



Faculty of Economics and Business

**The Impact of Financial Technology on the Profitability of Chinese
Commercial Banks**

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**Doctor of Philosophy
2025**

The Impact of Financial Technology on the Profitability of Chinese
Commercial Banks

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A thesis submitted

In fulfillment of the requirements for the degree of Doctor of Philosophy
(Finance)

Faculty of Economics and Business
UNIVERSITI MALAYSIA SARAWAK
2025

DECLARATION

I declare that the work in this thesis was carried out in accordance with the regulations of Universiti Malaysia Sarawak. Except where due acknowledgements have been made, the work is that of the author alone. The thesis has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

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Date: 03/09/2025

ACKNOWLEDGEMENT

In the process of completing this thesis, I would like to express my heartfelt gratitude to all those who have helped and supported me. First and foremost, I want to extend my sincerest thanks to my main supervisor Professor Dr. Puah Chin Hong for providing invaluable advice and guidance throughout the entire research process, enabling me to carry out my study smoothly and achieve certain results. Furthermore, your encouragement has motivated me to persevere and never give up. Additionally, I would also like to express my sincere appreciation to my co-supervisor Professor Dr. Dayang Affizzah binti Awang Marikan for her patient guidance and assistance.

Moreover, my deepest gratitude goes to my parents Yuan Changjie and Ma Hongli. Over the past thirty-six years, your selfless dedication has been a cornerstone of my life. You have consistently respected my choice to pursue an academic career and provided unwavering support with the most sincere love. I am also deeply grateful to my spouse Ma Jun. While I was immersed in my studies, you quietly shouldered the heavy responsibilities of our family. During my lowest moments, you offered boundless tolerance and trust. Thank you, my daughter Ma Zirui. Your unconditional trust and encouragement have been a source of strength. You are my warmest haven and the driving force that propels me to keep moving forward relentlessly.

Thanks to my dear friend Liu Ying who has been with me throughout this PhD journey. You are the essential light guiding me forward. During times of distress and confusion, I am deeply grateful for your unwavering support and steadfast presence.

ABSTRACT

In recent years, the inexorable trend of deep integration between finance and technology has been propelled by the emergence of cutting-edge technologies such as big data and artificial intelligence, alongside the rapid advancement of internet finance. The ascendancy of FinTech has disrupted the established position and advantages traditionally held by commercial banks within the industry. Recognizing that their conventional business models are no longer viable in today's fiercely competitive environment, banks have come to realize the urgent need for digital transformation. Against this backdrop, they have astutely seized opportunities presented by FinTech and made substantial investments in developing FinTech technologies to transcend traditional business paradigms and achieve transformative upgrades. However, profitability stands as a pivotal determinant for survival and growth of commercial banks, hence it is imperative to explore how FinTech applications impact their profitability. In light of the current state of FinTech development in China and the profitability situation of commercial banks, this study adopts theoretical framework based on the long tail theory, financial innovation, technological spillover, and financial disintermediation. It selects data from 50 listed commercial banks between 2012 and 2023 as samples and constructs a panel data model. Based on the Digital Inclusive Finance Index developed by Peking University and using the distribution of bank branches in each province as weights, a FinTech index is constructed as the core independent variable. Factor analysis is employed to synthesize a comprehensive profitability indicator from three dimensions: security, liquidity and profitability, serving as the dependent variable. Control variables are selected at both the macroeconomic and bank-specific levels, and a fixed effects model is utilized to empirically examine the non-linear impact of FinTech on the profitability of banks. Additionally, an income diversification moderating variable is introduced to explore its

mediating role in the relationship between FinTech and bank profitability. The impact of FinTech on the profitability of commercial banks is primarily examined through the channels of competition and risk. Based on the theoretical and empirical findings, it is demonstrated that there exists a U-shaped non-linear relationship between FinTech development and bank profitability, with a threshold value of 2.86. The negative effects observed in the early stages of FinTech development are primarily attributed to heightened competition and risks. Commercial banks can mitigate these adverse effects during this developmental phase by enhancing the diversification of their revenue structures. As the adoption of FinTech progresses, its impact on bank profitability shifts from negative to positive. In addition, the grouping regression analysis indicates that regional banks are more significantly influenced by FinTech compared national banks. Furthermore, in contrast to the pre-pandemic period, the impact of FinTech on the profitability of commercial banks has become increasingly pronounced since the outbreak of the pandemic. Based on these analytical findings, this thesis proposes the following countermeasures: The government should implement supportive policies for FinTech, increase investment in FinTech infrastructure construction, and refine the regulatory framework for FinTech innovation. Moreover, commercial banks must integrate FinTech into their long-term strategic planning and prioritize boosting their innovation capabilities. They should also adjust their revenue structures to effectively mitigate the challenges posed by FinTech. Additionally, commercial banks should deepen collaboration with FinTech firms, enhance risk management and early warning systems, and pursue a differentiated development strategy. Finally, they should expedite the development of digital infrastructure to ensure robust support for FinTech applications.

Keywords: FinTech, Chinese commercial banks, bank profitability, competition, risk, income diversification

Kesan Teknologi Kewangan Terhadap Keuntungan Bank Komersial China

ABSTRAK

Dalam beberapa tahun kebelakangan ini, trend integrasi mendalam yang tidak dapat dielakkan antara kewangan dan teknologi telah didorong oleh kemunculan teknologi-teknologi terkini seperti data raya (big data) dan kecerdasan buatan, seiring dengan kemajuan pesat dalam kewangan internet. Kebangkitan teknologi kewangan (TekFin) telah mengancam kedudukan dan kelebihan yang selama ini dipegang oleh bank-bank komersial dalam industri. Mereka menyedari bahawa model perniagaan tradisional mereka tidak lagi relevan dalam persekitaran yang sangat kompetitif pada masa kini, bank-bank komersial semakin menyedari keperluan mendesak untuk melakukan transformasi digital. Dalam konteks ini, mereka telah cerdik dalam merebut peluang yang ditawarkan oleh TekFin dan membuat pelaburan besar dalam pembangunan teknologi TekFin untuk melampaui paradigma perniagaan tradisional dan mencapai peningkatan yang bersifat transformasi. Namun begitu, keuntungan tetap sebagai penentu utama bagi kelangsungan dan pertumbuhan bank-bank komersial. Oleh itu, kajian tentang kesan aplikasi TekFin terhadap keuntungan mereka adalah penting. Memandangkan keadaan semasa pembangunan TekFin dan situasi keuntungan bank-bank komersial di China, kajian ini menggunakan kerangka teori yang berasaskan teori ekor panjang (long tail theory), inovasi kewangan, limpahan teknologi (technological spillover), dan pengantaraan kewangan (financial disintermediation). Kajian ini memilih data daripada 50 bank komersial tersenarai antara tahun 2012 hingga 2023 sebagai sampel dan membina model data panel. Berdasarkan Indeks Kewangan Inklusif Digital yang dibangunkan oleh Universiti Peking dan menggunakan taburan cawangan bank komersial di setiap wilayah sebagai pemberat, satu indeks TekFin dibina sebagai pemboleh ubah bebas teras. Analisis faktor digunakan untuk

mensintesis satu penunjuk keuntungan yang komprehensif daripada tiga dimensi: keselamatan, kecairan, dan keuntungan, yang berfungsi sebagai pemboleh ubah bersandar. Pemboleh ubah kawalan dipilih pada kedua-dua peringkat makroekonomi dan khusus kepada bank, dan model kesan tetap (fixed effects model) digunakan untuk mengkaji secara empirikal kesan tidak linear TekFin terhadap keuntungan bank-bank komersial. Selain itu, satu pemboleh ubah pengantara kepelbagaian pendapatan diperkenalkan untuk meneroka peranannya sebagai pengantara dalam hubungan antara TekFin dan keuntungan bank. Kesan TekFin terhadap keuntungan bank-bank komersial terutamanya dikaji melalui saluran persaingan dan risiko. Berdasarkan penemuan teori dan empirikal, kajian ini mendapati bahawa terdapat hubungan tidak linear berbentuk U antara pembangunan TekFin dan keuntungan bank komersial, dengan nilai ambang 2.86. Kesan negatif yang dilihat pada peringkat awal pembangunan TekFin terutamanya disebabkan oleh peningkatan persaingan dan risiko. Bank-bank komersial boleh mengurangkan kesan buruk ini semasa fasa pembangunan tersebut dengan meningkatkan kepelbagaian struktur pendapatan mereka. Apabila penggunaan TekFin semakin berkembang, kesannya terhadap keuntungan bank berubah daripada negatif kepada positif. Selain itu, analisis regresi secara berkumpulan menunjukkan bahawa bank-bank serantau lebih dipengaruhi oleh TekFin berbanding bank-bank nasional. Tambahan pula, berbeza dengan tempoh sebelum pandemik, kesan TekFin terhadap keuntungan bank-bank komersial menjadi semakin ketara sejak tercetusnya pandemik. Berdasarkan penemuan analisis ini, tesis ini mencadangkan langkah-langkah berikut: Kerajaan perlu melaksanakan dasar yang menyokong TekFin, meningkatkan pelaburan dalam pembinaan infrastruktur TekFin, dan memperbaiki rangka kerja pengawalseliaan bagi inovasi TekFin. Selain itu, bank-bank komersial mesti mengintegrasikan TekFin ke dalam perancangan strategik jangka panjang mereka dan

memberi keutamaan kepada peningkatan kemampuan inovasi. Mereka juga harus melaraskan struktur pendapatan mereka bagi mengatasi cabaran yang dibawa oleh TekFin dengan berkesan. Di samping itu, bank-bank komersial perlu memperdalamkan kerjasama dengan syarikat TekFin, meningkatkan pengurusan risiko dan sistem amaran awal, serta mengamalkan strategi pembangunan berbeza. Akhir sekali, mereka harus mempercepat pembangunan infrastruktur digital untuk memastikan sokongan yang kukuh bagi aplikasi TekFin.

Kata kunci: *TekFin, bank komersial Cina, keuntungan bank, persaingan, risiko, Kepelbagaian Pendapatan*

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LIST OF ABBREVIATIONS

FinTech	Financial Technology
ROA	Return on Assets
ROE	Return on Equity
NIM	Net Interest Margin
ROAA	Return on Average Assets
ROAE	Return on Average Equity
PBT	Profit before Taxation
NIR	Net Interest Revenue
GDP	Gross Domestic Product
GMM	Generalized Method of Moments
P2P	Peer to Peer
FTPs	FinTech Products
PU	Perceived Usefulness
PD	Difficulty Use
ATM	Automatic Teller Machine
BOPO	Operating Expenses to Operating Income
CPI	Consumer Price Index
LTA	Loan-to-asset Ratio
POLS	Pooled Ordinary Least Squares
FEM	Fixed Effects Model
REM	Random Effects Model
GGDP	Growth Rate of Gross Domestic Product
CIR	Cost-to-income Ratio

ROI	Return on Investment
NIIR	Non-interest Income Ratio
LTDR	Loan-to-deposit Ratio
NPLR	Non-performing Loan Ratio
PCR	Provision Coverage Ratio
HHI	Herfindahl-Hirschman Index
DIV	Income Diversification
GCPI	Year-on-year Growth rate of CPI
CR4	Concentration Ratio of China's Top 4 Banks
ALR	Asset-liability Ratio
COV	COVID-19 Pandemic
PRO	Comprehensive Profitability
LSIZE	The Logarithm of Total Assets
VIF	Variance Inflation Factor
lnNP	The logarithm of Net Profit
BPLM	Breusch-Pagan Lagrangian Multiplier
PBOC	People's Bank of China

CHAPTER 1

INTRODUCTION

1.1 Introduction

In recent years, the global economy has faced increasing risks and uncertainties, and the Chinese economy has shifted from high-speed growth to high-quality development (Xin, 2020). At the same time, the external environment facing China's banking industry is undergoing profound changes (Lee et al., 2021). From the macro level, under the background of steadfastly preventing and defusing financial risks, commercial banks need to adopt more effective measures to meet the strict requirements of financial regulation on the sustainability and safety of bank profits (Bozic and Bozic, 2025).

From the medium level, influenced by factors such as interest rate liberalization and financial disintermediation, the traditional profit model of banks faces challenges in transformation (Qi et al., 2021). Interest rate liberalization continuously diverts bank deposits and diversified financing channels affect the scale of bank loans (Wang, 2024). It is increasingly difficult to drive the profit growth of banks only by relying on the traditional "deposit, loan and exchange" business.

From the micro level, with the rapid development of information technology, Internet finance companies have redefined the efficiency of financial services (Bisht et al., 2022). Customers expect convenient, efficient and personalized financial services. However, there is still a large gap between the service level of commercial banks and the increasing needs of customers. At present, the profitability of commercial banks has declined, but the

operating risk is rising, so it is urgent to explore a new path to maintain the sustainable growth of profits (Chen et al., 2022).

