DIGITAL FINANCIAL INCLUSION, FINTECH AND COMMERCIAL BANK PERFORMANCE IN CHINA: THE MEDIATING ROLES OF RISK-TAKING

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DIGITAL FINANCIAL INCLUSION, FINTECH AND COMMERCIAL BANK PERFORMANCE IN CHINA:
THE MEDIATING ROLES OF RISK-TAKING

by

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LIST OF ABBREVIATIONS

ABC	Agricultural Bank of China
BCM	Bank of Communication
BOC	Bank of China
Bre	Digital Financial Inclusion Breadth of Coverage
Cap	Capital Adequacy Ratio
CCB	China Construction Bank
CPC	Communist Party of China
CSR	Corporate Social Responsibility
Dep	Digital Financial Inclusion Depth of Use
Dig	Digital Financial Inclusion Digitization Level
Eco	Level of Economic Development
Fin	Digital Financial Inclusion
FSB	Financial Stability Board
GDP	Gross Domestic Product
ICBC	Industrial and Commercial Bank of China
Ind	Degree of Industrial Agglomeration
Int	Bank Net Interest Margin
MSME	Micro, Small and Medium-Sized Enterprise
Per	Bank Performance
PBOC	The People's Bank of China
PSC	Postal Savings Bank of China
Ris	Risk-Taking
RMB	Chinese Yuan
ROA	Return on Assets
ROE	Return on Equity
R&D	Research and Development
SDG	Sustainable Development Goals
SME	Smal and Medium-Sized Enterprise
Tec	Fintech
Urb	Urbanization Level

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INKLUSI KEWANGAN DIGITAL, TEKNOLOGI KEWANGAN DAN PRESTASI BANK PERDAGANGAN DI CHINA: PERANAN PENGANTARA PENGAMBILAN RISIKO

ABSTRAK

Dalam beberapa tahun kebelakangan ini, teknologi canggih dan inovatif telah memacu perkembangan pesat inklusi kewangan digital dan teknologi kewangan dalam sektor kewangan China dan telah menghasilkan perubahan yang mendalam dalam bank perdagangan. Tahap penggunaan teknologi inovatif dalam industri kewangan juga secara langsung memberi kesan kepada kemudahan produk dan perkhidmatan kewangan, membentuk kepuasan pelanggan terhadap produk dan perkhidmatan, dan mentakrifkan semula cara pelanggan berinteraksi dengan bank. Prestasi bank perdagangan boleh dipengaruhi oleh pelbagai faktor, terutamanya perkembangan inklusi kewangan digital dan teknologi kewangan, yang memacu peningkatan prestasi dengan memberi kesan positif kepada keupayaan mengambil risiko bank perdagangan. Oleh itu, kajian ini mengambil data panel 30 wilayah di China (tidak termasuk Tibet, Hong Kong, Macao, dan Taiwan) dari tahun 2012 hingga 2021 sebagai sampel penyelidikan. Fokus utama adalah pada hubungan antara inklusi kewangan digital, teknologi kewangan, pengambilan risiko dan prestasi bank, dan ia digabungkan dengan penyelidikan sedia ada untuk menyelesaikan laluan kesan inklusi kewangan digital dan teknologi kewangan terhadap prestasi bank perdagangan. Dalam kajian ini, pembolehubah yang berkaitan dianalisis dengan statistik deskriptif dan ujian korelasi, ujian multikolineariti, dan regresi panel untuk menyusun korelasi potensi antara pembolehubah yang dipilih dan menentukan pilihan model kesan tetap. Kesan pengantaraan antara inklusi kewangan digital, fintech dan prestasi bank komersial juga

diuji menggunakan regresi berperingkat kausal. Di samping itu, kajian ini juga menggabungkan model Durbin spatial untuk menyiasat kesan limpahan spatial inklusi kewangan digital dan teknologi kewangan ke atas prestasi bank perdagangan. Kajian mendapati bahawa inklusi kewangan digital dan teknologi kewangan mempunyai kesan promosi yang ketara terhadap prestasi bank perdagangan, dan pengambilan risiko bank perdagangan memainkan kesan pengantaraan di dalamnya. Oleh itu, kajian ini memperluaskan perspektif penyelidikan dan memperkayakan sistem teori faktor-faktor yang mempengaruhi prestasi bank perdagangan. Pada masa yang sama, rangkuman kewangan digital dan teknologi kewangan mempunyai kesan limpahan spatial yang jelas terhadap prestasi bank komersial, jadi kajian itu juga menyediakan asas saintifik bagi kerajaan China untuk menggubal dasar mengenai peraturan kewangan, pembangunan rangkuman kewangan digital.

