-taking is closely related to how credit and other financial resources are allocated. It also affects the resilience of the banking system when external shocks occur.Some degree of risk exposure is unavoidable in normal banking activities and may support lending. The problem arises when risk grows faster than a bank's capacity to absorb losses [1-3]. Digitalization has also changed the way banks generate and manage risk. Whether these changes ultimately raise or lower bank risk is not obvious and needs to be tested empirically.

Chinese commercial banks increasingly use digital tools in credit assessment, customer management, transaction processing, and internal risk control.Digital tools can give banks quicker access to borrower information and make credit assessment less costly. They can also improve risk pricing and reduce part of the cost involved in routine banking operations [4, 5]. Cost reductions, however, can have another consequence. When expansion becomes cheaper, banks may have more room to increase lending or invest in assets carrying higher risk weights [6-8]. The direction of the overall effect is therefore uncertain beforehand.

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Existing studies do not reach a consistent conclusion on whether fintech increases or reduces banks' willingness to take risk [4, 7-9]. Another limitation is measurement. Regional or industry-level fintech indices cannot fully capture the large differences in digital adoption across individual banks.Less is also known about what happens inside banks after fintech adoption, particularly whether changes in operating efficiency help explain subsequent changes in risk-taking.

This paper uses panel data for Chinese listed commercial banks from 2010 to 2024. Unlike studies that rely on regional fintech measures, the analysis uses bank-level indicators from CNRDS, which makes it possible to distinguish differences in digital adoption across banks. The empirical analysis then examines whether the cost-to-income ratio changes with fintech development and whether this change is related to banks' risk exposure. In this way, the paper links bank-level digital adoption with both operating efficiency and risk-taking.

2. Literature review

Bank risk-taking cannot be explained by a single factor. A bank's profitability, capital position and the external policy environment can all affect its willingness and ability to hold risky assets. Capital is particularly important because it constrains both lending and asset allocation. Banks with different capital positions also differ in their capacity to absorb potential losses. Yuan and Rao [1], Zhang and Liu [2], and Zhang and Cao [3] provide evidence that capital constraints affect banks' risk-taking through lending, asset allocation, and loss-absorption capacity. Bank-level characteristics alone cannot fully explain risk-taking. Monetary conditions, macroprudential policies, and competitive pressure may also change the trade-off between expected returns and risk exposure. Ma and Yao [10] and Dai and Tao [11] show that policy and regulatory constraints can affect banks' risk-taking decisions, while the development of emerging financial models—such as internet finance—has further transformed the competitive landscape facing banks [12]. Neither bank characteristics nor external conditions alone fully explain changes in risk exposure. The increasing adoption of digital technologies adds another dimension to this decision-making process.

The introduction of fintech adds a technological dimension to these traditional determinants of bank behavior.In practice, digital systems can lower the cost of collecting information, processing transactions and screening customers. Such cost changes can affect not only daily operations but also decisions about how banks expand their business. The Research Group of the Development Research Department, Bank of Communications [13] and Zhang [14] has emphasized the role of technological progress in the digital transformation of banks. Building on this, related studies have further examined whether fintech can translate into improvements in operational efficiency [15]. Yang et al. [16] found that fintech can influence the technical efficiency of commercial banks. Liu Mengfei [17], however, pointed out that the outcome depends on the relative strength of technological spillover effects versus competitive effects. The effect of fintech therefore extends beyond technology adoption itself. Changes in costs and operating efficiency can alter later business decisions. Accordingly, research has increasingly shifted from the digital transformation process itself toward its consequences for bank behavior, including risk-taking.