With the arrival of the global FinTech wave, major breakthroughs and innovative applications of science and technology are reshaping the global economy, constantly driving profound changes in the organizational structure, service capability and customer experience of the financial industry (Kayed et al., 2025), and having a significant impact on the financial market (Elsaid, 2023; Bao et al., 2024). The rise of FinTech may provide opportunities for the operation transformation of commercial banks (Chen and Shen, 2024).

1.2 Background of the Study

1.2.1 The Development of FinTech in China

In the wave of science and technology, along with the promotion of financial digitalization, Internet finance cannot meet the increasingly diversified service and regulatory requirements of the financial industry. Therefore, the further deep integration of technology and finance gives birth to FinTech. FinTech is a new form of financial industry that has developed rapidly in recent years (Jalal et al., 2023).

Since the FinTech Committee was formally established by the People's Bank of China in 2017, various departments and regions have intensively released policies to promote the development of the FinTech industry, and the top-level plan for FinTech has been continuously launched. In August 2019, the Central Bank's "Financial Technology (FinTech) Development Plan (2019-2021)" clearly promotes the innovative and integrated development of FinTech products and services, plays a good active role in policy banks, guides commercial banks to continuously innovate and optimize traditional financial products and services, increases support for innovative credit funds for enterprises. The 14th

Five-Year Plan for 2020 stresses the need to steadily develop FinTech, accelerate the digital transformation of financial institutions, strengthen the application of regulatory technology and financial innovation risk assessment, and explore the establishment of a mechanism for correcting and suspending innovative products. In March 2022, the Central Bank's "Financial Technology (FinTech) Development Plan (2022-2025)" proposed that China's financial information technology gradually reach the international advanced level, and the reform and innovation of the financial industry deepen comprehensively. The financial information industry is expected to achieve innovation-driven development, establish a sound financial network security protection system and promote the application of financial high technology.

In the global environment of a new round of technological revolution and industrial change, the FinTech industry has achieved rapid development, mobile Internet, big data, artificial intelligence and other information technology and financial business effectively integrated, financial institutions need to adhere to innovation-driven development, deepen the structural reform of the supply side, increase the strength of the service of the real economy, relying on big data industry technology to accurately prevent and resolve all kinds of financial risks (Anifa et al., 2022). The introduction of these policies accelerated the pace of commercial banks' reform, and also provided a new environment and policy support for commercial banks to develop FinTech.

In recent years, China's FinTech has developed rapidly, and the size of the FinTech market is constantly expanding and showing a trend of continuous growth (Hua and Huang, 2021; Wang et al., 2021). This indicates a gradual increase in domestic demand for FinTech, with an emerging recognition of its significance among individuals. The data presented in

Figure 1.1 shows that the size of the FinTech market reached 618.3 billion yuan in 2023. This is mainly due to the steady growth of financial institutions' investment in technology, the rapid development of FinTech enterprises and the further improvement of FinTech regulation.

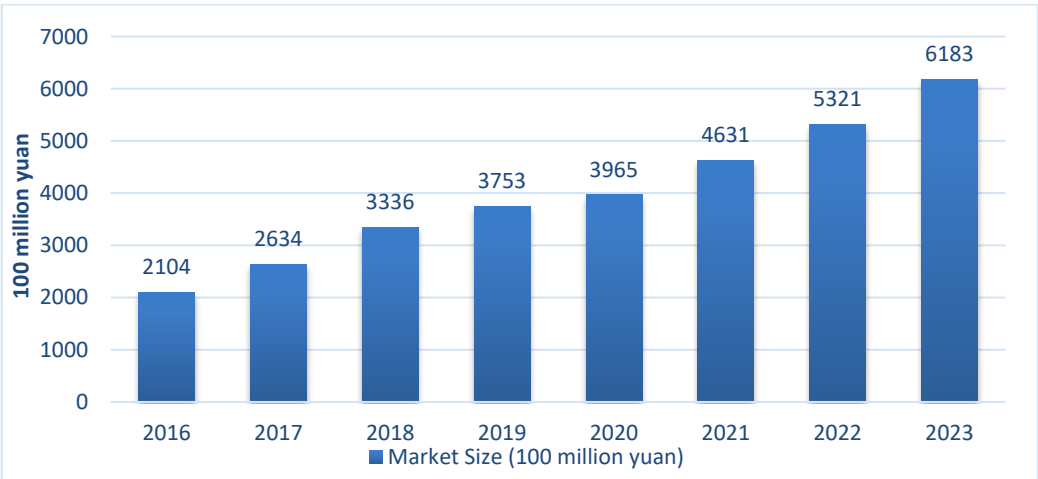


Figure 1.1: Size of China's FinTech Market, 2016-2023

Source: China FinTech and Digital Financial Inclusion Development Report (2016-2023).

As shown in Figure 1.2, from the perspective of the investment amount and financing amount of FinTech, due to the rapid development of Internet finance, the heat of FinTech increased and reached the highest in 2018 (Wei and Yang, 2024). After the large-scale investment and financing in 2018, the popularity of FinTech in China decreased after 2019. The regulatory authorities have strengthened their oversight of the industry, leading to an escalation in market entry barriers for new companies and products, consequently resulting in a decline in overall industry growth. Affected by the COVID-19 epidemic in 2020, the amount of FinTech investment and financing reached the lowest value. After the outbreak of the epidemic, the amount and quantity of financing in 2021 picked up to a certain extent, and the activity of investment and financing gradually increased. In 2022, China's FinTech

market scale, investment and financing scale continues to expand. The People's Bank of China, China Banking and Insurance Regulatory Commission and other departments put forward more stringent requirements on the development of FinTech segments, which also encourages commercial banks and other traditional financial institutions to accelerate the pace of reform, actively respond to the development of FinTech and promote their own digital transformation with FinTech. In 2023, China's investment and financing activities demonstrated sustained high levels of engagement. During the first three quarters, total investments in China's FinTech sector amounted to 118.13 billion yuan, with a total of 907 financing transactions recorded. Both the aggregate investment value and the number of financing deals showed significant increases compared to prior periods. The comprehensive advancement of Digital China, coupled with more prudent and thorough FinTech regulation, has underpinned the ongoing growth and expansion of China's FinTech sector (Chorzempa and Huang, 2022).

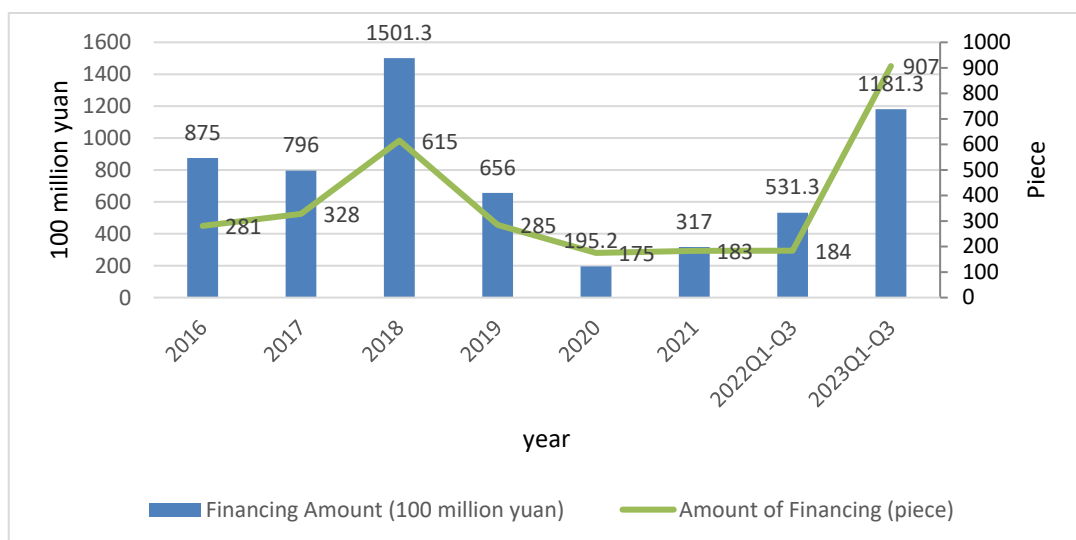


Figure 1.2: The Amount and Quantity of Investment and Financing in China's FinTech Market, 2016-2023Q3

Source: China FinTech and Digital Financial Inclusion Development Report (2016-2023Q3).

1.2.2 The Profit Status of Chinese Commercial Banks

As an important pillar of the modern national economy, commercial banks are profitable financial institutions that provide financial services to businesses and individuals (Sadillovevna, 2024). Chinese commercial banks have long relied on the margin between deposits and loans for their profits, due to regulated interest rates (Zhang et al., 2023). Since the process of interest rate liberalization was officially started in 1996, banks are engaged in a price war with other banks in order to obtain deposit funds, which causes the cost of obtaining funds to rise, and the difference between interest rates on deposits and loans to narrow year by year (Wu et al., 2023). Although the commercial banks' profits are on the rise, its profit margin is experiencing a decline.

The net profit of commercial banks exhibits a gradual upward trend over the years, albeit with a relatively modest growth rate, as depicted in Figure 1.3. However, in 2020, there was a marginal decline attributed to the impact of the pandemic. The profits of commercial banks are derived from interest income generated by the spread between deposit and loan interest rates, as well as non-interest income such as commission fees and investment returns. The sustained growth of the Chinese economy has created a favorable external operating environment for commercial banks, leading to increased demand for loans from both businesses and individuals (Shi et al., 2021). Despite a decreasing interest rate spread on deposits and loans, it remains the primary source of profit for Chinese commercial banks (Rathnayake, et al., 2022). Furthermore, with the continuous development of China's financial market and innovation in financial products, banks are also diversifying their revenue streams through non-traditional services including commission fees, consulting service charges, and wealth management (Pasha and Lewaaelhamd, 2024). Consequently,

although the net profit growth rate of commercial banks is moderate, it exhibits an upward trend year after year.

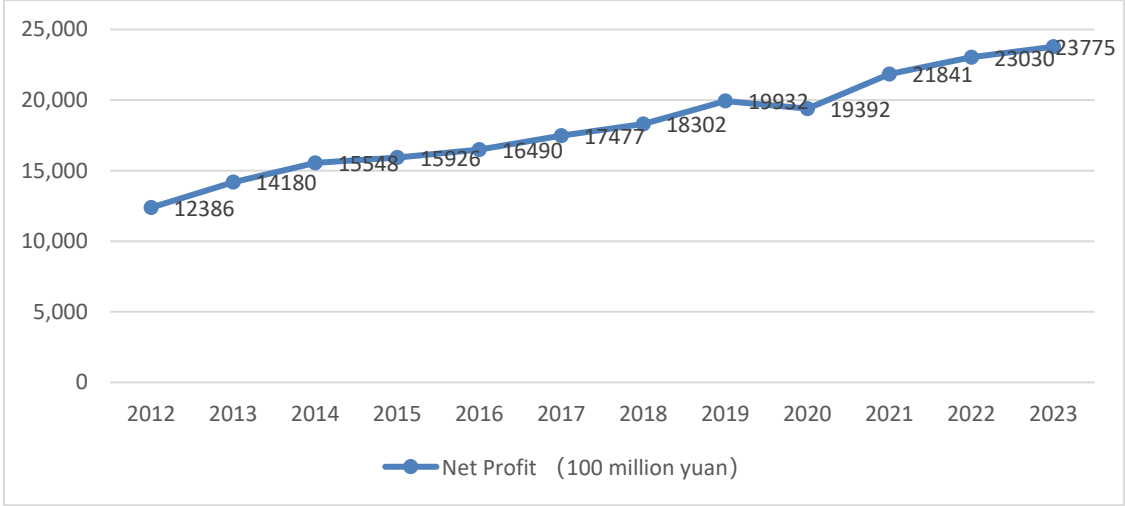


Figure 1.3: Net Profits of China’s Commercial Banks, 2012-2023

Source: China Banking and Insurance Regulatory Commission (2012-2023).

As shown in the Figure 1.4, the net interest margin of commercial banks has been declining year by year in the past decade, from 2.75% in 2012 to 1.73% in 2023. In the process of interest rate marketization reform in China, significant progress has been achieved in gradually relaxing control over interbank interest rates and aligning bank loan rates with market rates (Muganyi et al., 2022). This transformation has resulted in a compression of banks’ net interest margin income. Moreover, as financial marketization continues to advance, it fosters intensified competition among banks (Knafo, 2022). To gain a larger market share, many banks opt to reduce their loan rates. However, due to challenges in reducing funding costs, this leads to an ongoing narrowing of net interest margins (Guo et al., 2022). The data suggests that the era in which Chinese commercial banks relied solely on the interest rate spread of deposits and loans to generate substantial profits has come to

an end. Consequently, they must explore novel business models and sources of profit growth while simultaneously enhancing their ability to effectively serve the real economy.