DIGITAL FINANCIAL INCLUSION, FINTECH AND COMMERCIAL BANK PERFORMANCE IN CHINA: THE MEDIATING ROLES OF RISK-TAKING

ABSTRACT

In recent years, advanced and innovative technologies have driven the rapid development of digital financial inclusion and fintech in China's financial sector and have produced profound changes in commercial banks. The extent to which the financial industry adopts innovative technologies can have a direct impact on the convenience of financial products and services, determine customer satisfaction with products and services, and redefine the way customers interact with commercial banks. For commercial banks, performance can be affected by a variety of factors, especially the strong development of digital financial inclusion and fintech, which will drive performance through the positive impact on the risk-taking capacity of commercial banks. Therefore, this study takes the panel data of 30 provinces in China (excluding Tibet, Hong Kong, Macao, and Taiwan) from 2012 to 2021 as the research sample. The main focus is on the relationship between digital financial inclusion, fintech, risk-taking, and commercial bank performance. The most originality of the study is it combines with the existing research to sort out the mediating role of risk-taking between digital financial inclusion and fintech on commercial bank performance. In this study, the relevant variables are analysed with descriptive statistics and correlation tests, multicollinearity tests, and panel regression to sort out the potential correlations between the selected variables and determine the choice of a fixed-effects model. The mediating effect of risk-taking between digital financial inclusion, fintech, and commercial bank performance is also tested using causal stepwise regression. In

addition to this, another originality of the study is it combines the spatial Durbin model to investigate the spatial spillover effects of digital financial inclusion and fintech on commercial bank performance. The result shows that digital financial inclusion and fintech have a noticeable promotion effect on commercial bank performance, and risk-taking plays a mediating effect in it. Therefore, this study expands research perspectives and enrich the theoretical system of commercial bank performance influencing factors. At the same time, digital financial inclusion and fintech have apparent spatial spillover effects on the commercial bank performance, so the study also provides a scientific basis for the Chinese government to formulate policies on financial regulation, digital financial inclusion development.

CHAPTER 1

INTRODUCTION

1.1 Introduction

In recent years, the rapid development in digital financial inclusion and fintech has produced profound changes in commercial banks, driving the digitization level of China's financial industry (Hu & Cheng, 2022). China has the world's largest mobile internet market and mobile payment industry, and four of the world's top five fintech companies are from China, include Ant Group, Lufax, East Money, and JD Digits (Gao, 2022). This development has not only injected new vitality into the economy but also provided new opportunities for transforming the banking industry. The rise of fintech has prompted China to deepen the structural reform of the financial supply side, promote the sustainable development of financial inclusion, and bring positive momentum to China's financial industry (Wang et al., 2023).

In China, advanced and innovative technological infrastructures are increasingly used in commercial banks and other financial institutions, as digital technologies such as big data, cloud computing, and artificial intelligence have penetrated people's daily lives. The degree of adoption of these innovations in the financial sector directly impacts the convenience of financial products and services. It largely shapes customer satisfaction with products and services. Fintech innovations such as mobile payments, online banking, and blockchain technology are redefining how customers interact with banks (Boustani, 2020); it also brings new challenges to traditional commercial banks' business models and performance.

Commercial banks, one of the earliest financial institutions established in China, play an indispensable core role in the current financial system. According to Labrecque et al. (2013), it has been found that the variety of financial resources in society, people's consumption levels, and needs change and evolve; this further highlights the fact that multiple factors influence commercial bank performance. It is particularly noteworthy that the rapid rise of digital financial inclusion and fintech has reinforced the impact on commercial bank performance. Overall, China's commercial banks' performance has shown a continuous improvement trend as digital financial inclusion and fintech continue to be deeply applied (Li et al., 2021).

Meanwhile, with the rapid development of digital financial inclusion and fintech, commercial banks have been affected by them and diversified their risk-taking ability approaches. Although commercial banks explore new business models with unknown risks, such as the popularity of digital payment and lending platforms may increase cybersecurity risks (Li et al., 2021). However, the commercial bank risk-taking capacity is also increasing.

Therefore, the main focus of this study is centred on the relationship between digital financial inclusion, fintech, and commercial bank performance. In addition, risk-taking will act as a mediating role in this study. By sorting out how digital financial inclusion and fintech affect commercial bank performance, this study aims to help commercial banks improve their risk-taking capacity with the implementation of digital technology in the digitalized environment to achieve a sustainable improvement in their performance to maintain the stability of financial system in China and to promote the broader implementation of digital financial inclusion and fintech in China.

1.2 Background of the Study

1.2.1 Background of the Commercial Bank Development in China

In eastern Asia, China is a vast, multi-ethnic country with thirty-four (34) provincial-level administrative regions, including twenty-three (23) provinces, five (5) autonomous regions, four (4) municipalities directly under the central government, and two (2) particular administrative regions. Each provincial region has a certain degree of autonomy with its system of government and administration. The composition of China's provinces reflects a diversity of geographic, cultural, and economic characteristics, and these administrative regions play different roles in the country's overall development (Démurger et al., 2002); it forms the basis of China's comprehensive development. As individual provinces' demographic and economic conditions vary considerably, some provinces, such as Guangdong Province and Zhejiang Province, have developed rapidly in economics while others are relatively underdeveloped. The Chinese government is also working to reduce inequality and promote more balanced regional development by promoting technological innovation and financial reform and facilitating the development of digital financial inclusion (Liu et al., 2021).

In China, the financing system is still dominated by indirect financing, and commercial banks occupy a dominant position in China's financial system, being the most important financial institutions in China and an essential part of the national economy (Martin, 2012). Commercial banks in China are mainly divided into large state-owned commercial banks, joint-stock commercial banks, and city commercial banks. Large state-owned commercial banks have expanded from four to six: the Industrial and Commercial Bank of China (ICBC), China Construction Bank (CCB), Agricultural Bank of China (ABC), Bank of China (BOC), Postal Savings Bank of

China (PSC), and Bank of Communications (BCM) (Wu et al., 2007). According to The Banker's Global Banking 1000 list for 2023, the each of the previous four occupy the top four positions (Shi et al., 2023). In addition, many city-commercial banks have carried out shareholding reforms, which have led to more and more city commercial banks going public and transforming their business models to achieve rapid development.

