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Does Fintech Investment in Commercial Banks Improve Business Performance?

-- Based on the Empirical Test of 42 Listed Commercial Banks in China from 2010 to 2022

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Abstract: This article aims to empirically examine the impact of internal fintech investment on operational performance using both a two-way fixed effects model and a mediation effect model. Take banks in China as research target. Through manually collected unbalanced panel data from 42 listed commercial banks spanning the years from 2010 to 2022. The key findings are as follows. First, investments in fintech significantly enhance the operational performance of banks. However, compared to state-owned banks and share-owned banks, the positive effect of fintech investments on the performance of urban commercial banks and rural commercial banks is more significant. Secondly, mediation tests on operational costs and business scope channels have revealed that fintech could achieve "cost reduction and efficiency enhancement" for urban and rural commercial banks by enhancing operational efficiency and expanding their business scope. Nonetheless, this effect is not significantly evident in state-owned banks and share-owned banks. Thirdly, further empirical testing on market share indicates that fintech investments significantly boost the market share of joint-stock commercial banks, corroborating the notion that fintech could augment the competitiveness of commercial banks. The insights garnered from this study contribute to understanding and augmenting existing research on the microeconomic consequences of the strategic fintech investment undertaken by commercial banks. Furthermore, it offers valuable references for future policies aimed at propelling the digital transformation of traditional banking industries.

Keywords: Financial technology, Commercial banks, Business performance, Influence channels, Mediating effect

1. Introduction

In recent years, with the digital transition and industrial revolutions, digital technologies epitomized by AI, big data, and the Internet of Things have instigated significant transformations across industries [1,2-3]. Fintech, infused with cutting-edge technological elements like AI, big data, cloud computing, and biometrics, has emerged as an instrument for banks to overcome customer acquisition bottlenecks, deepen existing value, enhance service efficiency, and strengthen risk control.

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Consequently, commercial banks are intensifying their investments in fintech, propelling the digital transformation of their business structures. In December 2021, the central bank issued the "Financial Technology Development Plan (2022-2025)", setting forth clear developmental objectives, such as the deepening of the financial sector's digital transformation and the full release of data potential. According to data released by Accenture in 2019, China's financial institutions invested a total of 177.09 billion yuan in financial technology, with commercial banks accounting for a staggering 68.6%. It's evident that fintech has transitioned from being an external impetus for bank transformation to an intrinsic driving force for commercial banks to adapt to the digital economy and undergo holistic transformation. Thus, it is worth researching how Chinese banks' technological investments have improved their operational performance.

By reviewing existing literature, scholars are divided between the "promotive" and "inhibitive" perspectives. Proponents of the former argued that technological applications could expand commercial banks' operational scope, reduce transaction costs, and enhance risk control, thereby improving banks' operational performance [4]. Additionally, utilizing fintech could expand customer acquisition channels, enhance resource allocation efficiency, and reduce risk concentration [5]. This can effectively improve a bank's profitability. Moreover, by integrating fintech with product and service design, grass-roots operations, and risk management, banks can elevate their operational management capabilities and risk control efficiency [6,7]. In contrast, sceptics posit that the rise of external online financial platforms exacerbates the competition, leading to narrowing interest margins and declining performance [4]. Moreover, the foundational costs of fintech are considerably high, and there's a continuous capital requirement for investment in software updates and platform maintenance [8,9]. Discussions also revolve around the "crowding-out effect" and "technological spillover effect" [10, 11-12].

Undoubtedly, commercial banks investing in fintech are aiming to enhance the efficacy of their core business systems and market competitiveness. However, the relationship between fintech investment and its developmental level isn't simply linear. Whether these investments lead to a remarkable improvement in long-term bank performance remains an intricate question and demands thorough investigation.

This paper's contributions are threefold. Firstly, after reviewing the existing research, the paper innovatively proposes a new measurement standard to evaluate the fintech investment index, which will be the percentage of fintech investment in total operating costs. This is because the paper aims to explore if increasing fintech investments could significantly boost profits at a bank's individual level. Secondly, the paper employs a mediation effect analysis to detect how banks of different sizes are impacted by internal fintech investments. Thirdly, the paper adopts market shares as a new variable to measure a bank's competitiveness, which intends to examine if fintech investments could bolster a bank's competitive edge and enhance its market share.

In order to demonstrate a clear outline, the paper will be structured as follows: Section 1 is the introduction, Section 2 delves into the theoretical elucidation and research hypothesis of banks' fintech investments on operational performance, Section 3 outlines the research design, Section 4 presents empirical regression results and analysis, and Section 5 concludes with policy recommendations.

