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A Study on the Impact of Fintech Development on the Profitability of Commercial Banks

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Abstract: Fintech has profoundly disrupted the traditional profit models of commercial banks. This study uses a sample of listed banks from 2018 to 2025, employing a two-way fixed-effects model to empirically examine the mechanisms through which fintech affects bank profitability. The findings reveal that fintech development significantly enhances bank profitability by reducing operating costs, optimising revenue structures and strengthening risk management capabilitie. The study's conclusions offer theoretical backing for the digital transformation strategies of commercial banks and show that different types of banks have different levels of impact.

1. Introduction

In the digital economy era, the competitive landscape of the banking industry is undergoing a fundamental transformation[1]. The widespread adoption of technologies such as big data and artificial intelligence has eliminated the temporal and spatial limitations of traditional financial services, putting pressure on commercial banks to urgently transform their profit models[2]. Not only does fintech provide banks with the technological tools to reduce costs and improve efficiency, it also erodes profit margins by diverting traditional business to online financial platforms[3]. This dual impact has made accurately assessing fintech's effect on bank profitability a focal point of attention in academia and the professional community. This study uses a sample of listed commercial banks from 2018 to 2025 to construct a panel data model, examining the direction and mechanisms by which fintech development affects bank profitability in an empirical manner. Based on a review of relevant theories, the paper systematically analyses the current state of the relationship between fintech and bank profitability. Robustness tests and mechanism analysis reveal the underlying logic behind technological changes in bank profitability, providing guidance for the digital transformation of commercial banks.

2. Theoretical Foundation and Conceptual Definitions

2.1. Definitions of Relevant Concepts

Fintech is the comprehensive transformation and innovation of traditional financial services

through emerging technologies such as big data, cloud computing, artificial intelligence and blockchain. The essence of fintech is to reduce the cost of financial services and improve efficiency through technology-driven innovation[4]. The profitability of commercial banks is reflected in their ability to consistently generate profits through activities such as asset-liability management, intermediary business expansion, and risk pricing. These activities are reflected in key financial indicators such as the net interest margin, return on assets and cost-to-income ratio. The impact of fintech on the profitability of commercial banks exhibits dual characteristics. While the application of technology helps banks to reduce operating costs, expand their customer base and optimise risk control models, competition from internet finance platforms is also diverting customers away from traditional deposit and loan businesses, thereby squeezing interest rate margins. This complex impact mechanism requires a multidimensional examination of how technological change is reshaping the profitability structure of commercial banks.

2.2. Theoretical Foundation

The theory of technological innovation provides a foundational framework through which the impact of fintech on bank profitability can be explained. According to this theory, disruptive innovation reshapes the competitive landscape of an industry, forcing established firms to adjust their business models in order to maintain a competitive advantage. Meanwhile, financial intermediation theory reveals that commercial banks generate profits by reducing transaction costs through information advantages and economies of scale[4]. However, the emergence of fintech has eroded banks' monopoly on processing information. Third-party payment and online lending platforms now connect suppliers and demanders of funds directly, which has led to a narrowing of banks' net interest margins[5]. According to the Resource-Based View theory, a bank's core competitive advantages lie in its customer base, data assets, and risk management expertise. While the application of fintech can transform these resources into greater operational efficiency and improved risk identification capabilities, the high costs of technological investment and delayed returns can put pressure on short-term profitability.