Meanwhile, China's economy and finance have made outstanding achievements in the past decades, becoming the second-largest economy in the world. Against the backdrop of technological innovation, fintech has flourished in China because of its high innovation and large scale. However, the new economic and financial environment also means unknown risks and challenges for China's traditional commercial banks. From the international perspective, China continues to liberalize financial access barriers, and foreign banks have entered the Chinese market, making competition among commercial banks more intense. From the domestic environment, the development of fintech has revolutionized the traditional financial model. Coupled with the implementation of interest rate marketization reform in China, which has narrowed the profit margins of commercial banks, these had a deep influence on the income structure of traditional commercial banks. It also requires commercial banks to proactively explore the market, actively explore transformation, and expand their sources of income.

As a result, Chinese commercial banks are constantly adjusting and transforming to cope with changes in the market and competitive environment. At the same time, commercial banks are gradually focusing on sustainable financial development, actively participating in green finance and socially responsible investment (Dong et al., 2020), and providing more sustainable financial support for economic development. Commercial banks, as the financial organizations with the most complete structure, the most comprehensive coverage, and the most convenient services in China's economy and society, are naturally the main body to undertake financial inclusion development (Luo, 2020). In particular, some small and medium-sized banks have close social relationships in their localities and thus have detailed information about various types of customers and their financing needs (Shen et al., 2009). This market position determines the rationality and necessity for commercial banks to provide financial inclusion services. However, commercial banks are torn between "safety" and "profitability" in the promotion process. Therefore, there is a need to explore how commercial banks can promote financial inclusion and how fintech can play a synergistic role.

In August 2019, the People's Bank of China (PBOC) issued the Financial Technology (Fintech) Development Plan (2019-2021), requires commercial banks to increase the application of information technology in financial business, and promotes the in-depth integration and coordinated development of financial business and technology, which brings both opportunities and challenges to commercial banks (Taylor, 2023). On the one hand, commercial banks can get better transformation and development opportunities with the help of digital technology and realize performance improvement; on the other hand, the competitive environment of commercial banks is more dangerous, and risk management is more challenging than before. Therefore, commercial banks are the main force of traditional finance in China and the new central body of digital financial inclusion and fintech development (Zhu & Guo, 2024).

1.2.2 Digital Financial Inclusion and Commercial Bank performance

Digital financial inclusion refers to the further development of financial inclusion in the context of integrating finance and technology. The opposite of financial inclusion is financial exclusion, which implies that specific individuals or groups cannot access, use, or benefit from financial services and products (Dexu & Wenlong, 2016). This phenomenon is generally considered detrimental to social and economic development, as it exacerbates poverty and inequality. Financial inclusion aims to help financially excluded groups address and eliminate the lack of access to financial activities and services financial institutions provide (Stein et al., 2011). Worldwide, commercial banks have played a vital role as key drivers in driving the development of digital financial inclusion (Nkuna et al., 2018). Shihadeh et al. (2018) believe that commercial banks, in the course of their operations, provide customers with some essential financial services and products, which can have the effect of improving people's living standards, enhancing the operational efficiency of enterprises, and promoting the development of the macro-economy. These effects are consistent with the development goals of digital financial inclusion.

Some researchers have argue that financial inclusion provides better-matched financial products and services for all types of customers and helps improve the financial system's stability (Kuznyetsova et al., 2022). Improving financial inclusion helps to ensure that more people have access to and effectively utilize financial services, thereby contributing to sustainable social and economic development. In this process, financial institutions have been actively exploring new and more technologically oriented financial products and services, as they need to consider cost and performance while promoting financial inclusion. Hassouba (2023) believes that commercial banks are significant in developing financial inclusion. However, it should be noted that in commercial banks in the process of promoting the development of financial inclusion, the problem of input costs is more prominent; it is recommended that commercial banks should use technology to offer more financial products to their customers and broaden their clientele to reduce the cost of services. The emergence of digital finance has contributed significantly to the sustainability of financial inclusion (Mavlutova et al., 2022), make financial services more accessible, efficient, and cost-effective for individuals and micro and small businesses.

Since the beginning of the twenty-first century, there has been a growing worldwide consensus advocating a shift in the financial system away from decentralized microfinance institutions and financial innovation towards the creation of a more financial inclusion system that eliminates financial discrimination and enables disadvantaged groups to have access to a more comprehensive range of financial services. The United Nations introduced the broad concept of "inclusive finance" in 2005, emphasizing providing practical and comprehensive financial services at an affordable cost to all members of society (Ji et al., 2021). Researchers and scholars widely recognize that financial institutions are essential in reducing poverty, achieving financial inclusion, and promoting economic growth (Chibba, 2009; Ratnawati, 2020).