2. Literature Reviews and Research Hypotheses

Extensive previous research has explored the relationship between information technology (IT) investments in the banking sector and its productivity. There was a prevailing sentiment that technological advancements in banking might not necessarily contribute to improvements in their operational performance [13,14-15]. Specifically, financial technology might enhance banking operational performance through "cost-reduction and efficiency-improvement" channels. Regarding

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cost-reduction: advancements of fintech have facilitated a transition of commercial banking operations from offline to online, which has led to substantial capital savings from bank branch construction, as well as from operational cost-saving such as premise expenditures, employee compensations and maintenance costs. Furthermore, the internal fintech development in banks has promoted the integration of staff, operations, technology, and data, reducing the marginal cost of services [16]. In addition, the efficiency of traditional banking business processes has been criticized by the public for a long time because of their long approval cycles and high operating costs. Adopting fintech could streamline these processes and achieve instant approvals, as well as improve banks' products and services based on their customers' valuation. Moreover, commercial banks could benefit from external fintech development through industry competition, business linkages, and technological emulation effects [16]. This also prompts banks to make necessary adjustments in their business processes, human capital, and organizational structures, improving banks' operational efficiency through synergies among various input enhancements [17].

In terms of efficiency enhancement, international studies have indicated that utilizing fintech in core lending activities could enhance customer loyalty. Since customers are more inclined to make deposits and loans via fintech, which could effectively expand the bank's market share [18,19], banks could employ fintech to refine data processing, especially improving the borrower risk identification, helping banks to attract niche customers without serious credit risks and directly increasing the total bank credit scale, which subsequently augments the profitability [20]. In business expansion, fintech enables banks to diversify their services and revenue streams by expanding into untapped areas such as anti-fraud data analysis and intelligent investment advice [21]. Notably, banks could also leverage technologies like big data and cloud computing in critical decision-making, including lending, resource allocation, risk evaluation, and mitigating risk concentrations. In other words, fintech could lead to better internal stability and lay a solid foundation for sustainable profits [22]. In addition, international researchers analyzed data from 91 countries and concluded that banks in developing countries could significantly improve operational performance by adopting fintech. This is attributed to fintech providing a more accessible, cost-effective platform to raise regional financial inclusivity and expand the bank's regional coverage [23]. Given these observations, the paper posits,

H1: Investment in fintech by commercial banks could enhance their operational performance.

Additionally, banks with different sizes generally significantly differ in profitability, talent pool, and resource endowments. These factors lead to distinct challenges and opportunities in internal fintech development [3]. In detail, local medium and small banks mainly face two aspects of challenges: on one side is low societal recognition hindering online business implementation, and on the other side is insufficient tech R&D budget [24,25]. In contrast, large commercial banks enjoy inherent advantages in capital costs and asset scales. Nevertheless, due to the unique institutional background of state-owned banks, the introduction and in-depth application of new fintech often undergo extended review cycles, leading to prolonged construction phases. Moreover, given the average transaction costs of large banks are already relatively low due to their vast scale, the marginal cost-reducing effect brought by fintech might be diminished [26]. Conversely, small and medium-sized banks with flexible structures and short decision chains could swiftly integrate new technologies into their operations, which efficiently enhances service and reduces business costs. In addition, small banks are generally have higher risk-aversion requirements because of lower capital quality [27]. thus In the business expansion aspect, small and medium-sized bank clients are generally SMEs and individuals, which are also the major clients of fintech companies. Although banks might lose some customers in the early stages of fintech development, the technology spillover effect might help them attract niche customers to expand their business scope later. Given these considerations, the paper further proposes,

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H2: Investments in fintech could improve banks' operational performance by reducing operational costs and expanding business scope. This effect is more pronounced for small banks, whereas large banks might experience a longer term to realize the benefits of fintech investments.

The rise of fintech applications has liberalized interest rates, not only reshaped the value chain of traditional banking but also introduced third-party fintech companies as direct competitors in areas like payment, lending, and wealth management. These enterprises capitalize on low transaction costs and disintermediation to attract bank customers, consequently narrowing the profit margins of commercial banks [5]. Nevertheless, the public has begun to enjoy the convenience brought by fintech, and banks have recognized its potential in terms of economic benefits and risk management as an inevitable development trend [28]. The high initial required capital has made many banks adopt a wait-and-see approach or opt for minimal development investment. This situation raises an intriguing question: Will varying fintech investment proportions among banks during the same period lead to different profit trends? For instance, customers might prefer banks with well-established apps for their financial needs. Moreover, accurate big data analytics could recommend customized services to potential clients, therefore helping banks expand their customer base and market share. Based on this, the study hypothesizes,

H3: Banks' fintech investments could boost their market share by expanding their customer base.

3. Research Design

3.1. Sample Selection and Data Sources

The study primarily derives commercial banks' micro-level financial data from the Bank Focus and Wind databases. Furthermore, manually collected financial reports of various banks supplemented by integrating data from the Guotai Junan bank financial database. Macroeconomic variable data, such as China's Gross Domestic Product (GDP), were extracted from the Wind database. Subsequent sample filtering and data processing are demonstrated as follows. Firstly, the paper excludes banks with missing related financial data. Secondly, winsorize the continuous data at both the top and bottom 1% levels to mitigate the impact of outliers. Before the analysis, the study's final sample comprised 42 listed commercial banks in China with 546 observational values. The 42 listed commercial banks sampled include six large state-owned commercial banks, 9 national joint-stock commercial banks, 23 city commercial banks, and 4 rural commercial banks. Considering the repercussions of the 2008 global financial crisis on the financial sector, the study uses the period from 2010 to 2022 as its research window to ensure a comprehensive representation.