Existing studies point to two different risk effects of fintech. Better access to information and more effective borrower evaluation and asset pricing may help banks identify potential risks earlier and manage their exposures more effectively. Conversely, cost savings and efficiency gains may create additional capacity for business expansion and risk-asset investment, particularly when banks face strong competitive and profitability pressures. These opposing channels may partly explain why previous empirical studies reach different conclusions [7-9]. Studies by Sun and Yu [7], as well as Chen and Gao [8], among others, focus more on the effects of fintech on competition and business

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expansion. Li et al. [5] and Ji [6], on the other hand, emphasized channels such as improved information, operational efficiency, and risk management. Estimating only the direct relationship leaves an important question unanswered: how does fintech change banks' risk decisions? Operational efficiency offers one way to examine this process. Fintech can change banks' operating costs, while changes in those costs may affect later asset-allocation decisions.

3. Methodology

3.1. Sample selection and data sources

The sample consists of Chinese listed commercial banks observed annually between 2010 and 2024, forming an unbalanced panel. The banks' financial data were primarily sourced from the Guotai An (CSMAR) database and supplemented and verified using the annual financial reports of listed banks. Bank-level fintech data were obtained from the China Research Data Service Platform (CNRDS). Data from different sources were matched based on bank names and years, and bank-year observations with missing core variables were excluded, ultimately forming the research sample for this paper.

3.2. Variable definitions

3.2.1. Dependent variable

This paper uses commercial banks' risk-weighted assets (RWA) as the dependent variable, measured as the ratio of risk-weighted assets to total assets, as shown in (1). Here, i and t represent the bank and the year, respectively. Risk-weighted assets take into account the risk weights of different assets; therefore, a higher RWA indicates a higher overall level of risk exposure in the bank's asset portfolio.

$$\mathrm{RWA}_{it}=\mathrm{Risk\ Weight\ Asset}_{it}/\mathrm{Total\ Asset}_{it} \tag{1}$$

3.2.2. Core explanatory variables

Fintech is the main explanatory variable and is obtained from the bank-level fintech indicators reported by CNRDS. The CNRDS measure covers internet application, intelligent technologies, information technology and digitalization. A larger value corresponds to a higher level of fintech adoption by the bank. Compared to regional-level proxy indicators for fintech, bank-level indicators can more directly reflect differences in fintech development across different banks.

3.2.3. Mediating variables

This paper uses the cost-to-income ratio (CIR) to measure the operational efficiency of commercial banks and employs it as a mediating variable for mechanism testing. The cost-to-income ratio reflects the relationship between a bank's operating costs and operating revenue; a lower ratio indicates stronger cost control and higher operational efficiency. Fintech can lower operating costs and simplify transaction processing. If these changes improve efficiency, they may also affect subsequent business expansion and asset allocation.

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3.2.4. Control variables

Based on relevant research on risk-taking by commercial banks and taking into account data availability, this paper selects return on equity (ROE), capital adequacy ratio (CAR), non-interest income ratio (NIIR), asset growth rate (AssetGrowth), total asset turnover (TATO), and equity ratio (Equity Ratio) as control variables to account for characteristics such as bank profitability, capital adequacy, income structure, asset expansion, asset utilization efficiency, and capital structure, respectively. The definitions of the main variables are presented in Table 1.

Table 1. Definitions of key variables

Variable Types	Variable Name	Symbol	Variable Definitions	Data Sources
Dependent variable	Bank Risk-Taking	RWA	Risk-Weighted Assets / Total Assets	CSMAR, Bank Financial Reports
Key Explanatory Variables	Level of Fintech Development	Fintech	Indicators of FinTech Development at the Banking Level	CNRDS
Mediating variable	Cost-to-Income Ratio	CIR	The ratio of operating costs to operating revenue, used to measure operational efficiency	CSMAR, Bank Financial Reports
Control Variables	Return on Equity	ROE	Measuring a Bank's Profitability	CSMAR, Bank Financial Reports
	Capital Adequacy Ratio	CAR	Measuring a Bank's Capital Adequacy and Risk Resilience	CSMAR, Bank Financial Reports
	Percentage of Non-Interest Income	NIIR	Percentage of Non-Interest Income to Total Operating Revenue	CSMAR, Bank Financial Reports
	Asset Growth Rate	Asset Growth	Annual Growth Rate of Total Bank Assets	CSMAR, Bank Financial Reports
	Total Asset Turnover Ratio	TATO	Measuring the Efficiency of Bank Asset Utilization	CSMAR, Bank Financial Reports
	Equity Ratio	Equity Ratio	Ratio of Shareholders' Equity to Total Assets	CSMAR, Bank Financial Reports