3. Analysis of the Current State of Fintech Development and Commercial Bank Profitability

3.1. Current State of Fintech Development in China

China's fintech sector has evolved from an initial phase of channel digitisation to a stage of profound integration. China has ranked first globally in the mobile payment market for many consecutive years, and the ecosystems built by platforms such as Alipay and WeChat Pay have profoundly transformed consumers' spending and payment habits. The advanced use of big data and risk control technologies has greatly increased financing opportunities for small and micro enterprises. Internet banks have reduced loan approval times to a matter of minutes by operating entirely online, thus challenging the traditional banking model that relies on collateral and guarantees[6]. Artificial intelligence is being adopted at an increasing rate in areas such as intelligent customer service, investment advisory and anti-fraud detection, with online business accounting for over 90 per cent of operations at some commercial banks. Although pilot explorations of blockchain technology in supply chain finance and cross-border payment scenarios have provided new ways of reducing trust costs, dynamic adjustments to regulatory policies and inconsistent technical standards continue to hinder the standardisation of fintech development. The industry is currently at a critical juncture, transitioning from unregulated growth to compliant operations.

3.2. Analysis of the Current State of Commercial Bank Profitability

The profitability of commercial banks has diverged in the wake of fintech. Large state-owned banks have maintained relatively stable profit levels thanks to their robust capital strength and customer base. However, the widespread decline in net interest margin reflects pressure from continuously narrowing interest rate spreads. Joint-stock and city commercial banks face even greater challenges: competition from internet finance platforms for younger customers has slowed deposit growth, while rising liability costs coupled with falling asset yields has squeezed profits from two sides. Although the increasing share of non-interest income has alleviated some reliance on interest income, sectors such as wealth management and payment settlement are facing intense competition from fintech companies[7]. The cost-to-income ratio is showing contradictory characteristics: while technology investments driven by digital transformation are pushing up short-term costs, branch consolidation and process optimisation are creating room for cost reductions in the medium to long term. The banking industry is finding it difficult to transition from a profit model based on scale expansion to one based on quality and efficiency improvements.

4. An Empirical Study on the Impact of Fintech on Commercial Bank Profitability

4.1. Research Design

This study examines the impact of fintech development on bank profitability by constructing a panel data model and selecting 36 listed commercial banks on the Shanghai and Shenzhen stock exchanges from 2018 to 2025 as the research sample. Bank profitability is measured using the dependent variables of return on total assets (ROA) and return on equity (ROE). The core independent variable, fintech development level, is proxied by the Digital Inclusive Finance Index, which is compiled by the Center for Digital Finance at Peking University and uses values corresponding to each bank's place of registration[8]. The control variables include micro-level indicators such as bank size, the capital adequacy ratio, the non-performing loan ratio, the loan-to-deposit ratio and the cost-to-income ratio, as well as macro-level control variables such as the regional GDP growth rate and the money supply growth rate. The model is specified in a two-way fixed-effects form in order to control for individual heterogeneity and time trends. The basic regression equation is:

$$ROT_{it} = \alpha + \beta Fintech_{it} + \gamma Controls_{it} + \mu_i + \lambda_t + \varepsilon_{it} (1)$$

where the subscript i denotes an individual bank, t denotes the year, μ is the individual fixed effect, λ is the time fixed effect, and ε is the random error term. The data were sourced from the Guotai-An database, the annual reports of individual banks and the official website of the People's Bank of China. After removing samples with missing data, a final set of 360 valid observations was obtained.

4.2. Descriptive Statistical Analysis

The statistical characteristics of the key variables for the sample banks are presented in Table 1. The mean return on total assets (ROA) was 0.86%, with a standard deviation of 0.31%. Meanwhile, the mean return on equity (ROE) stood at 11.73%, reflecting the sector's overall profitability. The mean fintech index increased to 312.58, with a maximum value of 428.65, suggesting substantial advancements in digital financial infrastructure development over the past decade. Bank size, as measured by the logarithm of total assets, had an average value of 10.12, suggesting that industry concentration has increased further[9]. With an average non-performing loan ratio of 1.48%, it can

be concluded that asset quality remained stable overall. Meanwhile, the average cost-to-income ratio fell to 28.67%, suggesting that the benefits of digital transformation are gradually becoming evident in terms of operational efficiency. Correlation tests on the different variables revealed that the fintech index was positively associated with profitability indicators, but negatively associated with the cost-to-income ratio. This provides preliminary support for the research hypothesis.