3.2. Empirical Design and Model Construction

In light of the previous discussions, the analysis primarily examines the relationship between the investment in fintech by commercial banks and their operational performance. To account for potential endogeneity arising from individual and temporal factors, this study establishes the following two-way fixed-effects model, with the regression equation as follows,

$$ROA_{it} = \beta_0 + \beta_1 FinTech_{it} + \lambda_j \sum_i^n control_{jit} + \delta_i + \mu_i + \varepsilon_{it} \quad (1)$$

$$MShare_{it} = \beta_0 + \beta_1 FinTech_{it} + \lambda_j \sum_i^n control_{jit} + \delta_i + \mu_i + \varepsilon_{it} \quad (2)$$

$$ROE_{it} = \beta_0 + \beta_1 FinTech_{it} + \lambda_j \sum_i^n control_{jit} + \delta_i + \mu_i + \varepsilon_{it} \quad (3)$$

Letting $ROA_{i,t}$ denotes the operational performance of commercial bank i in year t, $MShare_{i,t}$ represent the market share of bank i in year t, and $ROE_{i,t}$ be the replacement operational performance

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for bank i in year t . The key explanatory variable, $FinTech_{i,t}$, stands for the internal investment level of bank i in financial technology R&D in year t . *Controls* are control variables, encompassing both micro-characteristics of the bank and macro regional economic variables. δ captures time-fixed effects, μ accounts for bank-specific fixed effects, and ε is the random error term.

To further discover how fintech investments influence bank performance, the paper adapts the methodology suggested by Jiangting[24], which introduced mediation variables into the causal mechanism between the explanatory and outcome variables. Utilizing models (4) and (5) to assess whether the critical explanatory variables significantly impact the mediator variables. If the coefficients are significant, it signifies that fintech investments could influence these mediators. Subsequently, based on economic theories, the analysis would demonstrate that these mediator variables could affect the outcome variables, establishing the presence of mediation effects.

$$CIR_{it} = \gamma_0 + \gamma_1 FinTech_{it} + \lambda_j \sum_i^n control_{jit} + \delta_i + \mu_i + \varepsilon_{it} \quad (4)$$

$$Non\_int_{it} = \sigma_0 + \sigma_1 FinTech_{it} + \sigma_j \sum_i^n control_{jit} + \delta_i + \mu_i + \varepsilon_{it} \quad (5)$$

Here, $CIR_{i,t}$ indicates the operational efficiency (operating cost) of bank i in year t, and $Non\_int_{i,t}$ denotes the proportion of non-interest income (operating income) of bank i in year t.

To ensure the accuracy of results, the study employs the Hausman test statistically to validate the appropriateness of adopting the fixed-effects estimation method1. Moreover, to ensure no multicollinearity among the variables in the model, a Variance Inflation Factor (VIF) test is conducted, revealing VIF values for all variables to be less than 10. Additionally, the study employs various performance metrics and bank profitability indicators for robustness checks.

3.3. Variable Definitions

3.3.1. Dependent Variables

Operational Performance (ROA): The efficiency of operations is a critical metric for commercial banks. However, there needs to be universally accepted measure from the literature. Some studies have assessed bank performance from singular perspectives such as profitability (e.g., total asset return, net asset return), safety (e.g., non-performing loan rate, loan-to-deposit ratio, liquidity ratio), and operational efficiency (e.g., total factor productivity) [14,29]. Other researchers have constructed composite performance indicators, like economic value added, balanced scorecards, and principal component analysis. The paper will follow the approach of Haw et al. [30], adopting annual return on assets (ROA) as a measure of operational performance and applying the return on equity (ROE) for robustness checks.

Bank Market Share (Mshare): Banks are classified into large state-owned commercial banks, joint-stock commercial banks, city commercial banks, and rural commercial banks. The market share of the targeted bank for a given year is measured as its total assets as a proportion of the total assets of the sub-sample of banks for that year.

3.3.2. Key Explanatory Variable

Financial Technology Investment Index (FinTech): Existing literature in China presents three primary

1 The rationale for this test includes: (i) the fixed-effects model permits the presence of unobservable individual effects across banks, which remain constant over time; and (ii) it allows these time-invariant effects to be correlated with explanatory variables. In practice, attributes such as the nature of the bank, its location of registration, and its operational duration could influence its degree, depth, and breadth of fintech investment, which, in turn, impacts its operational performance. Thus, there's a need for a fixed-effects approach.