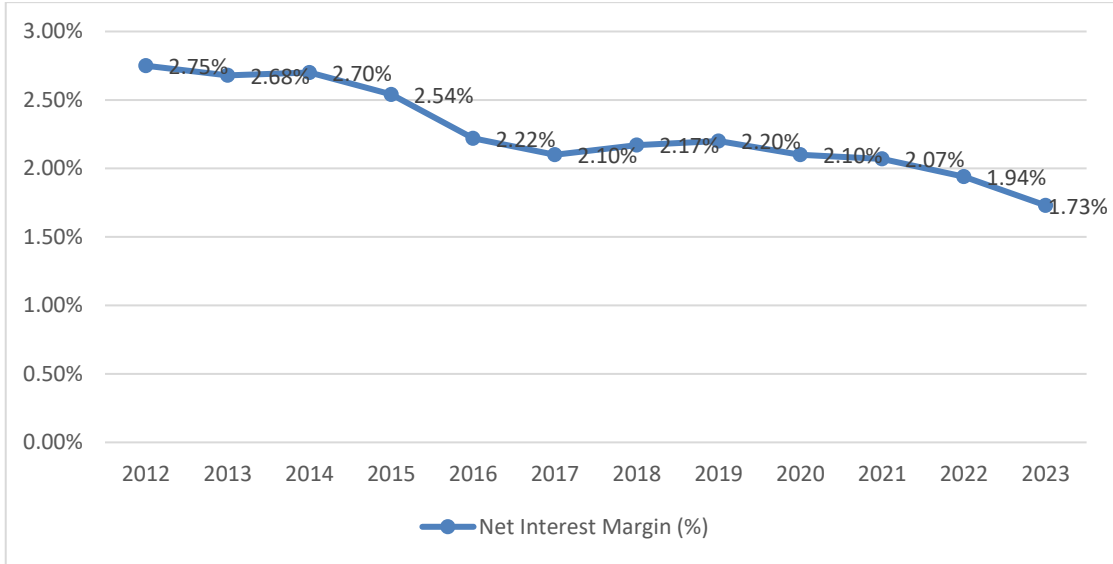


Figure 1.4: Net Interest Margin of China’s Commercial Banks, 2012-2023

Source: China Banking and Insurance Regulatory Commission (2012-2023).

According to the classification of commercial banks depicted in Figure 1.5, it is evident that state-owned large commercial banks, joint-stock commercial banks and city commercial banks exhibit similar trends. Their net interest margins display slight fluctuations but demonstrate an overall downward trajectory. However, rural commercial banks possess a higher net interest margin compared to these three types of banks. This can be attributed primarily to their focus on serving economically vulnerable sectors such as rural areas and small and micro enterprises, which entails relatively higher risks (Wang et al., 2022). Consequently, there may exist certain risk pricing concerns regarding loan interest rates. Furthermore, rural commercial banks prioritize traditional credit business over alternative revenue sources and operate within a relatively homogeneous competitive landscape. Hence, their net interest margin remains comparatively high with greater

volatility. With the progression of interest rate marketization and financial liberalization in China’s banking industry, the income structure of commercial banks has become more diversified (Zuo and Ma, 2019; Jian, 2024).

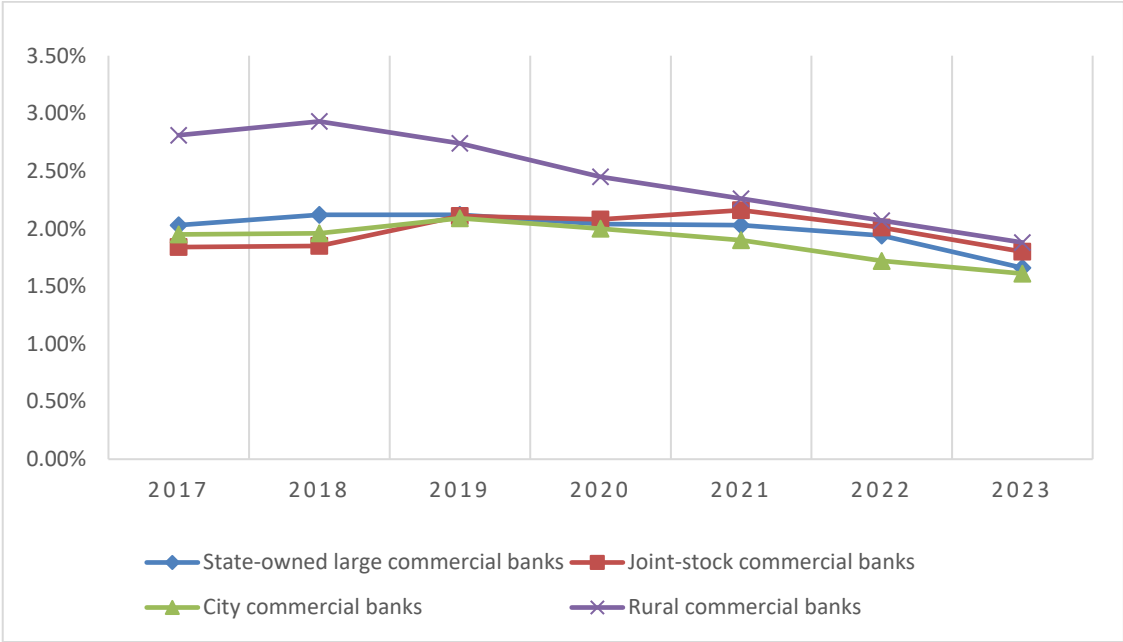


Figure 1.5: Net Interest Margin of China’s Different Types of Banks, 2017-2023

Source: China Banking and Insurance Regulatory Commission (2017-2023).

According to Figure 1.6, the proportion of non-interest income in Chinese commercial banks increased from 20.12% to 25.22% between 2012 and 2016. However, it has exhibited a declining trend since 2017. This change can be primarily attributed to intensified market competition and regulatory policy adjustments. The continuous opening of financial markets and the development of internet finance have posed new competitive pressures on traditional banks regarding non-interest income (Yang and Masron, 2024). Additionally, regulatory policies that restrict businesses such as wealth management and trusts have also exerted pressure on the growth of non-interest income (Tavakoli, 2023). In recent years, factors such as COVID-19 pandemic, global economic instability, domestic

economic downturn and intensified market competition have contributed to a decline in non-interest income (Bernardelli et al., 2021). After pandemic, the proportion of non-interest income has started to show a recovery trend recently. As an integral component of commercial bank profit structure, non-interest income not only enriches the bank's business portfolio but also mitigates profit risks. However, compared with Western countries where it exceeds 50%, the proportion of non-interest income in Chinese commercial banks remains relatively low-level (Liu, 2023). Therefore, future attention should be directed towards exploring the potential growth of this business.

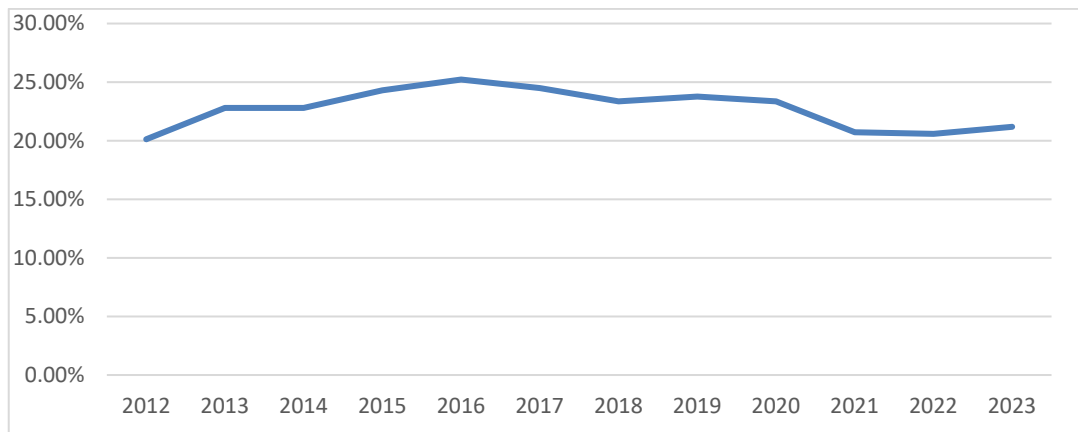


Figure 1.6: Proportion of Non-interest Income of China's Banks, 2012-2023

Source: China Banking and Insurance Regulatory Commission (2012-2023).

In addition, return on equity and return on asset are also important indicators to measure the profitability of commercial banks. Return on equity is the ratio relationship between net profit and average capital of commercial banks, and return on asset is the ratio relationship between net profit and average total assets of commercial banks. Figure 1.7 and Figure 1.8 reflect the changes of return on equity and return on asset of Chinese commercial banks during 2012-2023. The data show that in these years, the return on equity of commercial banks decreased from 21.51% in 2012 to 9.59% in 2023, and the return on asset

decreased from 1.38% in 2012 to 0.75% in 2023. The two profit indicators both declined significantly. This is mainly attributed to a variety of factors, such as the complicated economic situation at home and abroad, the sluggish macroeconomic environment, the tightening of external regulation, the Chinese interest rate liberalization reform and the development of Internet finance and digital economy (Shen et al., 2023).

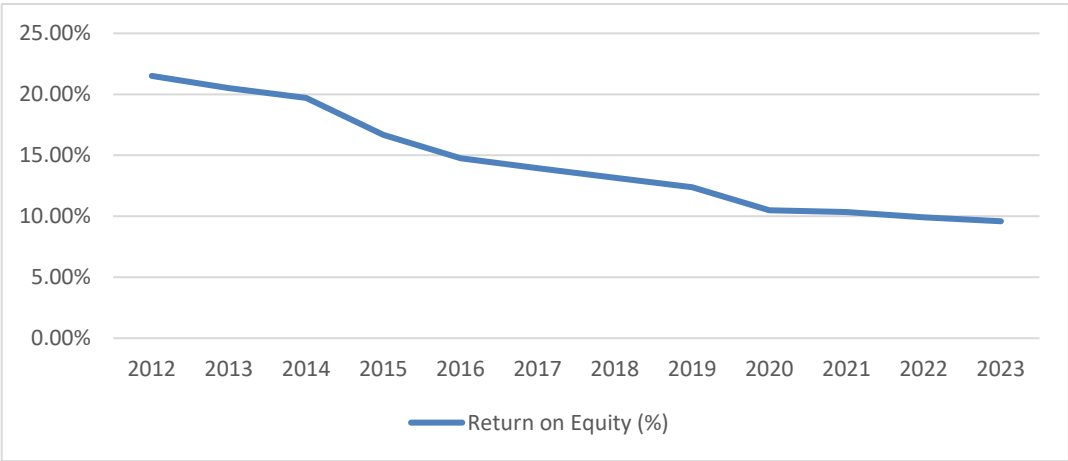


Figure 1.7: Return on Equity of China’s Commercial Banks, 2012-2023

Source: China Banking and Insurance Regulatory Commission (2012-2023).

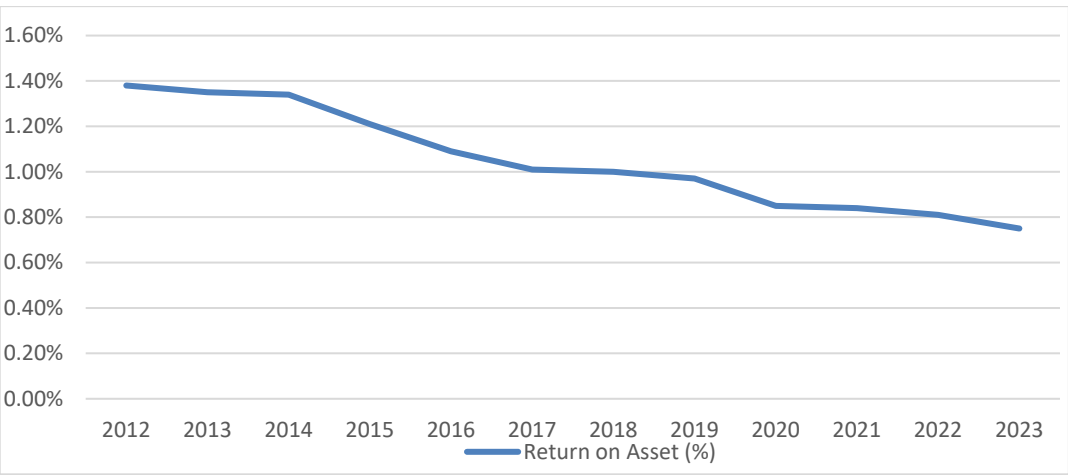


Figure 1.8: Return on Asset of China’s Commercial Banks, 2012-2023

Source: China Banking and Insurance Regulatory Commission (2012-2023).