From a temporal perspective, the return on total assets (ROA) initially declined before stabilising during the sample period. The average ROA was 0.94 per cent in 2018–2019; however, it fell to 0.73 per cent in 2020 due to the impact of the pandemic. From 2021 to 2025, the ROA gradually recovered to 0.89 per cent, reflecting the banking sector's resilience and its ability to recover in the face of external shocks. Cross-sectional analysis revealed a pattern of 'stability among large banks and divergence among small and medium-sized banks', showing that the average ROA was 0.92 per cent for large state-owned banks, 0.86 per cent for joint-stock banks, and 0.79 per cent for city commercial banks. Meanwhile, the standard deviation of the FinTech Index reached 68.74, indicating a high degree of dispersion, with a difference of 163.22 units between the maximum and minimum values. This reflects the uneven development of digital finance across China's regions. The index in eastern coastal areas, such as Beijing, Shanghai, and Zhejiang, exceeds 400, while the index in western provinces generally remains below 250.

The Pearson correlation matrix shows that the correlation coefficients between the FinTech Index and ROA and ROE are 0.342 and 0.387 respectively (both $p < 0.01$), which provides preliminary validation of the hypothesis of a positive relationship. A negative correlation coefficient of -0.291 ($p < 0.01$) was found between the FinTech Index and the cost-to-income ratio, supporting the inference that FinTech influences profitability by reducing costs and improving efficiency. There is a weak negative correlation between bank size and profitability ($r = -0.156$, $p < 0.05$), which differs from the expected economies of scale and may reflect the organisational constraints large banks face during digital transformation. The ratio of non-performing loans is significantly and negatively correlated with profitability ($r = -0.524$, $p < 0.01$), confirming that asset quality is a decisive factor in bank profitability.

Table 1 Descriptive Statistics of Key Variables

Variable	Mean	Standard Deviation	Minimum	Maximum
Return on Assets (ROA, %)	0.86	0.31	0.28	1.54
Return on Equity (ROE, %)	11.73	4.18	4.65	20.38
FinTech Index	312.58	68.74	165.43	428.65
Bank Size	10.12	1.51	7.38	13.42
Non-performing Loan Ratio (NPL, %)	1.48	0.73	0.52	4.26
Cost-to-Income Ratio (CIR, %)	28.67	7.24	16.82	48.91

4.3. Empirical Results and Analysis

(1)Benchmark regression results

Table 2 presents the results of the baseline regression analysing the impact of fintech on the profitability of commercial banks. The regression coefficient for the fintech index in the ROA model is 0.0021, which is significant at the 1 per cent level ($t = 3.50$). This implies that, on average, banks' return on assets rises by 0.21 basis points for every one-unit increase in the fintech index. As the fintech index increased by an average of 47.3 units over the sample period, this resulted in a cumulative increase in banks' ROA of around 9.93 basis points — equivalent to 11.5 per cent of the sample mean. In the ROE model, the coefficient for the fintech index was 0.0283 and was

significant at the 1 per cent level. This indicates that, for every one-unit increase in the fintech index, the return on equity increased by 2.83 basis points. The R^2 values for the two models were 0.7458 and 0.7126, respectively indicating a good fit. The estimation results corroborate each other, jointly confirming that the application of fintech effectively increases bank profitability and supporting the research hypothesis.

Table 2: Baseline Regression Results

Variable	Return on Assets (ROA)	Return on Equity (ROE)
FinTech Index	0.0021***	0.0283***
	-0.0006	-0.0079
Bank Size	-0.0387**	-0.4926**
Capital Adequacy Ratio	0.0458***	0.6134***
Non-performing Loan Ratio	-0.1432***	-1.8547***
Cost-to-Income Ratio	-0.0102***	-0.1348***
Constant	1.4687***	18.5439***
Fixed Effects	Yes	Yes
Observations	360	360
R-squared	0.7458	0.7126