At the end of 2015, the State Council promulgated the Plan for Promoting the Development of Financial Inclusion (2016-2020), which explicitly states that financial inclusion refers to the provision of appropriate and effective financial services at affordable costs to all social strata and groups in need of financial services based on the requirements of equal opportunity and the principle of commercial sustainability. Tay et al. (2022) argue that digital financial inclusion emphasizes expanding formal financial services through technology more than financial inclusion. The 2019 Central

Economic Work Conference of China emphasized "innovation-driven and reform and opening-up as the two power sources to comprehensively improve the overall competitiveness of the economy" and proposed that "the digital economy should be vigorously developed." Against the backdrop of fintech, China's economy has shifted from high speed to high quality, and financial inclusion is shifting to digital financial inclusion.

Since the implementation of the Plan for Promoting the Development of Inclusive Finance (2016-2020), China has made significant progress in expanding the accessibility of financial services, particularly through digital financial inclusion (Hasan et al., 2022). The Chinese government has introduced a new regulatory framework to strengthen risk management and balance innovation with financial stability. In addition, initiatives such as rural revitalization and small business financing have been promoted to ensure that digital financial services extend from urban areas to underserved populations. Today, fintech-driven financial inclusion not only increased accessibility but also improved financial risk control, efficiency and service customization, marking a shift from expansion-oriented policies to a more sustainable and regulated digital financial ecosystem (Fang et al., 2023; Wang et al., 2024).

The limitations of traditional finance have led to insufficient supply and slow progress in the early stages of financial inclusion in China. In the context of fintech innovation, the adoption of digital financial inclusion can increase the breadth and depth of financial services as well as their efficiency and can reduce the cost of supplying financial services (Makina, 2019); this all contributes to a better and more effective response to the demand for financial services. China has recently emerged as one of the world's digital financial and fintech leaders. With the convergence of digital technology and financial services, both traditional financial institutions and emerging internet financial service providers have further expanded their ability to tap into the traditionally unmet and neglected financial needs of consumers, such as micro and small businesses (Chen & Yuan, 2021), digital financial inclusion is also getting better in China.

It is worth noting that when financial inclusion is mentioned, financial institutions are usually associated with it; this is because financial institutions have been widely recognized as essential tools for reducing poverty and achieving inclusive economic growth (Amadou, 2018; Corrado & Corrado, 2017; Erlando et al., 2020). Financial institutions are crucial in universalizing financial services and providing financial products such as savings, credit, and insurance, especially in developing countries, where they are often the dominant financial service providers. The vision of financial inclusion and the role of commercial banks as the main body of financial institutions make it necessary for commercial banks to carry out active attempts and exploration to carry out this mission. In addition, the disruptive changes technology has brought to the world have made it imperative for commercial banks to take advantage of fintech to raise public financial awareness and connect more customers with financial activities (Murinde et al., 2022).

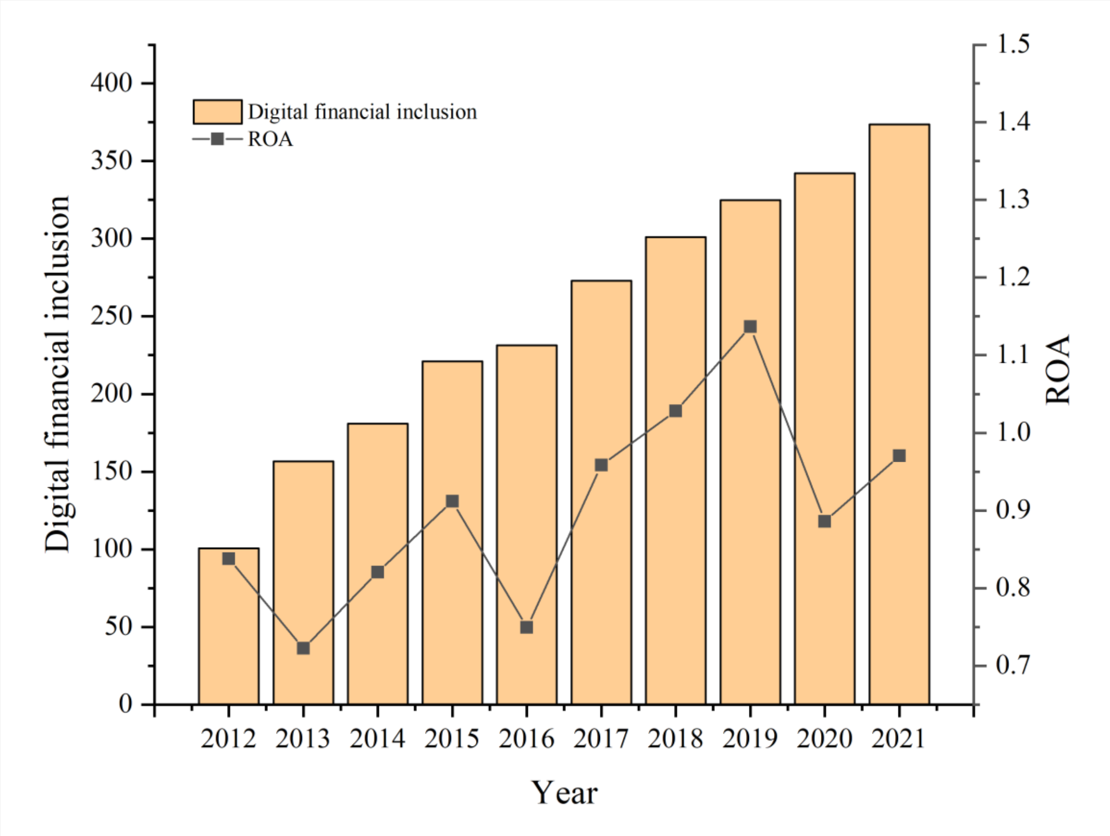

Figure 1.1 Trend of China's digital financial inclusion development
Source: the Peking University Digital Financial Inclusion Index (2022)