After classification analysis, it can be seen from Figure 1.9 that the decline in ROA of rural commercial banks is the most significant. Rural commercial banks mainly serve small and medium-sized cities and rural areas, where the level of economic development and income are relatively low. Poor repayment ability may lead to higher credit risks, thus exerting a greater negative impact on ROA. State-owned large commercial banks and joint-stock banks have consistent trends in the early stage, but the decline in state-owned large commercial banks is relatively moderate. Chinese commercial banks began promoting FinTech development around 2016. In the early stages, these commercial banks still experienced a noticeable decline in ROA, which only started to improve in recent years with a slower rate of decrease observed and even a rebound in ROA for joint-stock commercial banks.

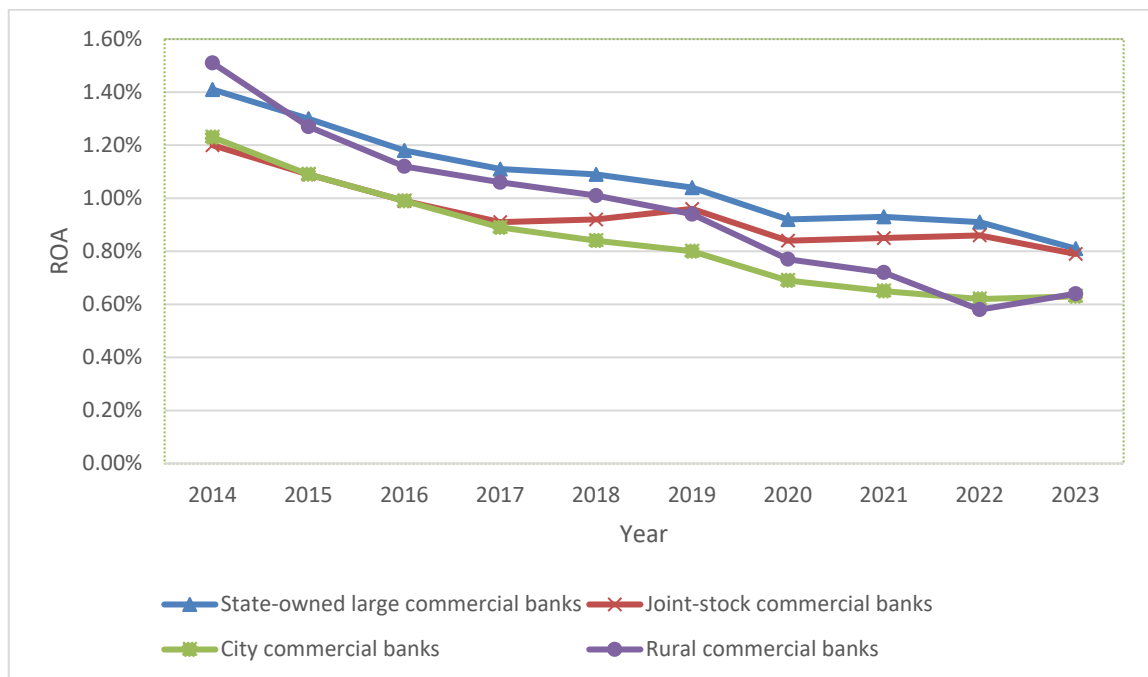


Figure 1.9: Return on Asset of China's Different Types of Banks, 2014-2023

Source: China Banking and Insurance Regulatory Commission (2014-2023).

In summary, the five efficiency indicators of net profit, net interest margin,

proportion of non-interest income, return on equity and return on asset of Chinese commercial banks all show that the profit situation of Chinese commercial banks is not very optimistic, and it is urgent for commercial banks to transform and upgrade, as well as seek new profit models.

Additionally, Figure 1.10 illustrates the evolving trends of the non-performing loan ratio and the provision coverage ratio for commercial banks. These two critical indicators serve as essential tools for assessing the risk profile of commercial banks and their implications for profitability (Yu and Li, 2023). The non-performing loan ratio represents the proportion of non-performing loans in a bank's total loan portfolio, providing a direct measure of asset quality. The provision coverage ratio, defined as the ratio of loan loss provisions to non-performing loans, evaluates a bank's capacity to absorb potential losses and mitigate risks. As depicted in Figure 1.10, the non-performing loan ratio increased gradually from 0.95% in 2012 to 1.61% in 2023, peaking at 1.91% in 2020 due to the economic disruptions caused by the pandemic (Kryzanowski et al., 2023). This upward trend was primarily driven by the slowing growth rate of China's economy and the progression of supply-side structural reforms, which exposed corporate debt risks and consequently elevated the non-performing loan ratio (Hotchkiss et al., 2023). In recent years, however, with enhanced regulatory oversight and stricter risk management requirements, commercial banks have intensified their efforts in disposing of non-performing assets, leading to a gradual decline in the non-performing loan ratio (Tang et al., 2024).

Concurrently, the provision coverage ratio declined steadily from 290.77% in 2012 to 206.10% in 2023, reaching its lowest point of 175.73% in 2016. Following this, regulatory policies mandated higher provisioning levels, prompting a moderate recovery in the

provision coverage ratio. Therefore, an increase in risks may potentially result in a decline in the profitability of commercial banks.

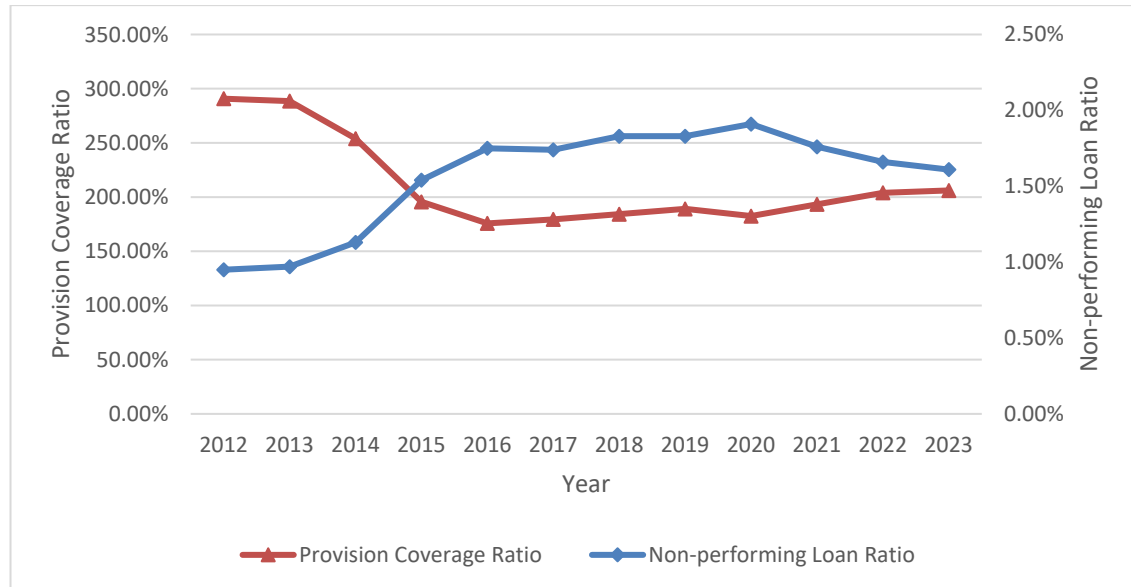


Figure 1.10: Non-performing Loan Ratio and Provision Coverage Ratio of China's Commercial Banks, 2012-2023

Source: China Banking and Insurance Regulatory Commission (2012-2023).

1.2.3 The Current Situation of Chinese Commercial Banks Developing FinTech

In recent years, emerging FinTech has been widely used in the financial industry, which playing a crucial role in improving financial products and services. The emergence and development of FinTech has effectively expanded the ways of commercial banks' business management development, actively sought transformation and innovation, and also brought new opportunities for commercial banks to improve their profitability (Hu et al., 2024). In addition, the pandemic has accelerated the pace of digital transformation in the banking sector (Elsaid, 2023). But at the same time, the innovation of information technology also makes commercial banks face certain challenges, some FinTech companies fully use efficient and convenient mobile transactions, payments and financial management

and other technological means to effectively make up for the shortcomings of the upper commercial banks in this field, with its fast and low-cost diversion of a large number of commercial banks' customers, to commercial banks capital financing and credit business, payment and settlement and other businesses have brought a considerable impact, bringing challenges to the profitability of commercial banks (Ozili, 2020; Suryanto et al., 2022). Therefore, FinTech has brought both opportunities and challenges to commercial banks.

Building a digital China has become the general trend of national development. In the process of digital transformation, major banks are also actively responding to the continuous development of FinTech by increasing the investment in FinTech, increasing the recruitment of scientific and technological personnel (Lee et al., 2021). Thus, the application of FinTech in the banking industry has been developed rapidly. According to statistics from the annual reports of commercial banks, currently large and medium-sized commercial banks have intensified their FinTech investment, and the number of FinTech employees and capital investment are constantly rising.

The data presented in Table 1.1 demonstrates that in 2023, the total investment of Industrial and Commercial Bank of China, China Construction Bank, Agricultural Bank of China, Bank of China, Bank of Communications and Postal Savings Bank of China reached 122.822 billion yuan, up 5.38% year on year, and each of the six banks invested more than 10 billion yuan in FinTech. These data show that large commercial banks attach importance to the development and application of FinTech. They are constantly increasing their investment in FinTech applications and new technologies. Among joint-stock commercial banks, China Merchants Bank invested more than 14 billion yuan in FinTech, while China Citic Bank invested more than 12 billion yuan, the growth rate has increased relatively

compared with the previous two years. Industrial Bank also invested more than 8 billion yuan in recent years. In addition to increasing investment in FinTech numerous banks also regard the construction of FinTech talent team as one of their priorities. The number of FinTech talents in banks is increasing, and many banks have more than 10,000 FinTech employees. The Industrial and Commercial Bank of China leads in both FinTech investment and the number of FinTech professionals. Thus, it can be seen that FinTech has been highly valued by the banking industry.

Table 1.1: FinTech Development Indicators of China's Major Banks, 2021-2023

Bank Name	2021		2022		2023	
	FinTech Investment (100 million yuan)	Number of FinTech Employees	FinTech Investment (100 million yuan)	Number of FinTech Employees	FinTech Investment (100 million yuan)	Number of FinTech Employees
Industrial and Commercial Bank of China	259.87	35,000	262.24	36,000	272.46	36,000
China Construction Bank	235.76	15,121	232.90	15,811	250.24	16,331
Agricultural Bank of China	205.32	9,059	232.11	10,021	248.5	13,150
Bank of China	186.18	12,873	215.41	13,318	223.97	14,541
Bank of Communications	87.5	4,539	116.31	5,862	120.27	7,814
Postal Savings Bank of China	100.3	5,350	106.52	6,373	112.78	7,055
China Merchants Bank	132.91	10,043	141.68	10,846	141.26	10,650
China Citic Bank	75.37	4,286	87.49	4,762	121.53	5,626
Industrial Bank	63.64	3,303	82.51	6,699	83.98	7,828

Source: Annual Reports of Chinese Commercial Banks (2021-2023).

In the face of the development of FinTech and digital transformation, commercial banks actively deepen the transformation of digitalization and intelligence, promote the

integration of industrial technologies and focus on improving FinTech (Kaihui et al., 2024). Industrial and Commercial Bank of China focuses on growth drivers, builds new high-quality development engines for digital transformation, improves digital service life and strengthens the three platforms of “mobile banking, open banking and ICBC e-life”. It will also strengthen digital services for the convenience and benefit of the people, accelerate cross-border cooperation between banks and enterprises, deepen scientific and technological research and application. Moreover, it targets cutting-edge technologies and weak links, constantly improves the system of scientific and technological innovation and the system of financial service platforms.

China Construction Bank has been strengthening its capacity to build digital infrastructure and driving financial innovation with technology and data. Furthermore, it has built a distributed new technology system based on independent control, built a systematic, engineering and productized artificial intelligence capability, independently developed an artificial intelligence platform, and launched the brand “China Construction Bank Cloud”.

The Bank of China adheres to the innovation-driven approach and takes “data + technology + scene + experience” as the core to build digital capabilities and promote the transformation and upgrading of financial services. In 2023, Bank of China will maintain strategic focus, further promote major projects such as oasis project, data governance, intelligent operation and scene construction. It improves digitalization and marketing, operation management and service capabilities, which contribute more digitalization force to high-end industries.

Agricultural Bank of China continues to enhance its capability of digital rural financial service, accelerate the application of digital rural in key areas, continue to improve

data analysis and application capabilities, improve data infrastructure, deepen the application of data in key areas such as precision marketing, precise risk control and refined management. It relies on digitalization to empower grassroots and reduce burdens.

Bank of Communications continues to deepen the construction of digital national grid and promote the implementation of the FinTech development vision with “platform, open, intelligent, enterprise-oriented and reshaped” as the core. Digital transformation took the lead in making breakthroughs in retail transformation, supply chain finance, financial ecological layout and other fields. It comprehensively improved online and digital business operations and internal operations.