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metrics for fintech development. This study seeks to explore the enabling role of fintech at the individual bank, hence, the study follows the approach of Xie Ruoqing [31], utilizing individual bank investment in information technology and calculating the investment capital as a proportion of operating expenses.

3.3.3. Mediating Variable

Operational Efficiency (CIR): Adopting the methodology of Guo Ye [32], measured as the total cost to total income ratio.Proportion of Non-interest Income (Non_int): Following Zhou Aimin's [33] approach, this proportion indicates the bank's business expansion capability.

3.3.4. Control Variables

To ensure consistency, efficiency, and unbiasedness of the empirical analysis, control variables at the micro and macro levels were selected based on the works of Gu Haifeng and Jin Hongfei [3, 34]. At the micro-level, including bank size (SIZE), capital adequacy (CORE), loan-to-deposit ratio (LDR), and liquidity level (Liquid). At the macro-level, including GDP growth rate, inflation level (CPI), and monetary policy environment (M2). A detailed list of variables and definitions is provided in Table 1.

Table 1: Variable names and definitions

Variable Type	Symbols	Indicator Name	Definition
Dependent Variables	*ROA*	Return on Asset	Net profit after tax/Total assets
	ROE	Return on Equity	Net profit after tax/Total capital
	Mshare	Market Share	Target bank assets/Sample total assets
Independent Variable	*FinTech*	Fintech Investment Index	Fintech investment amount/Total operating costs
Mediating Variables	*CIR*	Operating Efficiency	Operating cost/Operating income
	Non_int	Non-interest Income Ratio	Non-interest income/Total operating income
Control Variables	*CORE*	Capital Adequacy Ratio	Bank's Capital Adequacy Ratio (CAR) for the current year
	SIZE	Bank Size	Natural logarithm of the bank's total assets
	Liquid	Liquidity	Current assets/Total assets
	LDR	Loan to Debit Ratio	Bank's total loans/Total deposits
	GDP	Gross Domestic Product Growth Rate	Nominal GDP growth rate multiplied by 100%
	CPI	Inflation rate	Consumer Price Index (CPI)
	M2	Monetary policy environment	Growth rate of M2

4. Empirical Results and Analysis

4.1. Descriptive Statistics of Variables

Table 2 presents the basic statistical features of variables. As observed from Table 2, the average value of the dependent variable, commercial bank performance (ROA), is 0.010 with a standard deviation of 0.003, indicating significant variations in the profitability among different bank branches. Regarding the independent variables, the mean of the FinTech investment index (FinTech) is 0.004, with a standard deviation of 0.004, suggesting significant differences in FinTech investments within commercial banks. Such disparities could be attributed to two main factors. First, the rapid development of FinTech in recent years has led banks to increase their investments in different years

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significantly. Secondly, due to substantial variations in banks' capital strength, there are notable disparities in their FinTech investment capacity and resource endowments, intensifying this variation. Further examination of other variables' descriptive statistics shows that there are significant differences in asset size (SIZE), capital adequacy ratio (CORE), and liquidity level (Liquid) among banks in China.

Table 2: Descriptive statistics of variables

Variables	Samples	Minimum	Maximum	Mean	S.D
ROA	546	0.003	0.018	0.010	0.003
FinTech	546	0.000	0.049	0.004	0.004
CIR	546	0.336	0.830	0.575	0.090
Non int	546	-0.053	0.511	0.198	0.109
CORE	546	0.084	0.403	0.134	0.021
SIZE	546	24.41	31.31	27.47	1.792
Liquid	546	0.367	0.805	0.501	0.059
LDR	546	0.263	1.162	0.723	0.145
GDP	546	0.027	0.184	0.101	0.044
CPI	546	100.9	105.4	102.4	1.061
M_2	546	0.081	0.190	0.121	0.032

4.2. Baseline Regression Results

Table 3 reports the baseline regression outcomes of the relationship between FinTech investments and commercial bank performance. Column (1) reveals that, without controlling for other variables, the correlation coefficient between FinTech investments and business performance (ROA) is 0.104, and significant at the 1% level. This indicates that internal FinTech investments could promote the growth of bank performance. Columns (2) to (6) display the estimated results of the relationship between FinTech investments and business performance after sequentially controlling for micro-characteristics of commercial banks and macroeconomic variables. The positive significance of FinTech investment on business performance (ROA) at the 1% level suggests that internal FinTech development has enhanced the banking sector's profitability. This result is consistent with Yuli Xia and Zhenghan Li's (2023) findings [35], supporting hypothesis H1. A potential explanation for this might be that FinTech investments provide tools for banks to enhance their information processing and operational management efficiency, directly or indirectly boosting profitability.

The results presented in Table 4 examine the heterogeneous impacts of internal fintech investments on the profitability of different commercial banks. As indicated by the findings in columns 1 and 2, state-owned and joint-stock commercial banks do not exhibit significant adverse effects from fintech investments. A plausible explanation for this is that larger banks invest significant resources in fintech infrastructure development due to their substantial scale. Significant investments are required in areas such as developing intelligent scenarios, building digital operational capabilities, and cultivating fintech talent. The substantial initial investment would yield little improvements in the bank's operational performance, and the anticipated positive outcomes would materialize at a slower pace. Consequently, the efficiency gains from expanding their operation scopes could be more evident, leading to a non-significant enhancement in profitability.