3.3. Model specification

3.3.1. Baseline regression model

To examine the relationship between fintech development and risk-taking by commercial banks, this paper constructs the following baseline regression model:

$$RWA_{it}=\alpha+\beta Fintech_{it}+\gamma Control_{it}+\mu_i+\delta_t+\varepsilon_{it} \quad (2)$$

In this model, RWA_{it} represents the risk exposure level of bank i in year t; $Fintech_{it}$ represents the level of fintech development at the bank; $Control_{it}$ represents control variables at the bank level, including ROE, CAR, NIIR, AssetGrowth, TATO and Equity Ratio; $\mu_i+\delta_t$ represents the fixed-effects term, used to control for unobservable heterogeneity in the model specification; and ε_{it} is the random disturbance term. This paper focuses on the coefficient β, which reflects the relationship between changes in the level of fintech development and changes in a bank's risk-taking, holding all other conditions constant.

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3.3.2. Testing the operational efficiency mechanism

To further analyze the potential operational channels through which fintech influences commercial banks' risk-taking, this paper uses the cost-to-income ratio as a proxy for operational efficiency and employs the three-step mediation analysis method for testing. The specific model is as follows:

$$RWA_{it}=\alpha+\beta Fintech_{it}+\gamma Control_{it}+\mu_i+\delta_t+\varepsilon_{it} \quad (3)$$

$$CIR_{it}=\alpha+\beta Fintech_{it}+\gamma Control_{it}+\mu_i+\delta_t+\varepsilon_{it} \quad (4)$$

$$RWA_{it}=\alpha+\theta CIR_{it}+\beta Fintech_{it}+\gamma Control_{it}+\mu_i+\delta_t+\varepsilon_{it} \quad (5)$$

4. Results

4.1. Descriptive statistical analysis

Table 2 presents the descriptive statistics for the main variables. RWA has a sample mean of 0.643 and a standard deviation of 0.104. The dispersion suggests that the banks in the sample do not have identical risk profiles.Fintech varies more noticeably across banks: its mean is 2.514, the standard deviation is 1.237, and observed values range from 0 to 5.493. The control variables also vary considerably across banks, especially in profitability, asset growth, income structure and capital conditions.

Table 2. Descriptive statistics

	Obs	Mean	SD	Min	Max
RWA	1515	0.643	0.104	0.000	0.893
Fintech	1616	2.514	1.237	0.000	5.493
ROE	1611	11.810	5.666	-10.440	33.447
CAR	1556	13.458	2.891	0.000	59.610
NIIR	1522	21.205	14.937	-32.844	111.430
AssetGrowth	1609	16.248	26.737	-23.550	876.510
TATO	1613	0.026	0.007	0.007	0.067
Equity Ratio	1614	7.465	1.812	2.530	32.510

4.2. Correlation analysis and multicollinearity tests

Table 3 reports the results of the correlation tests for the main variables. The correlation coefficient between the level of fintech development (Fintech) and bank risk-weighted assets (RWA) is 0.080, and it is significant at the 1% level, preliminarily indicating a positive correlation between fintech development and bank risk-weighted assets. At the same time, RWA is significantly negatively correlated with ROE, CAR, and AssetGrowth, and significantly positively correlated with Equity Ratio. These correlations also show that several bank characteristics are related to RWA. These correlations confirm that several bank characteristics are related to RWA, supporting their inclusion as controls based on the model specification.Correlation coefficients, however, do not isolate the effect of fintech from other bank characteristics. The relationship is therefore examined further using regression models.

