Research on the Impact of Financial Technology on Bank Performance: From the Perspective of Profitability, Operational Efficiency and Risk-taking

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Abstract. In today's era, terms such as "big data", "cloud computing", "blockchain", and "digitalization" continue to emerge, and financial technology has become a hot focus in the financial industry. In recent years, financial technology has flourished, acting as a powerful force for change. It has not only sparked a revolutionary wave of technological innovation in the traditional financial industry, represented by banks, but also had a profound and wide-ranging impact on the modern economic landscape. This article comprehensively and systematically reviews relevant contemporary academic literature, focusing on the impact of financial technology on bank performance. The article focuses on three key indicators of bank performance: profitability, operational efficiency, and risk-taking level. From multiple dimensions such as research variables, indicator selection, and model method application, it summarizes the research results in this field in recent years, deeply analyzes the limitations of the research, and points out future research directions, providing scientific and clear theoretical references for bank managers, practitioners, and policy makers.

1 Introduction

The emergence of Internet technology, artificial intelligence, and other technology sectors in recent years has caused significant changes and advancements in a number of conventional industries. And in the financial industry, the term "financial technology" has gradually begun to appear in people's vision. There are many different opinions in the academic community about the definition of FinTech. Generally speaking, it combines traditional finance and emerging technologies, covering areas like big data technology, cloud computing technology, blockchain technology, artificial intelligence technology, and Internet technology etc. As the core hub of the modern economy, the banking industry is naturally facing unprecedented opportunities and challenges in this transformation driven by emerging technologies. How banks are affected by financial technology is multi-level, multi-directional, and multi-channel. The advancement in financial technology has promoted financial product innovationand technological progress, expanded the business model and delivery channels of

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banks, such as the emergence of smart investment advisors, the popularization of mobile banking, online banking and mobile payments, and provided consumers with more diversified and targeted financial services more cost-effectively and efficiently. But at the same time, financial technology has also intensified competition among banks, resulting in fluctuations in their performance.

It can divide the impact of FinTech on banks into two categories: external FinTech and bank FinTech. The former is the impact of FinTech on enterprises other than banks, which indirectly affects banks through competition effects and technological spillover effects, while the latter is the direct technological implementation in the banking sector, which is the impact of banks' active investment in FinTech [1]. Together, the two constitute a complete picture of the impact of FinTech on banks. There is a large amount of existing research literature on external financial technology. Xiaoling Song et al. analyzed the impact of changes in the dominance of competition effects and technological spillover effects on bank profitability at different stages of financial technology development [2]. Pohl and Birte combined regional factors to explorehow competition and technological spillovers affect domestic banks' efficiency.in South Africa [3,4]. The two studies explored external financial technology from the perspectives of the financial technology's stage of development and Geographical considerations. However, there are relatively few articles on bank fintech. Therefore, to further sort out the effect of bank fintech on bank performance and the state of studies at this time, this article retrieved relevant literature in recent years from academic websites such as Google Scholar and Sci-Hub, and analyzed, sorted, and summarized them. Profitability, operational efficiency, and risk-taking are key indicators that reflect bank operations. Profitability is the key to measuring bank value creation; operational efficiency determines the bank's competitive advantage, operating costs, and service quality; and risk-taking is an important lever to balance bank revenue and security. Therefore, the following article starts from these three perspectives, first discussing how to measure investment in bank financial technology in empirical research and then sorting outhow financial technology affects banks'risk-taking, operational efficiency, along with profitability. Ultimately, the limitations of the current research and the outlook for future research are given, aiming to provide a more detailed and scientific theoretical basis for bank management and policymakers, it has great practical significance.

2 Measuring bank fintech

Banks' investment in financial technology is diverse and complex, and its results are difficult to quantify. Therefore, measuring banks' financial technology investment is a challenging task.

This is also one of the hot topics among researchers. As early as 1993, By examining the IT hardware and software expenses listed on the business's balance sheet, Brynjolfsson was able to determine the amount of digital investment [5]. However, due to the limited types of expenditure recorded on the balance sheet, it cannot reflect the company's overall investment, and it reflects the company's past transactions and expenditures, lacking foresight. Subsequently, in 2003, Tippins and Sohi extracted data from questionnaires and solved some of the problems, but Baker pointed out that the data were subjective due to the cognitive bias of the respondents, and a large amount of data was missing due to the high frequency of unanswered questions [5]. Text mining has been employed extensively in the creation of financial technology indices recently. It is predicated on intelligent algorithms and uses data mining methods and techniques to get useful information from a lot of diverse and unstructured content. For example, Cheng Maoyong and Yang Qu constructed a fintech keyword database, used the word frequency statistics method to count articles covering these keywords from the Baidu search engine, counted the frequency, and then used factor analysis

to finally create an index to reflect banks' fintech investment. Shen Jianjun, Guo Wenjing, Dong Jichang, and others also adopted a similar method [1]. (Elmadi et al., Alem Chaydar et al.) also used the digitalization score (DIG) as a proxy variable based on the text mining method, anddetermined the frequency of digital terms to gauge the level of digitization [6]. In addition, Zhao Jinsong et al. employed principal component analysis to build a bank fintech development index utilizing enterprise-level data based on the four parameters of total number of firms, registered capital, number of financing events, and financing amount [7]. Of course, research has also made use of some of the fintech indexes that are now in circulation, such the Digital HP Finance Index created by the Digital Finance Center and the Peking University Inclusive Finance Index. In summary, different studies have different methods for constructing fintech indexes, and there is no consensus on which index construction method can more scientifically and accurately reflect bank fintech investment.