Joint-stock commercial banks actively build ecology and scenes, build “light bank”, “digital bank”, “ecological bank” and “panoramic bank” to accelerate the deep integration of FinTech and industry ecology. China Merchants Bank established the industry's first investment and research platform for retail wealth management business and continued to support new capacity building and new mode exploration with the financial technology innovation project fund. Minsheng Bank builds cloud native application and service platform. Citic Bank pays more attention to the construction of digital infrastructure base and focuses on cloud infrastructure and big data research. Ping An Bank is transforming into “digital bank, ecological bank and platform bank”.

Faced with the shrinking profit space of commercial banks, the difficulties of digital transformation and the huge development space brought by FinTech, commercial banks have taken FinTech as the breakthrough of transformation and development under the new situation, seized the opportunities brought by FinTech to optimize the traditional financial

service model, change the profit model of commercial banks and find new profit growth points.

In recent years, commercial banks have independently developed FinTech by establishing FinTech subsidiaries with their own resources (Li et al., 2022). In the second half of 2015, the FinTech subsidiary of Industrial Bank named Xingye Shujin, was established. It became the first technology subsidiary of a bank in China (Liu and Liu, 2024). Since then, a number of banks have set up FinTech subsidiaries successively, such as China Merchants Bank formed Zhaoyin Yunchuang, China Everbright Bank formed Everbright Technology, China Construction Bank formed Jianxin Jinke, Minsheng Bank formed Minsheng Technology, Industrial and Commercial Bank of China formed Gongyin Technology, among others. Large state-owned commercial banks have universally established independent FinTech subsidiaries to facilitate technology transfer and digital transformation (Chen, 2024). Joint-stock commercial banks and some leading city commercial banks accelerate the development of self-researched technologies and technology transfer by forming technology subsidiaries or joint ventures. In contrast, small and medium-sized banks, constrained by resource limitations, seldom establish FinTech companies. Instead, they primarily adopt approaches such as co-building technology platforms, engaging in strategic collaborations with Internet companies and procuring third-party services (Wei et al., 2021). Both large banks and small and medium-sized banks are actively facing and applying FinTech.

In addition, commercial banks also make use of external cooperation and development. They carry out relevant strategic cooperation with FinTech companies to make up for their own shortcomings by virtue of their technological advantages (Jarvis and Han,

2021). For example, Baidu established cooperative relations with China Construction Bank and China Everbright Bank established cooperative relations with Du Xiaoman Finance. All of these reflect those commercial banks use FinTech to promote the change and financial innovation of commercial banks under the wave of FinTech.

On the other hand, the rapid development of FinTech gives technology finance companies the opportunity to enter the traditional financial business field, which brings huge impact and challenge to commercial banks (Ma, 2024). Large Internet enterprises, such as Tencent and Jingdong, make full use of the data advantages formed by cloud computing technology and the platform advantages with numerous customers accumulated over the years to efficiently layout the Internet finance field, breaking the business barriers between FinTech companies and commercial banks. Traditional commercial banks face a downward trend in financial services, resulting in the outflow of bank funds.

The widespread use of online payment methods such as Wechat and Alipay have greatly reduced the amount of bank payment business (Huang et al., 2020). From Figures 1.11 and 1.12, it can be seen that the number and amount of mobile payment services of China's commercial banks and non-banking payment institutions are constantly growing, but the number of mobile payment services handled by commercial banks is significantly lower than that of non-banking payment institutions. In 2021, the number of mobile payment services handled by non-banking payment institutions is 996 billion, while that of the banking industry is 151.228 billion. By the end of 2023, the number of mobile payment transactions of non-bank payment institutions reached 1,230 billion, while the number of mobile payment transactions processed by the banking industry was only 185.147 billion. Non-bank institutions possess a competitive edge due to their involvement in small-value,

high-frequency consumption scenarios. Although the amount per transaction is relatively low, the cumulative transaction volume is substantial. By contrast, commercial banks' payment services are predominantly focused on low-frequency, high-value domains such as large transfers and corporate settlements. Nevertheless, their overall transaction scale has experienced compression. The development of mobile business of non-bank payment institutions has brought a certain impact on the payment and settlement business of commercial banks (Wang, 2024). This has resulted in a reduction of intermediary business income for commercial banks and weakened customer loyalty. Fundamentally, this phenomenon reflects the reshaping of market dynamics driven by technological advancements and financial disintermediation.

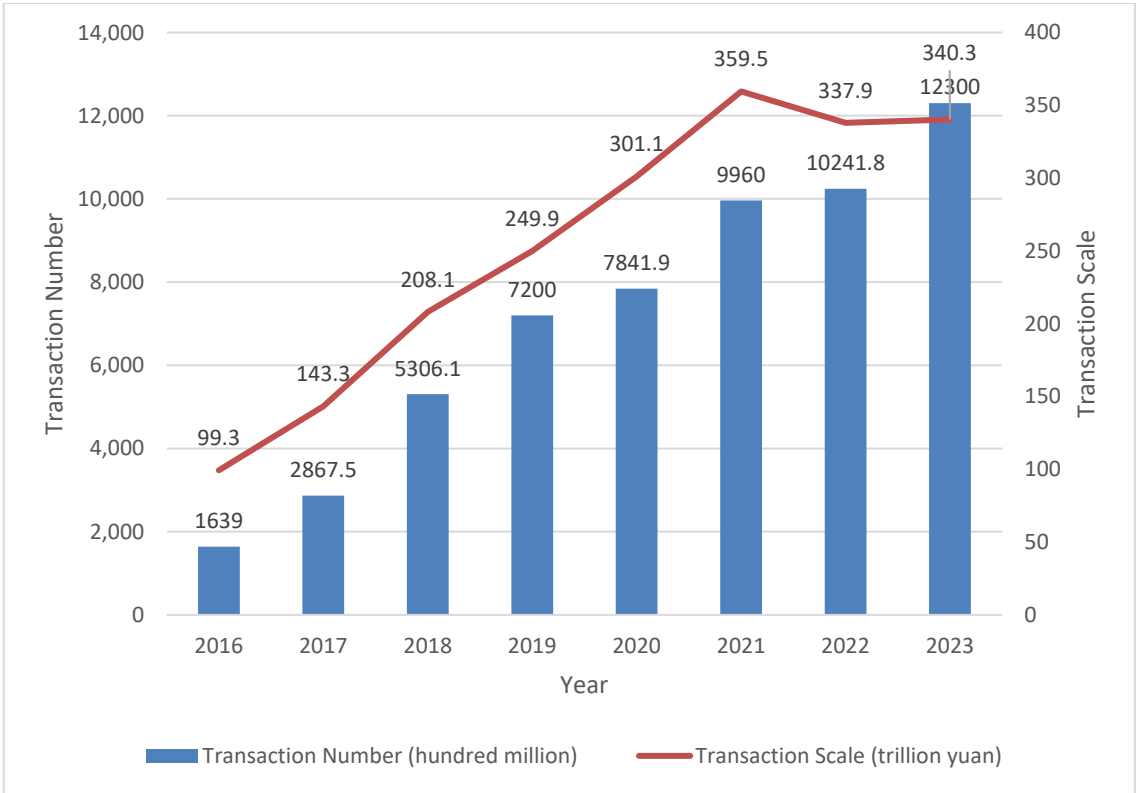


Figure 1.11: Status of Mobile Payment Services of Non-bank Payment Institutions, 2016-2023

Source: Payment and Clearing Association of China (2016-2023).

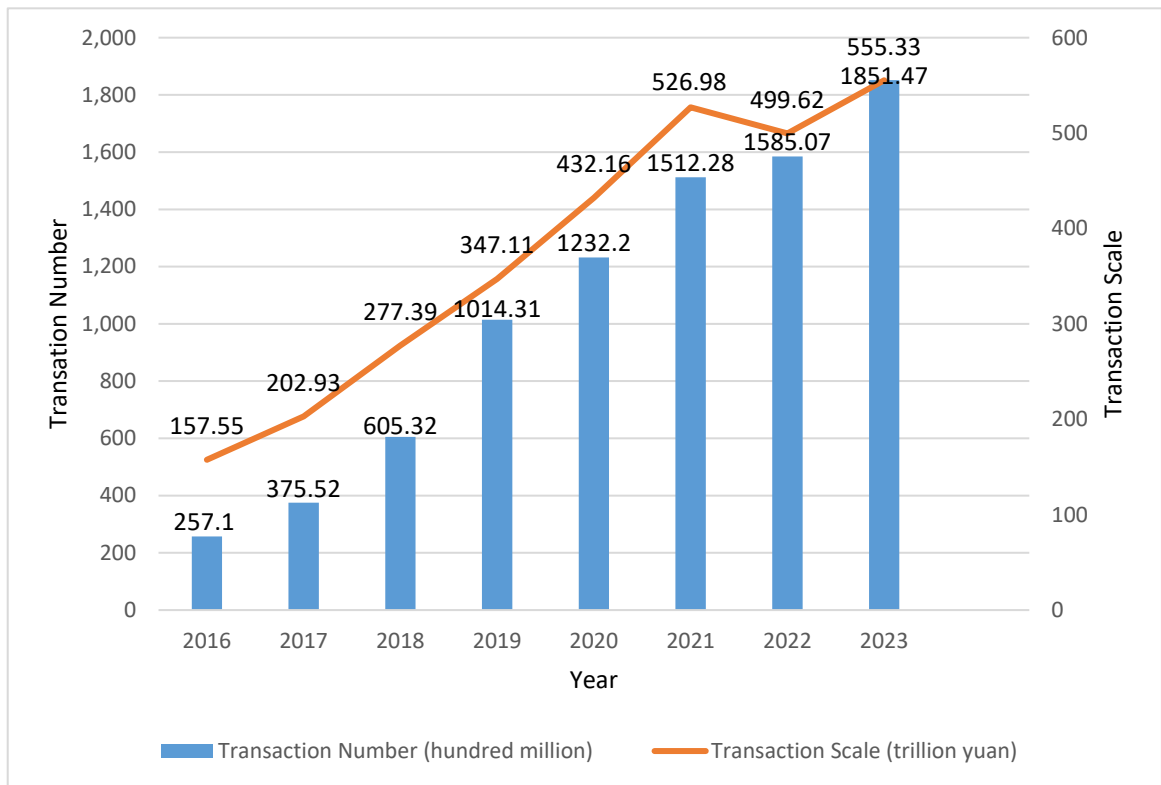


Figure 1.12: Situation of Mobile Payment Business of Bank Payment Institutions, 2016-2023

Source: Payment and Clearing Association of China (2016-2023).

Furthermore, Alipay's Yu'e Bao and Wechat's zero-sum Wallet are flexible and have value-added functions, which meet the needs of many small and medium-sized savers, reducing the share of bank deposits and increasing the cost of commercial banks' liabilities. In addition, consumer credit products launched by Alipay and other platforms have seized a large number of credit business markets of commercial banks (Zhang, 2023). This forces commercial banks to speed up the transfer of traditional financial services from counter to online. If banks do not innovate and stick to the old way, they will face the risk of being marginalized and their business operations will take a nosedive.

In addition, the sudden outbreak of the novel coronavirus epidemic at the end of 2019 resulted in increased credit risks, pressure on loan quality and more complex financial risks of commercial banks (Twum et al., 2022). Meanwhile, the constant changes of national financial regulatory policies also posed new challenges to the banking industry. Forced by the epidemic, online channels and “contactless” financial services have attracted widespread attention from the market as the epidemic restricts offline financial activities and changes users’ financial business handling habits (Jalal et al., 2023). The change of users’ financial business handling habits caused by the epidemic has promoted the online transformation process of banking business. The “contactless” financial service has put forward new requirements for banks’ digital operation capacity and other aspects, which has brought lasting and far-reaching impact on the digital development of banking industry and the change of financial service mode (Chen et al., 2023).

As shown in Figure 1.13, In 2021, the volume of outgoing transactions in China’s banking sector reached its peak at 2572.82 trillion yuan. While it began to decline slightly in 2022, it continued to remain at a relatively high level. The number of outgoing transactions generally exhibited an upward trend year by year. During the outbreak of the epidemic in 2020, there was a sharp increase in these transactions, and despite a slight decrease in 2021, they resumed their upward trajectory after the pandemic subsided. The epidemic spurred a significant rise in online banking activities, and even post-pandemic, the shift in customer behavior patterns ensured that online services remained highly favored among clients (Baker et al., 2023). Thus, in the context of rapid advancements in information technology, it is imperative for China’s banking industry to innovate its operational and management models, revitalize its product offerings, undergo digital and technological transformation, and achieve both digitalization and sustainable development of Chinese commercial banks (Liu

and Liu, 2024).