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Multicollinearity is checked using variance inflation factors. As reported in Table 4, the largest VIF is 3.13 and the mean is 1.90. Both values are well below the conventional threshold of 10, so severe multicollinearity is unlikely to affect the regressions.

Table 3. Correlation test

	RWA	Fintech	ROE	CAR	NIIR	AssetGrowth	TATO	Equity Ratio
RWA	1.000							
Fintech	0.080*** (0.002)	1.000						
ROE	-0.313*** (0.000)	-0.036 (0.166)	1.000					
CAR	-0.160*** (0.000)	0.057** (0.027)	-0.135*** (0.000)	1.000				
NIIR	-0.007 (0.787)	0.083*** (0.001)	-0.094*** (0.000)	0.049* (0.060)	1.000			
AssetGrowth	-0.210***(0.000)	-0.075*** (0.004)	0.069*** (0.007)	0.002 (0.924)	-0.013 (0.616)	1.000		
TATO	0.014 (0.583)	-0.185*** (0.000)	0.610*** (0.000)	-0.045* (0.084)	-0.082*** (0.002)	0.094*** (0.000)	1.000	
Equity Ratio	0.283*** (0.000)	-0.021 (0.415)	-0.352*** (0.000)	0.703*** (0.000)	0.047* (0.071)	-0.116*** (0.000)	0.067*** (0.010)	1.000

Note: The numbers in parentheses are p-values; *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

Table 4. Multicollinearity test

Variables	VIF
Equity Ratio	3.13
ROE	2.46
CAR	2.36
TATO	2.22
AssetGrowth	1.06
Fintech	1.06
NIIR	1.02
Mean VIF	1.90

4.3. The impact of fintech on banks' risk-taking

Table 5 reports two specifications. In the OLS regression, the coefficient on Fintech is 0.011 and significant at the 1% level. After bank and year fixed effects are included, the coefficient rises slightly to 0.012 and remains significant. The sign and significance of the coefficient are therefore not driven by time-invariant differences across banks.

In the fixed-effects model, a one-unit increase in the fintech index is associated with about a 0.012 increase in RWA, equivalent to roughly 1.2 percentage points.In other words, greater use of fintech is not accompanied by a decline in the share of risk-weighted assets. One possible explanation is that lower information and operating costs release resources for business expansion. If part of this expansion involves assets with higher regulatory risk weights, RWA will rise accordingly.

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Among the controls, ROE, CAR and AssetGrowth have negative coefficients, whereas TATO and Equity Ratio have positive coefficients. NIIR shows only a weak relationship with RWA.

Table 5. Results of the baseline regression and fixed-effects tests

	(1)OLS Regression	(2)Fixed Effects
Fintech	0.011***(0.002)	0.012***(0.003)
ROE	-0.005***(0.001)	-0.004***(0.001)
CAR	-0.027***(0.001)	-0.023***(0.002)
NIIR	-0.000(0.000)	-0.000*(0.000)
AssetGrowth	-0.000***(0.000)	-0.001***(0.000)
TATO	1.953***(0.446)	1.463***(0.553)
Equity Ratio	0.038***(0.002)	0.036***(0.003)
Constant	0.715***(0.016)	0.672***(0.019)
Observations	1486	1486
R^2	0.392	0.339
Adjusted R^2	0.389	0.258
F	136.063	96.844

Note: Figures in parentheses represent standard errors; *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

4.4. An analysis of the channels through which fintech affects banks' operational efficiency in risk-taking

Table 6 examines whether operating efficiency helps explain the relationship between fintech and RWA. CIR is used as the measure of bank operating efficiency.Column (1) reproduces the baseline result, with a Fintech coefficient of 0.012.In Column (2), the coefficient on Fintech is −0.929 and significant at the 1% level. Higher fintech development is therefore associated with a lower CIR.