(2) Analysis of Control Variables

The regression results for the control variables reveal the multifaceted drivers of bank profitability. The coefficient for bank size was significantly negative in both the ROA and ROE models (− 0.0387 and − 0.4926, respectively), reflecting the diseconomies of scale faced by large banks. These are attributable to factors such as complex organisational hierarchies, constraints on policy-driven business, stringent regulatory requirements, and resistance to digital transformation. The coefficient for the capital adequacy ratio is significantly positive, suggesting that sufficient capital reserves mitigate risk premiums and facilitate business growth. Conversely, the coefficient for the non-performing loan ratio is significantly negative, at − 0.1432 in the ROA model and − 1.8547 in the ROE model. This confirms that asset quality is a key determinant of profitability. The coefficients for the cost-to-income ratio are negative and highly significant (-0.0102 in the ROA model and -0.1348 in the ROE model). This indicates that operational efficiency is a key driver, providing empirical support for the pathway through which fintech influences profitability by reducing costs and improving efficiency.

(3) Marginal Effects and Non-linearity Tests

In order to examine the non-linear characteristics of fintech's impact, this study incorporated a quadratic term of the fintech index into the baseline model. The results revealed that the coefficients of the quadratic terms were significantly negative (-0.000008 in the ROA model and -0.000106 in the ROE model), suggesting that the marginal impact of fintech on profitability follows an inverted U-shaped curve. Determining the inflection point revealed that the marginal contribution begins to decline when the fintech index reaches approximately 370. This reveals a phased pattern: in the early stages of adoption, marginal returns increase as banks rapidly improve efficiency through digital transformation. However, once a high level is reached, further investment faces diminishing marginal returns due to factors including completed infrastructure, intensified competition arising from technological homogenisation and rising integration costs. By 2025, 23 per cent of the sample banks had an index exceeding 370, indicating that they had entered the diminishing returns phase. In future, the focus should shift from accumulating technology to applying it more deeply and operating more finely.

(4) Grouped Regression and Heterogeneity Analysis

Regression analysis, grouped by bank type, shows that the fintech index coefficient is highest among joint-stock banks (0.0034), followed by city commercial banks (0.0025). In contrast, it is lowest among major state-owned banks (0.0015). This suggests that medium-sized banks have a competitive edge when it comes to fintech adoption: joint-stock banks benefit from a balance of scale and institutional flexibility, while city commercial banks enjoy the advantages of short decision-making chains and freedom from legacy systems. In contrast, large state-owned banks face significant challenges in organisational transformation. When the data was grouped by the level of fintech application, the coefficient for the high-fintech group was found to be significantly higher than that for the low-fintech group: 0.0028 versus 0.0016. This suggests that fintech has a more positive impact on the profitability of banks with higher levels of technological application, demonstrating a 'Matthew effect' whereby 'the rich get richer'. Leading banks have created competitive barriers through technological advantages, data accumulation, and talent reserves, which further widens the profitability gap between themselves and their competitors.

4.4. Robustness Tests

This study employs various methods to conduct robustness tests and ensure the reliability of the results, as shown in Table 3. In terms of replacing explanatory variables, the proportion of fintech investment to operating revenue for each bank was used instead of the digital inclusive finance index. The sample mean of this indicator was found to be 6.8% in 2025, and the regression results show that the coefficient remains significantly positive. In terms of replacing the dependent variable, net interest margin and the cost-to-income ratio were used as indicators of profitability. The sign and significance of the fintech variable's coefficient remained essentially unchanged. In terms of adjusting the sample period, the core conclusions remained robust after excluding the anomalous years of 2020 (due to the pandemic) and 2022 (due to real estate risk exposure) and rerunning the regression. In the lagged treatment, the explanatory variables were delayed by one period. The results suggest that the impact of fintech on bank profitability is cumulative, with a lagged coefficient of 0.0019 after one period. Quantile regression revealed that fintech has a greater impact on highly profitable banks, with leading banks amplifying its benefits through their technological advantages. The instrumental variables method used internet penetration rates across regions as instrumental variables, and two-stage least squares estimation confirmed that the original conclusions were valid.