The rapid development of digital financial inclusion in China has narrowed the spatial heterogeneity of financial services while expanding their availability and coverage. According to the Figure 1.1, China's digital financial inclusion business has achieved leapfrog development between 2012-2021. It can be found that, in the deep integration of fintech and financial inclusion, the breadth and depth of China's digital financial inclusion has been further developed, successfully improving the availability of financial services for women, the elderly, small and medium-sized enterprises (SMEs), and other underserved "long-tail" groups of consumers, and enabling the gradual extension of financial services to the grassroots level, counties, townships, rural areas, and communities. However, commercial banks' return on assets (ROA) shows volatility, suggesting that while the expansion of digital financial inclusion offers opportunities for the banking sector's performance, other external factors such as economic conditions, regulatory policies, and risk exposures may also affect profitability.

China's rapid development of digital financial inclusion is mainly due to the following reasons: First, China has the world's leading mobile Internet, IT technology, and telecommunication infrastructure (Dong & Li, 2004). Although China's financial infrastructure construction is relatively backward, these technological advantages make up for the shortcomings of traditional financial infrastructure construction and amplify the functional substitution effect of fintech, enhancing the application and efficiency of digital financial inclusion. Second, financial inhibition has instead fuelled robust market demand, indirectly driving the rapid development of digital financial inclusion (Abor et al., 2020). China's large population base lays a solid foundation for developing digital financial inclusion (Song et al., 2021). In turn, the development of digital financial inclusion reduces the cost of financial services, reinforcing each other. Third, the traditional financial regulatory model provides growth space for fintech innovation.

In China, commercial banks, as the leading force in the traditional field, are more willing to grasp the development opportunity of digital financial inclusion and actively carry out transformation and upgrading in order to improve the quality and competitiveness of financial services and fulfil their social responsibility (Pu, 2023). Many commercial banks are actively exploring digital financial inclusion as a critical area of transformational opportunity. China Construction Bank is laying a solid foundation for developing digital financial inclusion by actively exploring information technology development and system construction. Industrial and Commercial Bank of China (ICBC) has established the Big Data and Cloud Computing Innovation

Laboratory to promote the deep integration of technology and business and drive innovation in financial services. Agricultural Bank of China and Pudong Development Bank, on the other hand, provide customers with diversified financial services such as life bill payment and wealth management through the skilful application of digital technology to strengthen customer interaction. These efforts highlight the active exploration and innovation of China's commercial banks in digital financial inclusion, aiming to better meet the trends of the times and the needs of their customers.

Against the backdrop of digital financial inclusion and the rapid development of fintech, the role of commercial banks in the economy and society is becoming increasingly prominent. With the full use of powerful technology, data, and customer advantages, they will also play a more significant role in the future. For commercial banks, contributing to the development of digital financial inclusion can not only improve the situation of China's low-income groups who do not have access to financial services and products but also facilitate their business transformation with the help of technology, broaden the channels of profitability, and thus realize performance improvement. Of course, this will inevitably lead to an increase in risk, posing new challenges to commercial banks' risk management (Li et al., 2022; Wang et al., 2021).

1.2.3 Fintech and Commercial Bank performance

Fintech is often defined as the convergence of "finance + technology." The Financial Stability Board's (FSB) definition of fintech emphasizes its basis in various technological innovations, such as big data, cloud computing, artificial intelligence, and blockchain. Several technologies, including big data, artificial intelligence, cloud computing, blockchain, biometrics, and the Internet of Things, are widely used in the financial sector. Therefore, Anyfantaki (2016) believes that fintech is a financial innovation driven by technology.

At the core of fintech is the application of innovative technologies to the financial sector, aimed at expanding the range of financial products and services, improving their quality, and innovating how they are delivered to satisfy customers' needs and enrich the application of the financial sector (Wu et al., 2023). These new technologies include big data, cloud computing, artificial intelligence, and blockchain. Among them, the application of big data in financial business is mainly reflected in the combination of cloud computing and big data technology, which significantly shortens the length of loan applications; big data is also combined with artificial intelligence algorithms to provide deep insights into customers' spending habits, which in turn builds compelling and detailed customer profiles. The application of artificial intelligence in financial business is reflected in the chatbots to help customer service provide basic customer business consulting, and even based on big data and cloud computing, it can also be tailored according to the customer's individual needs to the investment advice (Ris et al., 2020).

Therefore, one of the main reasons why fintech has been able to rapidly emerge and bring disruptive changes to the financial sector in a short period is that traditional commercial banks and other financial institutions have always relied on high-quality products or services to attract a highly reputable and profitable customer base (Auka, 2012), this reflects the "law of two or eight" in the financial sector. Moreover, the rise and growth of fintech are undoubtedly favourable for the relatively risky long-tail segment. Fintech companies have also used this to find a foothold in less lucrative markets long ignored by traditional financial institutions (Anagnostopoulos, 2018). In this process, fintech companies reduce the cost of financial services and improve product quality through continuous technological innovation, diverting the high-end market of traditional financial institutions, thus challenging the dominant position of existing traditional financial institutions.