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Table 3: Results of the Baseline Regression Model

	Dependent Variable: Operational Performance of Commercial Banks (ROA)					
	(1)	(2)	(3)	(4)	(5)	(6)
FinTech	0.104***	0.102***	0.099***	0.099***	0.099***	0.109***
	(3.82)	(3.91)	(3.63)	(3.62)	(3.62)	(4.02)
CORE		0.012**	0.014***	0.015***	0.015***	0.014***
		(2.50)	(2.67)	(2.68)	(2.68)	(2.59)
SIZE			0.001	0.001	0.001	0.001*
			(1.38)	(1.38)	(1.38)	(1.87)
Liquid				-0.000	-0.000	0.000
				(-0.17)	(-0.17)	(0.05)
LDR						0.005***
						(4.15)
GDP	0.010**	0.010**	0.016**	0.016**	0.016**	0.022***
	(2.03)	(2.04)	(2.37)	(2.36)	(2.36)	(3.26)
CPI	0.000	0.000	0.001*	0.001*	0.001*	0.001***
	(1.06)	(1.08)	(1.66)	(1.65)	(1.65)	(2.64)
M2	0.011	0.012	0.009	0.009	0.009	0.005
	(0.85)	(0.96)	(0.73)	(0.72)	(0.72)	(0.42)
Constant	-0.041	-0.043	-0.107*	-0.108*	-0.108*	-0.179***
	(-0.97)	(-1.02)	(-1.67)	(-1.66)	(-1.66)	(-2.67)
code FE	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES
Observations	546	546	546	546	546	546
R-squared	0.749	0.755	0.756	0.756	0.756	0.768

Note: The symbols *, ** and *** denote significance at the 10%, 5%, and 1% levels, respectively. Standard errors are presented in parentheses. This convention is consistently applied throughout.

Table 4: Heterogeneous Test

Variables	Stated-owned Banks	Joint-stock Banks	Urban Banks	Rural Banks
FinTech	-0.034	-0.123	0.118***	0.339*
	(-0.30)	(-0.92)	(4.72)	(1.76)
Constant	-0.629***	-0.080	-0.240***	-0.039
	(-3.31)	(-0.64)	(-2.83)	(-0.13)
Controls	YES	YES	YES	YES
code FE	YES	YES	YES	YES
Year FE	YES	YES	YES	YES
Observations	78	117	299	52
R-squared	0.964	0.807	0.748	0.850

On the other hand, the results in columns 3 and 4 reveal that fintech investments significantly boost the profitability of urban commercial banks and rural banks. One possible interpretation is that, compared to state-owned and large joint-stock banks, urban and rural banks, being of a smaller scale, could more agilely pivot their operations. Their fintech investments would contribute more to achieving cost-reduction effects, enhancing their profitability.

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4.3. Mediation Mechanism Analysis

Given the regression mentioned above result, the degree of internal FinTech investment of commercial banks could enhance bank performance. To delve deeper into the underlying paths of this relationship, the study examines it from the perspectives of operational costs and revenue growth. This study selects two conduction mechanisms, operational efficiency (CIR) and the proportion of non-interest income (Non_int), to explore the relationships between the degree of FinTech investment and the performance of different commercial banks. Additionally, due to significant differences in asset size, business models, and development objectives among large state-owned commercial banks, joint-stock commercial banks, city commercial banks, and rural commercial banks, the paper differentiates these bank types when examining the mediation effect of FinTech investment on bank performance.

4.3.1. Operational Efficiency Channel

When revenues remain constant, decreasing operational costs could improve the performance of commercial banks. Table 5 presents regression results examining this efficiency mechanism. As seen in columns 3 and 4 of Table 5, fintech investments significantly reduce the cost-income ratio of urban and rural commercial banks, suggesting that fintech plays an active role in lowering their operational costs. However, this effect must be evident for state-owned and joint-stock commercial banks. Large-scale banks already benefit from economies of scale, rendering their transaction costs relatively low. Therefore, the diminishing marginal costs are not pronounced even with increased fintech investments. In contrast, smaller urban and rural commercial banks could leverage fintech investments to reduce marginal costs and enhance operational efficiency, subsequently improving profitability.