3 Overview of current research results

A huge number of studies have indicated that bank financial technology has a substantial influence on its profitability, operational efficiency, and risk-taking.

3.1 The impact of banking fintech on risk-taking

Selecting appropriate proxy variables to reflect the risk-taking of banks is the basis for conducting empirical research, and different scholars have different choices. For instance, the bank's non-performing loan ratio (NPL), which may accurately represent the quality risk of bank credit assets, is the variable that Cheng Maoyong and Yang Qu, Papadopoulos, employ [8]. As a stand-in variable for bank risk control, Yang Wang et al. selected the owner equity to total assets ratio, which represents the bank's capacity to withstand risk from a capital structure standpoint [9]. In addition, The Z value or its natural logarithm is frequently used by academics like Wang Rui and Sui Yubing, Rabia Sajid et al., and Zhao Jinsong et al. as the primary metric for assessing the risk taken by banks. Its mathematical expression is:

$$Z = 1 + (ROA + EA)/\sigma(ROA) \quad (1)$$

The bank's overall stability, or the lower the chance of insolvency, is indicated by a greater Z number [10]. The Z value can more comprehensively reflect the risk-taking status of the bank. Investors often make investment decisions that meet their risk preferences by comparing the Z values of different banks. Regulators will also focus on supervising and reviewing banks with Z values below a certain threshold. Regarding the impact direction of risk-taking, researchers [11].

In order to take into account the heterogeneity of the effects of financial technology on bank risk-taking, several researchers have chosen the size of the bank, bank type, and bank location as control variables. Specifically, Deng Liurui et al. found empirically that since the level and speed of financial technology development in eastern and western China are higher than those in central China and are supported by relevant policies, in these areas, bank financial technology has a greater impact on lowering bank risks than in central China. At the same time, compared to rural commercial banks, urban commercial banks' risk-taking is more strongly inhibited by the advancement of financial technology. Urban commercial banks typically have benefits over rural ones in terms of scale and clientele, which might be the cause [11]. According to Cheng Maoyong and Yang Qu, there is not much of a negative effect of bank financial technology on the credit risk of listed banks, state-owned banks, and big banks. The possible explanation is that these banks have relatively complete risk governance systems, so the extent to which their risk-taking is improved by financial technology is limited [1]. Regarding the discussion of the mediating effect, Deng Liurui et al. believe that the net interest margin and management fees within the bank are the mediating

elements of the relationship between bank risk and financial technology [11]. Rabia Sajid et al. considered the mediating role of operational efficiency. By increasing bank operational efficiency, financial technology can lower bank risk-taking, according to their empirical findings [12].

3.2 Impact of banking fintech on operational efficiency

The selection of proxy variables for bank operating efficiency is relatively simple. Elmadi et al. used the ratio of operating expenses to operating income to reflect the operating efficiency of banks [6]. The ratio of operational expenses to total income was employed as a proxy variable by Wang et al. and Rabia Sajid et al [12].

From the literature reviewed, scholars unanimously believe that financial technology can improve the operational efficiency of banks. According to Yang Wang et al., commercial banks have used financial technology products including blockchain cross-border payment, mobile payment, and intelligent customer service to enhance existing business models, lower operating costs, and increase service efficiency [9]. Elmadi et al., Rabia Sajid et al. believe that financial technology and digital applications can improve operational efficiency by reducing various operating charges such transaction fees and bank monitoring fees. For example, banks use smart contract technology to reduce manual processing links and improve transaction transparency. Big data analysis can also help banks more accurately identify high-risk customers and potential risky transactions, allowing banks to take more targeted monitoring [12]. Hafiz Baker specifically applies financial technology to the use of ATMs, and concludes through empirical evidence that using APM instead of cash will improve bank operational efficiency [13].

Less attention is paid to how financial technology influences banks' operational effectiveness. Scholars pay more attention to the moderating effect of bank size, bank type, regional financial technology development level, and financial technology innovation category. Li Zhiquan et al. showed through their research that Financial technology has a greater effect on urban commercial banks' efficiency than it does on state-owned commercial banks, but it has less of an effect on joint-stock commercial banks. Additionally, they discovered that while the use of Internet technology and big data has clear benefits in lowering operating costs, such as borrower screening and monitoring, the two forms of financial technology innovation—payment and lending—have no discernible effect on banks' cost efficiency [14].