Commercial banks, as the backbone of China's financial system, have been significantly impacted by the rapid development of fintech. Fintech leverages technological advancements to provide more efficient and accessible financial products and services, intensifying competition in the financial sector. This competition has driven traditional commercial banks to accelerate their digital transformation, enhance service efficiency, and innovate in financial product offerings. In China, both fintech companies and traditional commercial banks play a crucial role in shaping the evolving financial landscape.

Is fintech threatening the growth of commercial banks? Researchers disagree on this issue. However, overall, commercial banks benefit from fintech in two main ways in China. One is that fintech development helps commercial banks alleviate information asymmetry (Zhang et al., 2022), expanding the service radius to bring new credit segments. The second is based on innovative technology. Fintech can promote innovation within commercial banks, help improve the quality of credit services, and expand the scope of credit business. In addition, commercial banks can also use fintech to analyse customers' characteristics effectively, accurately analyse customers, achieve accurate control of customer demand and risk, and provide customers with more personalized financial services. Arner et al. (2020) argue that fintech is a crucial driver of financial inclusion, which in turn is the basis for sustainable and balanced development, and that for any economy, finance can be transformed through fintech, digital financial inclusion, and sustainable and balanced development, and can transform economic and social development.

1.2.4 Risk-taking and Commercial Bank Performance

With the continuous evolution of the global financial system and the emergence of various challenges, the study of commercial bank performance has become an essential topic in several fields, such as finance, economics, and management (Al-Dmour et al., 2023; Barth et al., 2003; Bonin et al., 2005; Haralayya & Aithal, 2021). Firstly, commercial banks are a core component of the financial system, and their health is related to the stability of the financial system. Secondly, commercial banks play a crucial role in resource allocation, directly affecting the economy's development (Alsafadi & Altahat, 2021). Finally, with the continuous development of technology and the emergence of financial innovations, the operating environment of commercial banks has changed dramatically, and the rise of digital financial inclusion and fintech provides new development opportunities and challenges for commercial banks (Ediagbonya & Tioluwani, 2023; Hu et al., 2022).

Despite the long development process of commercial banks, the traditional core business remains deposit-taking and loan granting. Moreover, like other enterprises, their nature of operating to maximize profitability has remained the same (Hoque et al., 2018; Kipruto, 2013). On the asset side of the business, commercial banks assume credit risk and prefer to lend to large and micro enterprises with well-maintained financial statements and credit records (Gassiah & Kikula, 2022); on the liability side of the business, deposits are the basis for commercial banks' lending and other investment activities and therefore prefer to attract customers with financial strength.

Performance is mainly used to measure an enterprise's operational performance and efficiency over time (Tangen, 2003). Financial performance can be considered the enterprise's strength in producing new resources (Liyanage et al., 2021). Like other enterprises, commercial banks utilize performance evaluation to set operational goals and adjust operational strategies. Therefore, from a performance perspective, commercial banks are indebted, a model that requires them to adopt stricter risk management standards to avoid potential risks and to pay more attention to financial indicators in their performance assessment. According to the literature related to commercial banking, the stability and performance of the banking sector can be affected by any crisis or uncertainty that occurs in the financial markets, the nature of borrowers, and the nature of depositors (Crockett, 1996; Pham et al., 2021), and the interaction between the banking sector and depositors is inherently mutual (Sarmiento & Galán, 2017). This crisis or uncertainty described above is then known as risk-taking behaviour, which indicates the ability of commercial banks to bear risk in times of uncertainty (Banna & Alam, 2021). Many scholars agree that the overall stability of the economy and finance is related to the risk-taking (Abbas & Ali, 2022; Saif-Alyousfi & Saha, 2021).

Risk management plays a vital role for financial institutions in China and the rest of the world. Liyanage et al. (2021) argue that it will be relevant to ensure financial institutions' stable operation and profit growth. Especially in China, fintech has become a significant disruptor in the financial industry, revolutionizing how commercial banks operate and interact with their customers. He et al. (2023) argue that one of the main areas in which fintech has impacted commercial banks is in the area of risk. Madushani and Madurapperuma (2016) argue that commercial banks are mainly faced with three types of risk: credit, market, and operational. Among them, credit risk management is essential in accepting loans from commercial banks (Caouette et al., 1998), which usually occurs when commercial banks provide loan services to lenders. If a lender fails to repay the loan, it will likely negatively impact commercial banks' financial performance. Some researchers have argued that credit risk significantly affects commercial bank performance in China (Isanzu, 2017; Zhongming et al., 2019).

In terms of liquidity risk, when commercial banks pursue high profits, they need to compress idle funds to the minimum, while commercial banks have the lowest level of liquidity and more risk (Saiful & Ayu, 2019). Commercial banks, in the process of technological innovation, will realize a reduction in costs due to the addition of technology. Zouari and Abdelmalek (2020) state that with the help of technology, commercial banks can develop a particular competitive advantage, reducing overall risk, improving liquidity, and improving financial performance.