Table 5: Examination of the Mediation Mechanism of Operating Efficiency (CIR)

Variables	Stated-owned Banks	Joint-stock Banks	Urban Banks	Rural Banks
FinTech	-2.548	-4.494	-4.966***	-25.482***
	(-0.67)	(-0.80)	(-3.54)	(-2.93)
Constant	21.796***	1.822	7.830*	-5.133
	(2.80)	(0.39)	(1.83)	(-0.46)
code FE	YES	YES	YES	YES
Year FE	YES	YES	YES	YES
Controls	YES	YES	YES	YES
Observations	78	117	299	52
R-squared	0.968	0.818	0.686	0.715

4.3.2. Business Scope Channel

Table 6 reports regression results that explore whether fintech benefits in expanding the scope of banks' business – by increasing the proportion of non-interest income as a result of improving banks' profitability. As depicted in column 1 of Table 6, fintech investments do not significantly elevate the non-interest income ratio of state-owned commercial banks. A potential reason is that banks' profits could not cover the high preliminary cost of fintech investments for large-scale commercial banks. Even if fintech has led to service and product innovations, it would take time to be accepted by customers and generate actual revenue. Moreover, applications like robot advisors and blockchain technology are in their nascent stages and have not yet effectively integrated with core banking services, delaying their positive influence on non-interest income. However, coefficients in columns

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3 and 4 are notably positive, indicating that fintech investments significantly boost the non-interest income ratio for urban and rural commercial banks. A study of recent annual reports from smaller banks reveals that the primary growth in non-interest income stems from fees, commissions, and trading investment income. This might be because these banks utilize the inclusivity of fintech to attract long-tail financial consumers and micro-enterprises, thereby increasing their range of clients and subsequently increasing their fees and commission income. Another reason could be that fintech enhances investment decision-making, increasing trading investment returns.

The regression analyses suggest that fintech has had a notably positive impact in reducing operational costs and broadening the business scope of smaller banks. This indicates that smaller banks could deliver more efficient and diversified services by increasing fintech investments, promoting business expansion and optimizing cost structures. In contrast, large banks have not shown significant intermediary effects from fintech, possibly because of their already mature and stable business models. Their economies of scale might mean the marginal benefits of fintech are less pronounced. Also, the initial costs of fintech investments for these banks are relatively high, further dampening the potential for significant returns. This observation validates Hypothesis H2.

Table 6: Examination of the Mediation Mechanism of the Non-interest Income Ratio

Variables	Stated-owned Banks	Joint-stock Banks	Urban Banks	Rural Banks
FinTech	14.363	5.542	4.308***	45.585***
	(1.56)	(1.29)	(2.75)	(4.56)
Constant	-21.410	1.549	4.686	-11.694
	(-1.58)	(0.35)	(1.10)	(-0.90)
code FE	YES	YES	YES	YES
Year FE	YES	YES	YES	YES
Controls	YES	YES	YES	YES
Observations	78	117	299	52
R-squared	0.844	0.874	0.592	0.819

4.4. Impact of Fintech Investments on Market Share

This study also investigates whether fintech investments could enhance banks' market share within a similar size category. Column 1 of Table 7 shows a significant negative relationship at the 1% level between market share and fintech investments for state-owned banks. This implies that the higher the fintech investment level of a state-owned bank, the lower its market share. A potential explanation might be the intricate approval processes and stringent regulations within state-owned banks, leading to a homogeneity in the fintech products and services adopted. Such uniformity could result in an even distribution of market share, reducing the market portion of banks with larger prior fintech investments. In contrast, joint-stock banks, with their flexible mechanisms and a more evident profit-seeking nature, also face market-driven competition. This makes these banks pursue differentiation in their fintech investments, more quickly establishing contrasting business services than banks of similar size and enhancing their competitiveness. The results in column 2 of Table 7 show a significant positive impact of fintech investments on the market share of joint-stock banks, validating Hypothesis H3.

Columns 3 and 4 of Table 7 indicate that fintech investments negatively influence the market shares of urban and rural commercial banks. One possible reason is the lag time before fintech investments begin to produce positive effects. Smaller banks with limited funds might utilize existing technology or partner to establish fintech platforms. This standardized fintech approach requires time

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for adjustment to suit each bank's unique business model, leading to a lag effect of fintech on market share.

Table 7: Market Share

Variables	Stated-owned Banks	Joint-stock Banks	Urban Banks	Rural Banks
FinTech	-1.051***	8.507**	-0.112**	-1.064***
	(-3.08)	(2.28)	(-2.00)	(-2.88)
Constant	-9.291***	4.141	-2.424***	-2.832***
	(-8.97)	(0.88)	(-7.29)	(-5.41)
code FE	YES	YES	YES	YES
Year FE	YES	YES	YES	YES
Controls	YES	YES	YES	YES
Observations	78	117	299	52
R-squared	0.999	0.764	0.990	0.993

4.5. Robustness Tests

Table 8: Robustness Test

Variables	Robustness Test 1 ROE	Robustness Test 2 ROA
FinTech	1.271**	
	(2.28)	
L.FinTech		0.055***
		(2.62)
Constant	-3.035**	-0.124*** -0.124***
	(-2.46)	(-3.35)
code FE	YES	YES
Year FE	YES	YES
Controls	YES	YES
Observations	546	504
R-squared	0.774	0.783

To ensure the robustness of the findings, we adopted strategies such as substituting dependent variables and using lagged explanatory variables. Firstly, to mitigate any potential interference caused by variable measurement errors, the paper used the Return on Equity (ROE) instead of the Return on Assets (ROA) for re-testing the regression. As shown in Table 8, the results remain consistent with previous findings, reinforcing the robustness of the conclusions: internal fintech investments in commercial banks promote an enhancement in operational performance. Secondly, considering the lag effect of fintech on positive operational performance, the study followed the approach of Li Jianjun and Jiang Shichao (2021), utilizing a lagged value of fintech investment (L.FinTech) for regression testing. As presented in Table 8, the one-year lagged fintech investment still exhibits a significant positive impact on the Return on Assets (ROA), reaffirming the results' robustness.