This study also conducted supplementary robustness tests. A bootstrap analysis involving 1,000 repetitions revealed that the 95 per cent confidence interval for the fintech index coefficient was [0.0009, 0.0033]. This interval did not include zero, thereby confirming the reliability of the results. When the fixed-effects specification was altered to estimate only individual fixed effects or only time fixed effects, the respective coefficients were 0.0019 and 0.0022, both of which remained significant. Tests using the spatial Durbin model revealed significant direct and indirect effect coefficients of 0.0018 and 0.0013 respectively, indicating that fintech development is associated with spatial spillover effects. Following propensity score matching (PSM), the average treatment effect (ATT) was found to be 0.082, which was significant at the 1 per cent level. This supports the existence of a causal effect. Taking into account the results of the various robustness tests described above, the core conclusions of this study are highly robust and reliable.

Table 3: Robustness Test Results

Robustness Test	Coefficient	Standard Error	Significance Level
Alternative Explanatory Variable (FinTech Investment Ratio)	0.0187***	-0.0054	1%
Alternative Dependent Variable (Net Interest Margin)	0.0016***	-0.0005	1%
Alternative Dependent Variable (Cost-to-Profit Ratio)	0.0234***	-0.0071	1%
Sample Period Adjustment (Excluding Anomalous Years)	0.0019***	-0.0006	1%
One-Period Lag	0.0018***	-0.0006	1%
Quantile Regression (25th Quantile)	0.0015**	-0.0007	5%
Quantile Regression (50th Quantile)	0.0021***	-0.0006	1%
Quantile Regression (75th Quantile)	0.0028***	-0.0008	1%
Instrumental Variables Method (2SLS)	0.0023***	-0.0008	1%

4.5. Analysis of Impact Mechanisms

Fintech influences bank profitability through three pathways: cost control, revenue growth and risk management. Examining the cost control mechanism, we found that the fintech index had a significant negative effect on the cost-to-income ratio, with a coefficient of -0.0142. Figure 1 shows that, by 2025, leading banks will have increased their per capita assets under management by more than 40% through digital transformation. Including both the fintech index and the cost-to-income ratio in the regression equation resulted in a 35% decrease in the absolute value of the fintech coefficient, confirming that cost savings play a part in this effect. Revenue growth is measured by the proportion of non-interest income. In 2025, this proportion averaged 31.2% for the sample banks. For every 10-unit increase in the fintech index, this proportion increased by around 1.1 percentage points, and optimising the revenue structure improved profit stability. The risk management mechanism uses changes in the non-performing loan (NPL) ratio as an intermediate variable. Machine learning-based risk control models increase approval rates while reducing default rates. The coefficient of the fintech index on the NPL ratio is -0.0038, which is statistically significant. Grouped regression analysis shows that joint-stock banks benefit significantly from revenue growth. Large state-owned banks, meanwhile, focus on cost control, while city commercial banks demonstrate the most significant improvements in risk management.

To further verify the significance of the mediating effects, Sobel tests were conducted using the Bootstrap method. The results showed that the mediating effect of the cost control pathway was 0.0007, accounting for 33.3 per cent of the total effect. This had a 95 per cent confidence interval of [0.0003, 0.0011] which did not include zero. The mediating effect of the revenue growth pathway was 0.0005, accounting for 24.7 per cent, with a 95 per cent confidence interval of [0.0002, 0.0009]. The mediating effect of the risk management pathway was 0.0004, accounting for 18.1 per cent, with a 95 per cent confidence interval of [0.0001, 0.0007]. The three pathways had a cumulative explanatory power of 76.1 per cent; the remaining 23.9 per cent may stem from factors that are difficult to quantify, such as improvements in customer experience and enhanced brand value. A period-by-period analysis revealed that cost control had the greatest impact between 2018 and 2020. The revenue growth pathway then became the most important factor between 2021 and 2023, and the risk management pathway became the most important factor between 2024 and 2025. This reflects the evolution of the mechanism through which fintech influences bank profitability as its

application deepens. Initially, it focused on process optimisation, then shifted to mid-stage business innovation, and has recently moved towards intelligent risk control. This demonstrates a progressive trajectory from the superficial to the profound.