In China, the development of digital financial inclusion and fintech has led to the innovation and integration of digital technology with traditional financial services, dramatically improving the problems of low information transparency and high service costs in traditional credit businesses. Moreover, with the continuous development of digital technology, Chinese commercial banks are actively undergoing digital transformation and striving to develop new digital financial inclusion services and products to serve the public efficiently. The combination of fintech and financial inclusion has become an inevitable trend in China, and the development of digital financial inclusion services is also a development opportunity that commercial banks should seize. However, the risk issues the new financial business brings must be addressed. Furthermore, risk-taking is seen as a critical factor affecting commercial bank performance, which can directly affect profitability, capital adequacy, and soundness. Effective risk-taking helps commercial banks to operate well in a competitive market and improve their long-term profitability (Li et al., 2022). Unfortunately, in the current relevant research focus on China, fewer studies have examined the impact of digital financial inclusion and fintech on commercial bank performance regarding risk-taking mechanisms.

1.3 Problem Statement

Since 2015, China's macro-economy has entered a "new normal," with economic growth continuing to decelerate and the marketization of interest rates completed, with the comprehensive effects becoming increasingly apparent. For commercial banks, on the one hand, due to the incentive of market competition, the advancement of interest rate marketization and the changes in the financial market, the traditional net interest margin has gradually shrunk, and it is difficult for commercial banks to maintain the original level of profitability (Meng et al., 2020). On the other hand, with the increase in macroeconomic volatility and uncertainty, the repayment ability of some borrowers has been affected, resulting in increasing credit risk and non-performing assets in the banks' credit portfolio (Wei, 2016). Finally, with the liberalization of access to foreign banks, the internationalization of the RMB (Chinese Yuan) and a series of changes have made the survival environment of China's commercial banks become increasingly severe, and the overall performance level shows a downward trend. Luo (2017) argues that with the gradual reduction of deposit interest rates, the ability of commercial banks to rely on traditional credit businesses for profits is weakened, which in turn offsets the dilemma of a single source of income through the development of the intermediary business, and at the same time, it also prompts commercial banks to enrich their business structure and enhance their performance through innovation.

Therefore, the main issue of commercial bank in Chian is that the profitability models of commercial banks are under attack, with traditional businesses struggling to support their performance growth. Meanwhile, developing countries and countries with highly developed economies and finances face severe problems of financial exclusion. Usually, the main reasons for customer exclusion are, firstly, the risk assessment procedures of financial institutions that limit the access of customers to financial resources and the fact that some groups have access to financial products only at a price they cannot afford to pay (Yeung et al., 2017); Secondly, some groups believe it is doubtful that they can apply for financial products or services and, therefore, exclude themselves from the range of formal financial products and services available to them (Osei-Assibey, 2010). "Financial exclusion" is a global phenomenon and can be seen as an instinctive choice for financial institutions based on their safety, liquidity, and profitability. In China, "financial exclusion" refers mainly to the exclusion of long-tail customers from commercial banks' consideration of their financial activities.

The development of financial inclusion is a critical way to address financial exclusion, Some researchers have argued that financial inclusion improves economic welfare and has many benefits for commercial banks, including increased efficiency, reduced costs, increased savings, and enhanced lending and investment potential (Demirgüç-Kunt & Singer, 2017; Mbutor & Uba, 2013). Therefore, commercial banks in dire need of transformation are encouraged to actively engage in financial inclusion to expand the coverage of financial services while reversing the trend of declining profitability.

With the development of China's financial sector in recent years, the performance enhancement of commercial banks is not satisfactory; this is because the profit model of China's commercial banks does not match the goal of financial inclusion services (Koroleva et al., 2021). The operating principles of commercial banks, namely "safety," "profitability," and "liquidity," dictate that they are more willing to choose high-quality customers with good creditworthiness and low risk. But the beneficiary groups of financial inclusion are precisely the opposite. It is difficult for commercial banks, as the leading force in promoting financial inclusion, to improve their performance in this process. Without objective financial returns, commercial banks have no incentive to provide more services related to financial inclusion (Shah & Dubhashi, 2015); Cost reduction and risk control are the main obstacles for commercial banks to improve their performance through financial inclusion.

In the meantime, fintech has become a new opportunity to promote financial inclusion development through PBOC's plan in August 2019 (Cao & Nguyen, 2022); this puts commercial banks, which were already positioned to promote financial inclusion as an important financial institution, in the same part of applying fintech. Lee et al. (2021) argue that the development of fintech plays a crucial role in shaping banking activities, which can promote financial innovation and lead to improved bank performance while promoting financial inclusion through digital technology.

However, how digital financial inclusion affects commercial bank performance remains unclear. In fact, it is only in recent years that China has begun to propose and implement digital technology for financial inclusion and vigorously develop fintech. From the perspective of commercial banks, both the business model and the level of business are still in the formative period, which brings the direction of transformation to commercial banks and, at the same time, makes the level of risk-taking of commercial banks face new challenges. In particular, the security of user information and the increase in credit risk, coupled with the fact that China's credit and regulatory system has not yet been developed and the infrastructure is still weak, make it possible to increase the risk of commercial banks. Qiu et al. (2018) argue that digital financial inclusion increases the operational risk of traditional commercial banks and indirectly reduces their profitability.