3.3 Impact of fintech on bank profitability

First， let us continue to discuss the selection of variables. When investigating bank indicators, the majority of researchers, including Yang Wang et al., Guo Wu1 and Hongfei Yuan, and Wang Juan, have utilized ROA or ROE to represent the profitability of banks [15]. Some scholars, such as Hafiz Baker et al., believe that although financial ratios such as ROA and ROE can better measure the financial efficiency of banks, total deposits and net profit are more comprehensive and reflect the financial performance of banks in a form that is easier for investors and the public to understand [13].

Unlike the first two, regarding how financial technology will affect bank profits, opinions differ. Regional variations in the samples used for this research, variations in the period chosen, variations in the kinds of banks examined, variations in size, and variations in data processing, index building, and model technique selection might all be contributing factors. According to the direction of its impact, it can be simply divided into two categories: positive and negative. Elmadi argues that due to the high costs brought about by digitalization, there is a substantial negative connection between the deployment of financial technology and bank

profitability, and this negative correlation occurs regardless of the size of the bank [6]. Zhao Jinsong et al. found that when the bank size is relatively small, the return on assets (ROA) is significantly impacted negatively by financial technology, which limits small banks' capacity to be profitable. Guo Wu and Hongfei Yuan also reached a similar conclusion [7,15].

However, Dong Jichang discovered that Internet finance can increase commercial banks' profitability, while Yang Wang et al. think that the advancement of financial technology has increased commercial banks' profitability [16]. According to Yin Chunshuo et al., the improvement of financial technology significantly boosts banks' profitability in developing nations [17]. Financial technology could enhance banks' efficacy and efficiency to boost their profitability, as demonstrated by Hafiz Baker et al. [13].

It is worth noting that some scholars have also given more complex conclusions. Abdulla Al-Shaer and Bashar Abu Khalaf divided the application of financial technology into different categories and determined that while internet banking and mobile apps have a beneficial effect on the profitability of banks, the quantity of automated teller machines (ATMs) has an adverse impact on the performance of banks [18]. Yingying Kong discovered an inverse "U" connection among bank profitability and financial technology growth, meaning that while financial technology advancements boost commercial banks' performance in the short term, they will have a negative impact on their performance in the long run [19].

4 Limitations of the current study

Through the observation and analysis of several research studies on how financial technology affects bank performance metrics, this article found that most articles tend to analyze financial technology investment or development level as an overall indicator, and few scholars break it down into specific financial technology applications to consider its impact on banks. For example, when considering bank financial technology investment, researchers always tend to create a comprehensive index to gauge all financial technology investments., but do not break it down into the bank's investment in human, financial, and technical resources to build a more sophisticated indicator system. The disadvantage of this is that bank management and relevant system makers can't have a clearer and deeper understanding of the impact mechanism between the two, so it is impossible to formulate more specific, detailed, and practical plans and measures.

Moreover, many researchers have adopted similar quantitative analysis methods in their research, such as the GMM, including SYS-GMM and DIF-GMM,,OLS, instrumental variable method, etc., but lack a certain degree of improvement and innovation in model selection. In subsequent research, methods such as quantile regression and Bayesian estimation can be used to enhance the research's precision and dependability.

5 Conclusion

This paper systematically analyzes, organizes, and summarizes several contemporary documents retrieved from websites such as Google Scholar and Sci-hub, and comprehensively considers the index construction, variable selection, empirical results, and the mediating and moderating effects of specific variables in the articles, and sorts out the directional impact of bank financial technology on its risk-taking, operational efficiency, and profitability.

Through the summary,research indicates that a bank's risk-taking, operational effectiveness, and profitability are all greatly affected by its financial technology investment.. Specifically,financial technology lowers banks' degree of taking risks, and is affected by bank

size, bank type, and geographical location, showing heterogeneity. In addition, variables such as internal net interest margin and management expenses play a mediating role between the two.

Secondly, financial technology helps banks operate more efficiently, and is moderated by factors such as bank size, bank type, regional financial technology development level, and financial technology innovation category. Finally, the relationship between FinTech and bank profitability is complicated and contentious.. Some studies show that its impact is positive, while others believe that it has a negative impact. The fundamental reason is that different studies have selected samples with regional differences, period differences, different types and sizes of banks studied, as well as differences in data processing, index construction, and model method selection.

Most of the literature consulted did not make a detailed classification of the categories of bank financial technology investment. Future research can subdivide it into multiple dimensions such as human resources and technical resources, and consider the number of employees in financial technology research and development, financial technology research and development costs, system maintenance costs, etc. on bank performance. In addition, the sample time span of many studies is too short and cannot reflect obvious time trends. Most of the samples selected in the studies are concentrated in specific regions, such as China, Egypt and other countries, which have strong regional characteristics, and similar models are used for research. Future research can select samples with a larger time and regional span for research, and consider using different models, such as quantile regression and Bayesian estimation to draw more universal and practical conclusions.

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