In Column (3), CIR enters the RWA regression with a negative coefficient, while the coefficient on Fintech remains positive and significant. This pattern is consistent with an efficiency channel: fintech lowers operating costs, but the resulting capacity may also make it easier for banks to expand into risk-weighted assets.

Table 6. Testing the mechanisms of operational efficiency

	(1)Overall Effect(RWA)	(2)Mediating variable(CIR)	(3)Direct Effects(RWA)
Fintech	0.012***(0.003)	-0.929***(0.173)	0.011***(0.003)
ROE	-0.004***(0.001)	0.050(0.049)	-0.004***(0.001)
CAR	-0.023***(0.002)	-0.377***(0.103)	-0.023***(0.002)
NIIR	-0.000*(0.000)	-0.039***(0.010)	-0.000**(0.000)
AssetGrowth	-0.001***(0.000)	0.112***(0.005)	-0.000***(0.000)
TATO	1.463***(0.553)	-473.558***(37.216)	0.980*(0.582)
Equity Ratio	0.036***(0.003)	0.423**(0.181)	0.037***(0.003)
CIR			-0.001***(0.000)
Constant	0.672***(0.019)	49.298***(1.261)	0.726***(0.027)
Observations	1486	1506	1479
R^2	0.339	0.372	0.344

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Table 6. (continued)

Adjusted R^2	0.258	0.296	0.263
F	96.844	113.720	86.295

Note: Figures in parentheses represent standard errors; *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

4.5. Robustness tests

As a robustness check, the aggregate Fintech index is replaced by two component measures, AI and DG. Table 7 reports the estimates. Both variables have coefficients of 0.008 and are significant at the 1% level.

The two alternative measures therefore produce the same positive relationship with RWA as the aggregate fintech index. The positive association is also observed when AI and DG are used as alternative fintech measures.

Table 7. Robustness tests

	(1) Artificial Intelligence(AI)	(2) Digitization(DG)
AI	0.008***(0.002)	
DG		0.008***(0.002)
ROE	-0.002***(0.001)	-0.002***(0.001)
CAR	-0.021***(0.001)	-0.021***(0.001)
NIIR	-0.000(0.000)	-0.000(0.000)
AssetGrowth	-0.001***(0.000)	-0.001***(0.000)
TATO	2.419***(0.442)	2.419***(0.442)
Equity Ratio	0.039***(0.002)	0.039***(0.002)
Constant	0.623***(0.016)	0.623***(0.016)
Observations	1012	1012
R^2	0.553	0.553
Adjusted R^2	0.475	0.475
F	152.363	152.363

Note: Figures in parentheses represent standard errors; *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

5. Conclusion

5.1. Research conclusions

Evidence from Chinese listed banks over 2010–2024 points to a positive relationship between fintech development and RWA.The positive coefficient on Fintech remains significant after bank fixed effects are controlled for. The mechanism regressions also show that higher fintech development is associated with a lower CIR, while a lower CIR is associated with higher RWA. Replacing the aggregate fintech measure with the AI and digitalization indicators does not change the direction of the result.

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5.2. Policy implications

The results imply that banks should not treat digitalization as a purely efficiency-enhancing process. When operating costs fall, attention should also be paid to whether the additional capacity is being used to expand risk-weighted assets. Monitoring capital consumption and asset quality is therefore particularly important for banks undergoing rapid digital transformation.

From a supervisory perspective, rapidly digitalizing banks may require closer attention when fintech adoption is accompanied by fast balance-sheet expansion. More detailed disclosure of fintech investment, digital business growth, and related risk exposures could also improve supervisory assessment.

Efficiency gains should therefore be considered together with a bank's capacity to absorb additional risk. When fintech supports faster business expansion, the growth of risk-weighted assets should remain consistent with available capital and internal risk-management capacity. Risk pricing and asset allocation can be adjusted accordingly.

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