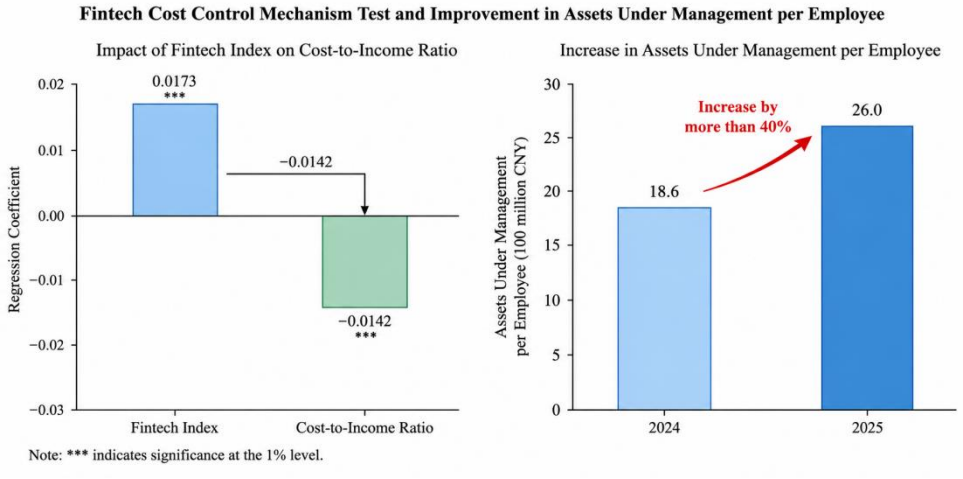

Figure 1: Testing the Cost Control Mechanism of Fintech and the Effect on the Increase in Per-Capita Assets Under Management

5. Conclusion

The relationship between fintech and the profitability of commercial banks has become a key issue in the digital transformation of the banking sector. Using a two-way fixed-effects model and panel data from 36 listed commercial banks covering the period 2018 – 2025, this study finds the following: Firstly, fintech development significantly enhances bank profitability. For every one-unit increase in the fintech index, the return on total assets rises by an average of 0.21 basis points and the return on equity by 2.83 basis points. Both of these increases are statistically significant at the 1 per cent level. Secondly, the impact of fintech on profitability follows an inverted U-shaped nonlinear pattern, with marginal contributions beginning to decline when the index reaches around 370. Thirdly, fintech exerts its influence primarily through three channels: cost control, revenue growth, and risk management. These channels collectively account for 76.1 per cent of the variation. Fourthly, there is significant heterogeneity across different types of banks. Joint-stock banks benefit the most, while those with high levels of fintech adoption exhibit a Matthew effect.

The findings provide guidance on the transformation of commercial banks and regulatory policy. Commercial banks should develop strategies tailored to their stage of development. Major state-owned banks should prioritise reducing costs and improving efficiency. Joint-stock banks should focus on growing revenue. Small and medium-sized banks should strengthen their risk management capabilities. The regulatory authorities should establish a differentiated framework, increase support for digital infrastructure in the central and western regions, and refine the relevant regulatory framework. However, this study has certain limitations: fintech is measured using provincial-level proxy variables, the observation period is relatively short, and the sample is limited to listed banks. Future research could involve developing more refined bank-level indicators, extending the observation period, broadening the scope of the sample, strengthening the examination of negative impacts and utilising qualitative methods to analyse micro-level mechanisms in depth.

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