Chen and Yuan (2021) argue that while digital technology offers many opportunities to achieve the long-term sustainability of financial inclusion, risks to the current digital financial inclusion model remain. Both personal and microenterprise loans are characterized by small amounts, dispersion, and short maturities; this "long-tail market" characterizes the natural riskiness of inclusive lending. Financial inclusion's "universal" nature dictates that commercial banks must be appropriately credit-subsidized to reach their target customers. The vast market demand may create more profound information asymmetry, making it more difficult for banks to identify risks, and operational risks are doubly magnified. The use of a large number of digital technologies may also increase credit risk by expanding the reach of the customer base and even increasing the risk that customers' private information will be compromised (Chen & Yuan, 2021); inevitably, they expose themselves to the risks specific to the digital financial inclusion.

Therefore, commercial banks need to adopt practical risk management tools with the help of fintech to enhance the accuracy of digital financial inclusion services. Risk is at the core of financial institutions, and commercial banks need to focus more on risk management to protect performance, the public interest, and the financial system's stability (Zhang et al., 2021).

The mechanism of the role of fintech in the transformation of commercial banks is also not yet clear. Arner et al. (2020) believe that fintech is a crucial driver for the development of financial inclusion, which is the foundation of sustainable development, and that the full potential of fintech to support the SDGs can be realized through the progressive development of the underlying infrastructure that supports digital financial transformation. Commercial banks are considered to play a leading role in the SDGs because of their ability to channel corporate, social, and environmental factors (Cosma et al., 2020). Onyango Ogola (2012) believes it is the social responsibility of banking financial institutions to provide financial inclusion services and equal access to financial services for all financial groups in need. There is a significant positive correlation between CSR and financial performance in the financial sector (Simpson & Kohers, 2002). Commercial banks must to develop financial inclusion services while also harmonizing social responsibility with commercial sustainability, focusing on the relationship between scale, cost, and risk. Realizing revenue-producing and sustainable development is an essential challenge that Chinese commercial banks face in developing digital financial inclusion and fintech.

Therefore, this study examines the relationship between digital financial inclusion, fintech and commercial bank performance. In the process, based on the gradual penetration of digital technology, the performance level of commercial banks is likely to be affected by the level of risk-taking (Fang et al., 2019). Rastogi et al. (2021) also argue that the sustainability of bank performance depends mainly on risk-taking; this is consistent with the hypothesis that risk-taking may be the transmission mediator of digital financial inclusion and fintech's impact on commercial bank performance. This study aims to understand the mediating effect of commercial bank risk-taking on the impact of digital financial inclusion and fintech on commercial bank performance.

There may be spatial spillovers from fintech and digital financial inclusion, and the regional impact on commercial bank performance is not yet clear. Because along with the deepening integration of digital technology and financial inclusion, the accessibility and affordability of financial inclusion in China has also increased, generally expanding the coverage of financial inclusion. Digital financial inclusion is emerging as an essential direction for financial inclusion, interconnected based on geographic connection. Su et al. (2021) argue that the development of digital financial technology has spatial characteristics, and there are also significant positive spatial spillovers in the development of digital financial inclusion among Chinese cities. Guo et al. (2020) believe that this effect shows an increasing trend from year to year. Wang and Guan (2017) also believe that the development of financial inclusion has significant spatial spillover effects, especially after the integration of digital technology.

The spillover nature of the technology also determines that spillovers and trends inevitably characterize fintech. Yang and Wang (2022) believe that from the perspective of new economic geography, the efficiency advantage of financial services demonstrated by digital finance as well as fintech is likely to absorb the economic resources of neighbouring regions, which in turn may attract the inflow of R&D factors from other regions, thus forming the advantage of industrial agglomeration. Therefore, when the level of financial inclusion and the level of fintech in the region is higher, the greater the reach of the bank's business will be, and it will have an uplifting effect on the bank's performance (Chen et al., 2024). Therefore, whether this effect on the bank's performance is equally spillover effect is also the angle of interest of this study.

In addition, the policy environment may also affect the spatial spillover effects of digital financial inclusion and fintech (Pei et al., 2024). For example, has the Chinese government introduce a series of policies to promote the development of the digital economy and fintech in recent years accelerated regional spillovers of financial services?

Has fintech in developed regions had a radiation effect on less developed regions? These questions still lack systematic empirical studies. Therefore, based on a spatial econometric model, this study will analyze in depth the spatial spillover effects of digital financial inclusion and fintech on commercial bank performance, and provide a theoretical basis for the policy formulation of fintech to promote the sustainable development of digital financial inclusion.

1.4 Research Objectives

In the context of fintech, the development of digital financial inclusion in China has had a more far-reaching impact on commercial bank performance, and there is a closer link between commercial bank risk-taking and their business performance. Therefore, provincial data from 30 provinces in China from 2012 to 2021 were used to empirically analyse the impact of fintech and digital financial inclusion on commercial bank performance by setting up a panel model, a mediating effect model, and a spatial effect model. In summary, this study proposes the following research objectives:

1. To analyse the effect of digital financial inclusion (digital financial inclusion index, breadth of coverage, depth of use, and digitization level) on commercial bank performance.

2. To evaluate the effect of fintech on commercial bank performance.

3. To examine the mediating effect of risk-taking between digital financial inclusion and commercial bank performance.

4. To investigate the mediating effect of risk-taking between fintech and commercial bank performance.