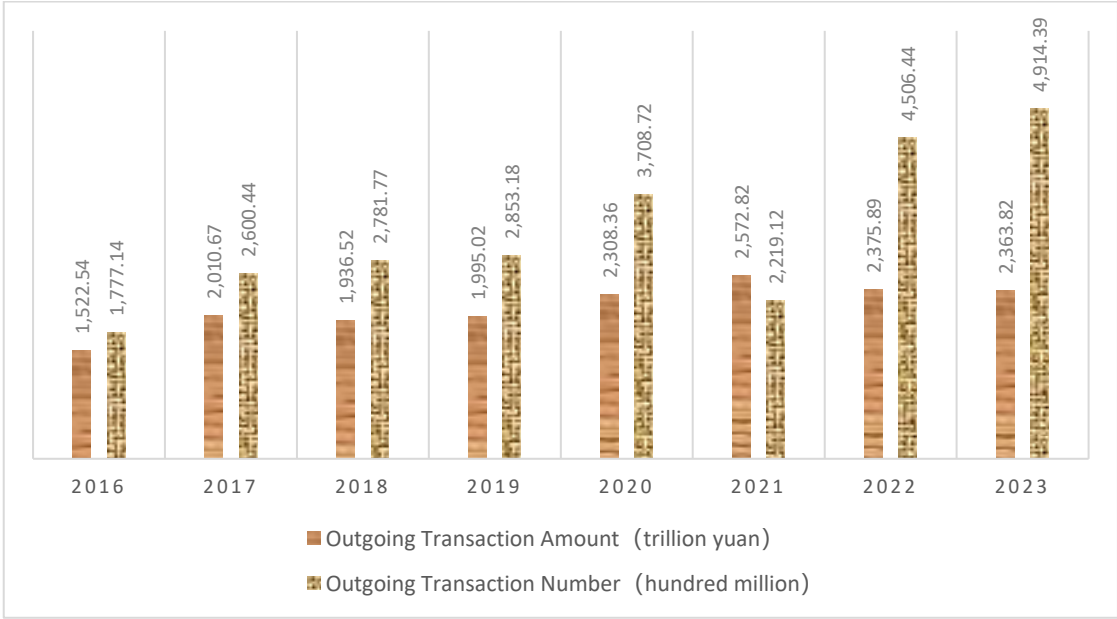


Figure 1.13: The Amount and Number of Outgoing Transactions in China’s Banking Industry, 2016-2023

Source: China Banking Services Report (2016-2023).

Based on the above background, the application of FinTech has brought not only opportunities and development, but also impacts and challenges to Chinese commercial banks (Tong and Yang, 2025). Therefore, whether the development of FinTech can empower and improve the profitability of commercial banks, promote the transformation and upgrading of China’s banking industry, deepen the reform of financial supply side or bring a huge crisis to China’s traditional banking industry, and whether there is heterogeneity in the impact on different types of commercial banks need to be further discussed and studied. This is of great significance for solving the difficulties and pain points of the digital transformation of commercial banks. It also has important implications for the sustainable and stable development of China’s banking industry under the new financial model, the

establishment of a sound financial system, and the high-quality development of China's economy.

1.3 Problem Statement

The source of profit of Chinese commercial banks is relatively simple and mainly depends on the interest margin of deposits and loans. With the market-oriented reform of interest rate, the net interest margin of commercial banks is decreasing year by year. At the same time, the return on asset and return on equity of commercial banks are also declining. While the profit margin of commercial banks is narrowing and the operating risk is rising. Therefore, it is urgent for commercial banks to reform their business models and find new ways to increase profits. Actively embracing FinTech innovation and exploring diversified revenue models have become essential strategic measures for commercial banks to overcome operational challenges and achieve sustainable development. In response to increasing market pressures, commercial banks are accelerating the integration of FinTech into their core operations and strategic planning. Through the establishment of online payment and online financing, it has built a FinTech system such as intelligent investment management and big data mining. In addition, commercial banks have gradually increased the proportion of FinTech capital and technical personnel investment, and they also have set up FinTech subsidiaries. Faced with the development of FinTech, commercial banks are actively exploring the construction of FinTech infrastructure platform and the expansion of digitalization. This has expedited the intelligence and digital transformation of commercial banks. By restructuring business processes and reshaping service models, new pathways for sustainable profit generation can be established.

But on the other hand, the swift advancement of FinTech is fundamentally transforming the financial ecosystem. As non-bank institutions capitalize on their technological capabilities, they increasingly challenge the dominance of traditional banking activities, potentially exacerbating profitability constraints in the near term. FinTech companies continue to seize the deposit and loan business market of commercial banks, which further narrows the net interest margin of commercial banks (Li and He, 2021). In addition, FinTech also weakens the role of commercial banks as financial intermediaries, leading to the decrease of intermediate income and customer scale of commercial banks, restricting the development and expansion of their potential markets. Nevertheless, this underscores the imperative for commercial banks to proactively enhance their adoption of FinTech. By strengthening internal technological capabilities or forging strategic partnerships with FinTech firms, commercial banks are endeavouring to convert emerging challenges into developmental opportunities.

From the aforementioned analysis, it is evident that FinTech exerts both positive and negative influences on the profitability of commercial banks. In the transformation process, commercial banks must allocate substantial funds and human resources. The relatively high initial costs may temporarily suppress profit margins. Simultaneously, during the early stages, FinTech companies, leveraging their technological advantages, diverted certain businesses from commercial banks, thereby exacerbating profit pressures within the banking sector. However, as FinTech continues to evolve, commercial banks have progressively increased their investments in this domain. Through measures such as establishing FinTech subsidiaries, they have facilitated the deep integration of technology and financial services, constructing a more comprehensive ecosystem. Hence, the sustained empowering impact of FinTech warrants increased attention. This favourable development has been explicitly

endorsed and promoted through national strategic policies. Since 2019, the People's Bank of China has released the "FinTech Development Plan", delineating the direction for FinTech development and gradually refining the regulatory framework. Against this backdrop, the collaborative relationship between FinTech firms and commercial banks has progressively intensified, with synergistic effects starting to manifest. This trend suggests that the positive influence of FinTech on the profitability of commercial banks is poised to become more pronounced. Consequently, at different stages of FinTech development, which reflect the evolution and maturity of financial technology, its impact on the profitability of commercial banks exhibits dynamic fluctuations. Clarifying whether FinTech can enhance the profitability of commercial banks holds not only significant theoretical value but also plays a critical role in assessing the effectiveness of commercial banks' strategic implementations.

Recently, with the acceleration of interest rate marketization and intensifying competition among banks, commercial banks are confronted with the challenge of continuously shrinking net interest margins. The traditional interest income is no longer sufficient to sustain profit growth. Hence, commercial banks urgently need to engage in precision management and explore emerging growth sectors. Factors such as the trend towards financial disintermediation, the construction of multi-level capital markets, and increased financial openness have resulted in non-bank financial institutions along with foreign banks venturing into similar or overlapping business areas as commercial banks. This has diversified the competitive landscape. Simultaneously, rapid advancements in internet finance and FinTech have presented significant challenges to traditional markets and brought about substantial disruptions for commercial banks. To address these internal and external environmental changes that pose difficulties for them, commercial banks need to

reduce their reliance on traditional interest margin businesses by broadening their perspectives and sources of revenue. In this context, leveraging FinTech to drive business innovation, upgrade services, and spark efficiency transformations, while simultaneously diversifying revenue structures and reducing dependence on traditional interest spreads, has become an essential strategic choice for commercial banks to strengthen core competitiveness, broaden profit channels, and mitigate market risks. Therefore, further empirical research is necessary to investigate how FinTech influences the profitability of commercial banks under a diversified bank income structure.

The development of FinTech is reshaping the traditional financial industry and the emergence of non-bank entrants and FinTech companies has created a highly competitive environment for banks due to their professional technical personnel and large user traffic advantages. For instance, in the payment sector, cutting-edge financial technologies such as mobile payments and third-party payments have disrupted the monopoly position of traditional intermediary services by offering low cost and convenience. Moreover, in the investment and financing field, internet companies have introduced diverse low-risk and accessible financial products that significantly compress profit margins for commercial banks (Li and He, 2021; Song et al., 2023). Furthermore, FinTech firms can leverage their technological advantages to design tailored financial products catering to the needs of underserved markets while providing funding support for customers with limited access to finance. This not only results in commercial banks losing high-quality long-tail customers but also impacts existing customer groups, thereby challenging their market dominance and increasing customer acquisition costs while reducing profitability. Consequently, third-party payment platforms, online lending platforms, along with other novel types of financial platforms have partially weakened the intermediation function traditionally performed by

commercial banks while further intensifying decentralization trends within finance that undermine profitability.

Driven by competitive pressure, commercial banks are proactively introducing and deepening the application of FinTech, not merely as a defensive response to market competition, but as a strategic initiative to strengthen their competitive advantage. Through the innovation of FinTech products and services (such as enhancing mobile payment experiences, developing differentiated online financing and investment offerings, and utilizing big data to serve small and underserved customer segments), banks aim to reinvigorate market activity, elevate customer experience, and both consolidate and expand their market share. Moreover, commercial banks establish FinTech subsidiaries or collaborate with external FinTech companies to internalize and enhance their own technological capabilities, thereby achieving resource sharing and win-win cooperation in an increasingly open competitive landscape. Therefore, it is crucial to explore how FinTech impacts the profitability of commercial banks through its influence on their competitiveness.

Due to the entry of FinTech companies in the early stages of FinTech development, competition among commercial banks has intensified. In order to prevent a decrease in business scale, commercial banks may grant high-risk loans at low interest rates, leading to an increase in operational risks and impacting profitability levels (Wu and Zhang, 2023). However, as FinTech further matures and develops, commercial banks can fully leverage technologies such as big data, blockchain and artificial intelligence to enhance their risk pricing capabilities and risk management mechanisms. This will reduce concentration of risks and improve accuracy in customer identification, thereby mitigating information asymmetry and reducing default risks faced by commercial banks while simultaneously

increasing profitability levels (Guo et al., 2022). Therefore, risk is also one of the crucial mechanisms through which FinTech influences the profitability capacity of commercial banks.

China's commercial banks can be divided into large state-owned commercial banks, joint-stock commercial banks, city commercial banks and rural commercial banks. Compared with small and medium-sized banks, large banks are able to provide customers with lower loan costs and better products and services by adopting new technologies, business models and risk management systems. Nevertheless, with the deepening of the reform of the national financial system and the continuous development of the corporate governance system, the backward management system and the backward incentive and restraint mechanism of large state-owned commercial banks are becoming more and more obvious. Under the impact of FinTech, the supervision requirements of large state-owned commercial banks are stricter, which further restricts the improvement of their profitability. However, the arrival of FinTech also brings opportunities for the reform of large state-owned commercial banks. Large state-owned commercial banks actively respond to FinTech by increasing their investment in FinTech year by year and increasing the training of scientific and technological talents, so as to give full play to their capital, technical base and talent advantages (Lee et al., 2021; Xiong et al., 2021).

Since its establishment, joint-stock commercial banks have actively studied foreign advanced management concepts and systems, they can quickly change coping strategies according to market changes. The advanced management philosophy enables joint-stock banks to take a leading position in system innovation, business innovation and product innovation. Therefore, joint-stock commercial banks can quickly adapt to the wave of

FinTech innovation, adjust their development strategies, innovate their business processes, and achieve a virtuous cycle of FinTech application in commercial banks' profitability.

Compared with large state-owned banks and joint-stock commercial banks, urban commercial banks and rural commercial banks have smaller asset scale, poor profitability and lack of talents. Furthermore, their FinTech investment and technical personnel are relatively small, so the technology research and development ability are insufficient and the technology infrastructure construction lags behind. Nevertheless, urban commercial banks and rural commercial banks have short decision-making chains, obvious regional characteristics and close links with local economy, which match with the small and micro fields focused by FinTech and absorb the technology spillover effect of FinTech. Therefore, for different types of commercial banks, the impact of FinTech on their business performance may be different. While analysing the impact of FinTech on the profitability of commercial banks, it is also essential to explore the heterogeneity of this impact across different types of commercial banks.

In conclusion, under the circumstances where traditional profit models are under pressure and the external competitive environment undergoes profound changes, FinTech has evolved from an emerging force that disrupts the traditional financial landscape to a core driving force for the transformation and upgrading of commercial banks, as well as an important strategic lever for enhancing profitability. Although the transformation process inevitably involves many challenges and costs, the significant potential and long-term value demonstrated by FinTech in promoting service innovation, improving operational efficiency, optimizing risk management, expanding diversified revenue channels, and reshaping the core competitiveness of banks have increasingly attracted widespread attention. At the same

time, the national level has also clarified the direction for the development of FinTech from a strategic perspective and provided policy support. This study will explore the impact of FinTech on the profitability of commercial banks, deeply analyse its action paths including diversification of income structure, competition and risk, and further examine its heterogeneity effects in different types of banks, aiming to provide theoretical basis and practical references for commercial banks to effectively seize the development opportunities of FinTech and achieve high-quality and sustainable development.