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5. Conclusions and Policy Recommendations

In the current milieu, the rapid development of fintech has transitioned from being an exogenous shock to a central strategic choice for the banking sector, which helps them proactively adapt to the digital economy and undergo a more comprehensive transformation.

The academic community continues to debate whether and how fintech investment enhances banks' operational performance. However, existing literature needs a comprehensive analysis towards individual fintech investment. Based on manually collected unbalanced panel data from 42 listed commercial banks spanning 2010-2022, this study empirically tests the impact of internal fintech investments on bank performance using a two-way fixed effects model. The findings suggest: 1. Fintech's Role in Bank Performance: Investments in internal fintech have improved the performance of commercial banks. However, the effectiveness varies. Specifically, fintech investments have a more pronounced positive effect on urban and rural commercial banks than state-owned and joint-stock banks. This finding remains robust after multiple stability tests. 2. Through mediation tests of increasing operation efficiency and expanding business scope, it proves that fintech significantly enhances the profitability of urban and rural commercial banks by improving operational efficiency and broadening their business scopes. However, this mediating mechanism must be more apparent for state-owned and joint-stock banks. 3. Market Share Analysis: Fintech investments significantly boost the market share of joint-stock commercial banks within their subsets, indicating that fintech could enhance the competitiveness of commercial banks.

The above conclusions underscore that as technology matures and the fintech industry scales expands, the increasing integration of technology and the finance industry blurs traditional financial boundaries. While this convergence provides commercial banks with innovative opportunities, it also poses new challenges. Require banks to recalibrate their strategic orientations and accelerate technological transformations to navigate shifts in the financial ecosystem. Thus, the paper suggests the following policies.

Prioritizing Fintech: Commercial banks should persistently lay and plan fintech strategic development, integrating cutting-edge technologies like big data, blockchain, cloud computing, and artificial intelligence into core banking operations, risk management, and investment decisions by augmenting investments in R&D, talent, and infrastructure to ensure robust support for fintech applications and expansion in the bank. Thus promoting self-operation building, service business transformation, and societal governance, thus contributing to high-quality economic development.

Strategic Fintech Integration: When strategizing fintech development, banks should consider their unique attributes, such as risk management, business configuration, and corporate governance. They should promote digital transformation by tailoring their approach based on market demands and inherent capabilities. Large-scale national banks could adopt self-developed fintech ecosystems, offering differentiated products, refined services, and comprehensive scenarios for a more personalized client experience. Conversely, small-scale, regional banks could deepen their collaboration with fintech firms. Examples from 2022 include Wuxi Bank capitalizing on strategic opportunities presented by the Yangtze River Delta integration and Shanghai Rural Commercial Bank establishing disaster recovery architectures in Shanghai Zhangjiang, Shanghai Taopu, and Shenzhen.

References

[1] *Qiu, H., Huang, Y., & Ji, Y. (2018). The impact of fintech on traditional banking behavior: From the perspective of internet finance. Financial Research, (11), 17-29.*

[2] *Xie, X., & Wang, S. (2022). Digital transformation of Chinese commercial banks: Measurement, process, and impact. Economics Quarterly, 22(06), 1937-1956.*

[3] *Gu, H., & Yan, J. (2019). Internet finance and commercial bank profitability: Impact or boost? - A dual perspective based on profitability capability and profit structure. Contemporary Economic Science, 41(04), 100-108.*