By viewing the research gap, although existing studies have examined the complex relationship between FinTech and bank profitability, there are still several areas for further investigation. First, most studies rely on linear models to analyse this relationship, which may fail to capture potential nonlinear dynamics such as U-shaped patterns in FinTech development. Second, the selection of profitability indicators often overemphasizes single metrics like ROA and ROE, which are insufficient to fully reflect the multidimensional nature of bank profitability. Third, the measurement of the FinTech environment remains relatively coarse, as many studies use data from a bank's headquarters to represent its nationwide operations, thereby overlooking the influence of branch network distribution on technology penetration. Furthermore, there is a lack of empirical evidence regarding how FinTech affects bank profitability through key mechanisms such as income diversification, market competition, and risk dynamics. To address these gaps, this study introduces a FinTech quadratic term model to identify nonlinear turning points, constructs a comprehensive evaluation system for bank profitability, and develops a provincial FinTech index weighted by branch distribution, aiming to explore the underlying mechanisms and optimization pathways through which FinTech influences bank profitability.

1.4 Research Questions

Based on the statement above, this study will put forward three research questions. The following questions will be tested:

RQ1: Does the application of FinTech at different stages have varying impacts on the profitability of commercial banks in China?

RQ2: Does income diversification affect the impact of FinTech on profitability of commercial banks in China?

RQ3: Does FinTech affect the profitability of commercial banks in China through competition and risk?

1.5 Objectives of the Study

1.5.1 General Objective

This study intends to examine the impact of FinTech on the profitability of different types of commercial banks in China.

1.5.2 Specific Objectives

The specific objectives of this study are as follows:

- i. To examine the non-linear effect of different stages of FinTech application on the profitability of commercial banks in China.
- ii. To examine the impact of income diversification on FinTech and profitability of commercial banks in China.
- iii. To examine the influence of FinTech on the profitability of commercial banks in China from the aspects of competition and risk.

1.6 Significance of the Study

China's 14th Five-Year Plan and the Financial Technology Development Plan (2022-2025) reaffirm the government's strong emphasis on financial technology and highlight its critical role in advancing the reform of the financial sector. FinTech has the potential to reshape the profit model of commercial banks, influence their risk-bearing capacity and affect capital adequacy ratios. This underscores the importance for the government to evaluate the potential impact of FinTech on banking system stability and mitigate systemic risks arising from declining profitability. Simultaneously, the government can establish a dynamic regulatory framework and leverage regulatory technology to monitor real-time changes in bank profit structures while preventing issues such as data misuse or algorithmic bias. Furthermore, this research will categorize commercial banks and analyse how FinTech affects the profitability of different types of banks. Based on these findings, the government can design differentiated subsidy schemes, tax incentives and evaluation mechanisms to lower the costs associated with the digital transformation of commercial banks and encourage them to enhance inclusive finance efficiency through FinTech. Additionally, by examining the competitive and cooperative dynamics between commercial banks and FinTech companies, the government can strengthen policy guidance to foster collaboration between these entities, thereby balancing innovation with risk management. Consequently, this research provides valuable insights for strengthening the supervision of commercial banks and helps banking regulators effectively reduce the likelihood of systemic risk outbreaks in China's banking industry, ultimately promoting the high-quality development of China's real economy.

This research focuses on the primary challenges faced by commercial banks in maintaining profitability within the context of FinTech. FinTech has significantly impacted

the traditional interest margin income of commercial banks. To address this, commercial banks can leverage FinTech to develop financial services such as wealth management and robo-advisory, thereby expanding their intermediary business and increasing the proportion of non-interest income, which helps optimize their revenue structure. Simultaneously, through automation and intelligence, banks can reduce their reliance on manual labour, lower operational costs and enhance efficiency. Furthermore, the growing demand for personalized services is driving banks to undergo transformation. Commercial banks have recognized that FinTech plays a crucial role in enhancing customer retention, reshaping competitive advantages and improving profitability. This study also examines the impact of FinTech on bank profitability through the lens of risk mechanisms, providing valuable insights into how commercial banks can strengthen their risk management capabilities and mitigate potential losses. Additionally, based on theoretical and empirical analyses, policy recommendations can be formulated to guide different types of commercial banks in effectively utilizing FinTech to boost profitability and operational performance. This contributes to accelerating the digital and technological transformation of commercial banks, reinforcing their competitive edge, enhancing the quality of financial services and better supporting the real economy.

In addition, the development of FinTech can be seen as an effective combination of the financial industry and information technology, a projection of technological progress in the field of financial development. From a historical perspective, a large number of information technology tools are also often the first to be widely used in the financial field. From a development perspective, FinTech and the financial industry have a very significant fit. So, studying the impact of FinTech applications on commercial bank performance has a

strong significance for promoting the promotion and development of information science and technology in more industries and fields in China.

Moreover, the research on this topic holds multifaceted significance for customers or consumers. This relevance is not only evident in the direct experience of financial services but also has a profound impact on consumers' financial behaviours, freedom of choice, risk tolerance and long-term interests. FinTech has effectively reduced the operating costs of banks through digital technologies. A portion of these cost savings may be passed on to consumers in the form of favourable terms, enabling them to access basic financial services at a lower cost. Simultaneously, the application of FinTech has optimized the service processes of commercial banks, allowing consumers to conduct operations such as payments and wealth management via mobile devices anytime and anywhere. This significantly reduces time costs and enhances the accessibility of financial services. Additionally, due to competition between FinTech companies and traditional banks, commercial banks are compelled to improve service quality and extend coverage to more long-tail customers. This provides consumers with greater options in terms of pricing, service diversity and user experience. However, while FinTech has successfully mitigated credit risks for banks through big data risk control and real-time monitoring, it may also introduce potential risks such as data privacy breaches. Therefore, although consumers face a reduced likelihood of fraud, they may still encounter the risk of personal information leakage. By thoroughly understanding the impact of FinTech on the profit models of banks, consumers can more clearly anticipate the evolving trends of future financial services, thereby actively adapting to technological innovations, avoiding potential risks and maximizing their own interests.

From a theoretical perspective, this thesis systematically examines the connotation of FinTech and the current situation of its development in China. Based on extensive literature references, it applies the Digital Inclusive Finance Index developed by Peking University. It is important to note that the core business activities of banks primarily occur in their branches, which are directly influenced by FinTech. Therefore, depending exclusively on the Inclusive Finance Index of the city where the headquarters is located may result in an underestimation of the actual disparities in FinTech application among sample banks. To more accurately capture the characteristics of the FinTech environment in which banks operate, this thesis introduces the number of bank branches in each province as a weighting factor and applies a weighted adjustment to the provincial Digital Inclusive Finance Index. This study deepens our understanding of the role and value that FinTech plays in the banking industry. Additionally, it introduces the moderating effect of income diversification and explores its regulatory role in how FinTech affects commercial banks' profitability. Furthermore, within a mediating effect model framework, it incorporates FinTech, competition, risk and commercial bank profitability into consideration scope while broadening research perspectives on profitability by further delving into discussions on how FinTech impacts the banking industry. The research further enhances the findings by examining the impact of FinTech on banks of varying sizes and types from a comprehensive perspective.

1.7 Scope of the Study

This study conducted an empirical analysis to systematically explore the impact of FinTech development on the profitability of 50 listed commercial banks in China from 2012 to 2023. The research subjects were limited to listed commercial banks in China, excluding unlisted banks and non-bank financial institutions. The level of FinTech development was

measured by the weighted Peking University Digital Financial Inclusion Index, combined with the spatial distribution of bank branches to construct a provincial FinTech index. The study employed a panel data model, with bank profitability as the dependent variable. This indicator was constructed through factor analysis, integrating three dimensions: safety, liquidity, and profitability, and included control variables at the macroeconomic and bank levels. This thesis focused on examining the U-shaped relationship between FinTech and bank profitability and its threshold effect. Further, it analysed the moderating mechanism through income diversification and explored the mediating path by considering competitiveness and risk. Additionally, the study also examined the heterogeneity performance of different bank types and during the pre- and post-pandemic periods.

1.8 Organisation of the Study

This thesis is structured into five chapters. Chapter One serves as an introduction, providing an overview of the current state and developmental trajectory of profitability and FinTech in Chinese commercial banks, while also posing research questions and objectives within this context. Chapter Two critically examines pertinent concepts, theories, and literature on FinTech and bank profitability, offering a comprehensive analysis of existing literature and identifying areas that require further exploration. Chapter Three outlines the methodology employed in this study, encompassing data sources utilized for the research, various indicators for variables considered, as well as the analytical techniques employed. The empirical findings, along with a discussion and justification, are provided in Chapter Four. Chapter 5 serves as the conclusion and recommendations, wherein valuable insights from the preceding sections are synthesized to provide strategic suggestions for the advancement of commercial banks.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

In recent years, the rapid advancement of science and technology, coupled with the evolving demands of the financial industry itself, has accelerated the integration of finance with technology. Consequently, FinTech has emerged as an indispensable component in global development exhibitions. The development of FinTech not only introduces novel technologies to businesses and banks but also poses significant challenges to traditional commercial banking models. Therefore, effectively addressing how banks can confront this “double-edged sword” of FinTech and leverage its potential for profitability improvement becomes a paramount issue that needs attention. Henceforth, studying the impact of FinTech on bank profitability assumes particular importance. However, there is a lack of consensus on the definition and quantification of FinTech across the industry. In this chapter, it aims to enhance comprehension of FinTech and bank profitability by reviewing important theoretical and empirical theories. It will also examine previous studies for the sake of identify any limitations and build upon them for current research.

2.2 The Concept of FinTech

The abbreviation “FinTech” is derived from the combination of “Financial Technology”, a term that has gained widespread usage in recent years across the globe. The inception of Fintech can be traced back to the early 1990s when Citigroup initiated a project within the Financial Services Technology Alliance. However, there lacks a universally accepted standard for defining FinTech.

From the perspective of organizations, Financial Stability Board provided a preliminary explanation in 2016, which is widely acknowledged by the academic community. It states that the emergence of network information technology drives financial innovation, facilitating operational model, product and service advancements within the financial sector. The FinTech, as defined by the People's Bank of China (2017), refers to an emerging financial model that integrates various functions such as financing, settlement, and information media through Internet technology and mobile communication technology. It represents a technology-driven financial innovation that has injected new vitality into financial development while simultaneously posing new challenges to financial security.

In addition to the organizations, the academic community is also engaged in a heated discussion on the connotation of FinTech. According to a definition provided by Schueffel (2016) through semantic analysis and Thakor (2020), FinTech is regarded as an emerging industry, which improves financial activities via the application of technology. Giglio (2021) stated that six business models were found for FinTech, including crowdfunding, payment, capital market, wealth management, insurance services and loan. Moreover, he discovered that the definition of FinTech has been given by various international organizations and nations. For Lee and Shin (2018), the emergence of FinTech has introduced a new paradigm of information technology-driven innovation in the financial industry. FinTech is widely regarded as a transformative disruptive innovation that has the potential to revolutionize traditional financial markets. They believe that FinTech ecosystem is important for FinTech innovation and the development of FinTech industry, which includes traditional financial institutions, government, FinTech startups, financial customers and technology developers.

The concept of FinTech in China was initially defined by Ba and Bai (2016), who emphasize that FinTech entails the seamless integration of advanced technological tools with finance, serving the people collaboratively while concurrently reducing costs and enhancing efficiency. He also indicates that Chinese FinTech development is mainly divided into three stages, covering the electronic stage of finance, the Internet finance stage and the FinTech stage. For Wang and Niu (2024), FinTech is a new type of technology that disrupts traditional business models by leveraging big data, artificial intelligence, blockchain, and cloud computing. It brings about a series of innovations in system management, operational models and product services within the financial sector to establish an ecosystem where finance and technology converge. Li et al. (2022) describe FinTech as an innovative activity aimed at reforming the traditional financial business. This transformation is facilitated by emerging technologies and overseen by financial regulators, with participation from market entities including both traditional financial institutions and emerging financial formats. Qin (2023) believes that FinTech, although defined differently by various perspectives, essentially refers to the utilization of cutting-edge technologies to reduce transaction costs for financial institutions and transform traditional business models in the financial industry. This can enhance operational efficiency for financial institutions and serve as a driving force for continuous upgrading and transformation within the financial sector.

As evident from the aforementioned review, FinTech is primarily defined by scholars as a convergence of financial and technological innovations, which essentially comprises a range of technical capabilities. By integrating finance with emerging technologies, it reinforces the application of technical support in the financial sector to foster financial innovation and enhance the efficiency of financial services.