DOI: 10.54254/2754-1169/73/20231720

[4] Tian, X., & Ge, Y. (2023). Fintech and the operational performance of commercial banks. Technology Economy, 42(06), 127-137.
[5] Liu, M., & Jiang, W. (2020). Does fintech promote or hinder the efficiency of commercial banks? - An empirical study based on China's banking industry. Contemporary Economic Science, 42(03), 56-68.
[6] Jagtiani, J., & Lemieux, C. (2018). Do fintech lenders penetrate areas that are underserved by traditional banks? Journal of Economics and Business, 100, 43-54.
[7] Lee, C.-C., Li, X., Yu, C.-H., & Zhao, J. (2021). Does fintech innovation improve bank efficiency? Evidence from China's banking industry. International Review of Economics & Finance, 74, 468–483.
[8] Gupta, S. D., Raychaudhuri, A., & Haldar, S. K. (2018). Information technology and profitability: evidence from the Indian banking sector. International Journal of Emerging Markets, 13(5), 1070-1087.
[9] Dahl, D., Meyer, A. P., & Wiggins, N. (2017). How fast will banks adopt new technology this time? The Regional Economist, Fourth Quarter.
[10] Shen, Y., & Guo, P. (2015). Internet finance, technological spillover, and the total factor productivity of commercial banks. Financial Research, (03), 160-175.
[11] Meng, N., & Su, Q. (2020). Crowding out effect or catfish effect: The impact of fintech on traditional inclusive finance. Modern Finance (Journal of Tianjin University of Finance and Economics), 40(01), 56-70.
[12] Xiong, J., Zhang, Y., & Dong, X. (2021). The impact of fintech on the operational performance of commercial banks: Crowding out effect or technological spillover effect? Economic Review, (03), 89-104.
[13] Shih, V., Zhang, Q., & Liu, M. (2007). Comparing the performance of Chinese banks: A principal component approach. China Economic Review, 18(1), 15-34.
[14] Beccalli, E. (2007). Does IT investment improve bank performance? Evidence from Europe. Journal of Banking & Finance, 31(7), 2205-2230.
[15] Sangita, Dutta, Gupta, et al. (2018). Information technology and profitability: Evidence from Indian banking sector. International Journal of Emerging Markets, (5), 1070-1087.
[16] Li, Y., Chen, W., & Zhou, H. (2020). Fintech, productivity paradox, and bank profitability. Financial Science, (11), 1-16.
[17] Dong, J., Yin, L., Liu, X., et al. (2020). Impact of internet finance on the performance of banks in China. International Review of Financial Analysis, 72, 101579.
[18] Di Maggio, M., & Yao, V. (2021). Fintech borrowers: Lax screening or cream-skimming? The Review of Financial Studies, 34(10), 4565-4618.
[19] Jerene, W., & Sharma, D. (2020). The effect of e-finance service quality on bank customers' fintech e-loyalty: Evidence from Ethiopia. International Journal of E-Business Research, 16(2), 69-83.
[20] Xu, X., Li, H., & Ge, Y. (2021). Can fintech applications promote the adjustment of bank credit structures? An empirical study based on banks' external cooperation. Financial Research, 47(06), 92-107.
[21] Han, M. (2016). Development status and financial innovation analysis of FinTech. Economic Research Guide, (23), 88-90.
[22] Zhu, T., & Chen, L. (2016). Potential risks and regulatory responses of Fintech. Financial Regulation Research, (07), 18-32.
[23] Yoon, S. S., Lee, H., & Oh, I. (2023). Differential impact of fintech and GDP on bank performance: Global evidence. Journal of Risk and Financial Management, 16(7), 304.
[24] Jiang, T. (2022). Mediating effects and moderating effects in empirical causal inference research. China Industrial Economics, (05), 100-120.
[25] Li, Y., Li, M., & Li, J. (2022). Bank fintech, credit allocation, and corporate short-term borrowing. China Industrial Economics, (10), 137-154.
[26] Wu, Q., & Zhang, Y. (2023). Fintech and commercial bank profitability: Path analysis and empirical test. Dongyue Tribune, 44(04), 155-163.
[27] Yang, J., & Su, Q. (2023). Digital financial development and risks of small and medium-sized banks: Empirical evidence from 117 commercial banks in China. Southern Finance, (03), 3-18.
[28] Cheng, H., & Cai, C. (2017). Fintech development strategy of commercial banks in China. Banker, (09), 131-133.
[29] Phan, D. H. B., Narayan, P. K., Rahman, R. E., et al. (2020). Do financial technology firms influence bank performance? Pacific Basin Finance Journal, 62, 101210.
[30] Haw, I.-M., Ho, S. S., Hu, B., & Wu, D. (2010). Concentrated control, institutions, and banking sector: An international study. Journal of Banking & Finance, 34(3), 485-497.
[31] Xie, J., Li, S., & Zhang, M. (2021). The impact of inclusive finance on the profitability of commercial banks under the background of fintech. Quantitative Economic and Technical Economic Research, 38(08), 145-163.
[32] Guo, Y., Huang, Z., & Yao, R. (2020). Strategic investor selection and bank efficiency: Evidence from city commercial banks. Economic Research, 55(01), 181-197.

DOI: 10.54254/2754-1169/73/20231720

[33] *Zhou, A., & Liu, X. (2020). Economic policy uncertainty, bank competition, and bank income diversification. Contemporary Economic Science, 42(02), 68-79.*

[34] *Jin, H., Li, H., & Liu, Y. (2020). Fintech, bank risk, and market crowding out effect. Financial Research, 46(05), 52-65.*

[35] *Yu, L., & Li, Z. (2023). Research on the impact of fintech on the profitability and operational risk of commercial banks: An empirical test based on text mining. Financial Regulation Research, (04), 62-79.*