2.3 Measurement of FinTech

Due to the diversity and complexity of forms and innovations, there is currently no unified, standardized, comprehensive index for constructing FinTech. The construction of a FinTech index through text mining based on keyword frequency is a commonly employed method. The specific techniques involved in text mining primarily encompass the following steps: Firstly, establishing an initial thesaurus based on the financial functional perspective of classifying financial technology; Secondly, quantifying the initial thesaurus by counting keyword frequencies; Thirdly, employing correlation analysis to identify effective keywords; Finally, synthesizing the index using factor analysis methodology. Guo and Shen (2015), Cheng and Qu (2020), Chen et al. (2022), Li (2022), Wang et al. (2022), Lee et al. (2023), Kharrat et al. (2023) construct the FinTech index according to this method. This method can extract a sufficient amount of sample data from banks, which can to some extent reflect the level of development in FinTech across various commercial banks. However, when establishing the keyword library through this method, there is a certain degree of subjectivity. Important words may be omitted and as FinTech develops rapidly, if the keyword library is not updated in time, it will lead to inaccurate index construction. Nevertheless, high-frequency words may only represent public opinion heat rather than real technological progress. In addition, when dealing with synonyms and multilingual mixed content, the technical requirements are relatively high. Therefore, constructing the FinTech index through this method may affect its accuracy.

There are also many scholars (Wang and Wu, 2018; Sheng and Fan, 2020; Deng et al., 2021; Lv et al., 2022; Che, 2023; Song et al. 2023; Bu and Tang, 2024; Wei and Yang, 2024; Tang et al., 2024) use the Peking University Digital Inclusive Finance Index, compiled by the Peking University Digital Finance Research Center, as another indicator for the

development of FinTech. The Digital Inclusive Finance Index is based on a vast amount of microdata from Ant Financial Group and reflects the level of FinTech development in various provinces and cities from different dimensions such as breadth of coverage index, depth of usage index and degree of digitization. A comprehensive analysis of the development of FinTech across provinces, cities, and counties in China has been conducted by this index. Ant Group, as a leading enterprise in China's FinTech sector, has significantly contributed to this progress through its products such as Alipay and Yu'E Bao, which have exerted substantial influence in mobile payment and investment management. The relevant data from these products offer a scientific and reliable foundation for assessing the FinTech development level in each sample region.

Additionally, certain scholars formulate FinTech indices based on various dimensions. The study conducted by Lavrineko et al. (2023) examine the pivotal role of FinTech in fostering financial development across EU countries. They employ three standards to construct FinTech index, which encompass FinTech companies' number, their accomplishments and indicators pertaining to the work environment. Using data from enterprises, a FinTech development index is constructed. The measurement of FinTech development encompasses four aspects: the overall number of established companies, registered capital, frequency of financing events and total amount of financing (Zhao et al. 2022). For Wang et al. (2021), factor analysis is used to roundly evaluate FinTech index. The index has five aspects, including the utilization of big data, the integration of artificial intelligence, the implementation of distributed technology, technological interconnectedness and technology security. The FinTech index developed by Wu et al. (2022) includes a wide range of indicators that assess the level of importance attributed to FinTech, the state of its infrastructure, the overall ecosystem supporting it, as well as the political and regulatory

framework surrounding it. For Wu and Yuan (2021), the FinTech index is formulated by conducting a principal components analysis, which contains the cumulative inclusion of third-party payment transactions, the market size of cloud computing, and the count of internet finance users.

Furthermore, the existing variables are also utilized as proxy variables for the FinTech index by a few scholars. The invention patent data of banks is incorporated into the construction process of FinTech indicators, and the search algorithm is tailored and optimized by leveraging the characteristics of the Chinese language, thereby enabling FinTech indicators to more objectively reflect the application of FinTech at an individual bank level (Li et al., 2022). In addition, Guo et al. (2022) underscore the significance of collaboration between commercial banks and technology enterprises. Banks leverage the technological research and development platforms as well as the competitive advantages of technology enterprises to facilitate the advancement of FinTech within commercial banks. Therefore, they employ the number of strategic partnerships established between banks and technology enterprises as a metric for evaluating FinTech. Medyawati et al. (2021) assess FinTech through the volume of transactions conducted through Automated Teller Machines (ATMs), as well as internet and mobile banking services.

Therefore, the above analysis indicates that current FinTech measurement methods exhibit a “multi-dimensional exploration and complementary coexistence” pattern. While various indicators possess distinct strengths in capturing the depth of technological penetration, they also face inherent limitations. The text mining method constructs indices by statistically analysing the frequency of financial function keywords. Its strength lies in capturing inter-bank variations in technology adoption and ensuring broad sample coverage.

However, this method is constrained by the subjectivity of keyword selection and the lag in updating word lists to reflect technological advancements. It also encounters technical challenges when handling synonyms and mixed multilingual texts. The multi-dimensional comprehensive index seeks to overcome the limitations of single-dimensional approaches by integrating diverse data sources, such as financing scale, patent activity, and infrastructure development. This approach achieves greater comprehensiveness, yet its implementation is complicated by the complexity of weight assignment and inconsistencies with international standards, resulting in operational difficulties. The alternative variable method simplifies measurement by using proxies such as patent counts and electronic transaction volumes. However, these proxies fail to accurately reflect the actual value of technological innovation because patents may not translate into practical applications, and transaction volumes may conflate digital channel migration with genuine technological progress, thus falling into the methodological pitfall of “partial indicators representing the whole”. Compared with the aforementioned approaches, the Digital Inclusive Finance Index developed by Peking University leverages Ant Group’s micro-level data to provide standardized provincial-level assessments across three dimensions: breadth of coverage, depth of usage, and degree of digitalization. It stands out for its authority and strong regional comparability. Table 2.1 summarizes the construction methods of FinTech indicators.

Table 2.1: Measurement of FinTech

Author(s) and Year	Construction Method of FinTech Index
Guo and Shen (2015), Cheng and Qu (2020), Chen et al. (2022), Li (2022), Wang et al. (2022), Lee et al. (2023), Kharrat et al. (2023)	Text mining based on keyword frequency analysis

Table 2.1 continued

Author(s) and Year	Construction Method of FinTech Index
Wang and Wu (2018), Sheng and Fan (2020), Deng et al. (2021), Lv et al. (2022), Che (2023), Song et al. (2023), Bu and Tang (2024), Wei and Yang (2024), Tang et al. (2024)	Peking University Digital Inclusive Finance Index
Medyawati et al. (2021)	Transaction volume via ATMs, internet and mobile banking
Wang et al. (2021)	Factor analysis based on big data, AI, distributed tech, interconnectedness, security
Wu and Yuan (2021)	Principal components analysis of payment transactions, cloud computing market size, internet users
Guo et al. (2022)	Number of strategic partnerships between banks and tech enterprises
Li et al. (2022)	Patent data and keyword-based text mining
Wu et al. (2022)	Principal components analysis of importance, infrastructure, ecosystem, and policy framework
Zhao et al. (2022)	Number of companies, capital, financing events, financing amount
Lavrineko et al. (2023)	Number of FinTech companies, accomplishments, work environment

2.4 The Concept of Bank Profitability

The profitability of commercial banks represents their ability to generate profits, which reflects their operational capabilities within the industry. It typically has a direct correlation with the level of business activity and serves as a crucial indicator for assessing the sustainability of commercial banks' operations. Generally speaking, a bank's profitability is higher when its operating conditions are better.

As profitable financial institutions, commercial banks prioritize maximizing profits as their primary objective. However, in China, commercial banks have heavily relied on interest rate spreads for income generation over many years, with more than 80% of their revenue coming from this source. On the other hand, non-interest spread income derived

from intermediate and investment businesses remains relatively small and limited in diversity. Furthermore, amidst ongoing interest rate liberalization reforms and the emergence of FinTech enterprises, commercial banks face significant challenges that test their operational models and hinder development prospects (Wang, 2018).

Enhancing profitability is not only an indication of improved risk resistance capabilities in related business activities but also signifies increasing vitality in terms of overall development for these banks. Therefore, it is imperative for commercial banks to establish favourable profit environments and systems while enhancing economic efficiency and benefits to continuously elevate profit quality levels and ensure stable operations.

2.5 Measurement of Bank Profitability

Assessing the profitability of banks is a multifaceted process that involves evaluating how internal operations and external activities interact with the environment. Various approaches have been employed in previous studies to approximate bank profitability by conducting financial ratios such as Return on Assets (ROA), Return on Equity (ROE), Net Interest Margin (NIM) and other comprehensive performance indicators.

Medyawati et al. (2021), Chhaidar (2022), Guo et al. (2022), Li et al. (2022), Wang et al. (2022) and Song et al. (2023) think that the primary source of revenue for banks is predominantly derived from the expansion of their asset base. Thus, they opt for the ROA index, as it is deemed to be more comprehensive and capable of fully reflecting the profitability and management prowess of commercial banks. However, certain scholars choose the ROE index for measurement purposes. As a measure of bank profitability, the ROE assesses the effectiveness of bank management in generating profits, it serves as a more reliable metric for assessing shareholder returns (Ali and Puah, 2019; Wu and Yuan, 2021;

Lv et al., 2022; Wu and Zhang, 2023). Although ROA or ROE directly reflect the return on assets or equity, relying solely on one of these indicators to measure a bank's profitability is overly simplistic and fails to provide a comprehensive assessment. For Chen (2020), Koroleva et al. (2021) and Yudaruddin (2023), they employ both ROA and ROE to test profitability of commercial banks.

In addition to ROA and ROE, Horobet et al. (2021) and Jadah et al. (2020) also incorporate NIM as an additional indicator for proxying bank profitability, which distinguishes the disparity between interest earnings generated by assets and interest costs incurred from liabilities in relation to the overall value of assets. The profit model of China's commercial banks remains relatively traditional, primarily relying on deposits and loans to generate interest margin profits. Interest margin serves as the primary source of income for commercial banks, reflecting not only their own effectiveness but also the intermediary transaction costs within the financial environment and the allocation of social resources. NIM demonstrates the level of profitability a bank achieves in relation to its interest costs. According to Wu and Zhang (2023), the advent of the Internet has led to a reduction in interest expenses for commercial banks, thereby augmenting their profitability.

As for Asterioua et al. (2021), they use ROAA, ROAE and NIM to measure the profitability of commercial banks. ROAA is a measure of the profitability of a bank's assets, calculated by dividing net income by average total assets. On the other hand, ROAE represents the return on shareholders' equity and is determined by dividing net income by average total equity.

Furthermore, Tan (2016) introduces the Profit before Taxation (PBT) index as an additional measure of profitability alongside ROA, ROE and NIM. The impact of taxes on

bank profitability is taken into account when analysing PBT. This index is considered a more accurate indicator of profitability than after-tax profit. Moreover, Saif-Alyousfi (2022) proposes five indicators as proxies, namely, ROA, ROE, NIM, PBT and NIR. NIR is short for net interest revenue to total revenue. They employ a range of comprehensive indicators to assess the profitability of banks relatively, offering a broad perspective and encompassing various aspects of profitability.

Currently, there exists another mainstream profitability measurement index for commercial banks that integrates security, liquidity, and profitability indicators through the use of principal component analysis, data envelopment analysis, and other methods to construct comprehensive performance indicators (Liu and Wang, 2021; Zhang and Xue, 2023). This index adheres to the “three characteristics” principle of commercial bank operations and provides a relatively comprehensive evaluation of bank profitability.

The existing literature demonstrates a clear trend toward evolving from single proxy variables to multi-dimensional comprehensive assessments in measuring the profitability of commercial banks. This evolution reflects the academic community’s deepening understanding of the complexity inherent in banking operations. Early studies predominantly relied on ROA as the core indicator, which effectively captures asset allocation efficiency but overlooks variations in leverage effects and capital structure. ROE, while informative in reflecting shareholder returns, is susceptible to regulatory capital adjustments and fails to distinguish between sustainable and transient profits. Some scholars attempted to mitigate these limitations by jointly employing both ROE and ROA; however, this dual-indicator approach still falls short of addressing the endogenous limitations of traditional metrics. Specifically, both indicators focus on accounting profits while neglecting risks arising from

asset-liability maturity mismatches. Furthermore, certain studies have introduced supplementary indicators, such as NIM, PBT, and NIR, to construct a preliminary structured framework for analysing profit sources. Nevertheless, these indicator systems remain fragmented and lack a systematic integration of profit quality and financial stability. Against this backdrop, Liu and Wang (2021) and Zhang and Xue (2023) introduced a comprehensive index methodology that represents a significant methodological advancement. By employing techniques such as principal component analysis, their approach integrates three critical dimensions: profitability, safety, and liquidity, into a unified evaluation framework. This method not only effectively avoids biases associated with reliance on a single indicator but also uncovers the dynamic trade-offs among the various performance dimensions. Table 2.2 provides an overview of the measurements used to develop bank profitability indicators.

Table 2.2: Measurement of Bank Profitability

Author(s) and Year	Measurement Method
Medyawati et al. (2021); Chhaidar (2022); Guo et al. (2022); Li et al. (2022); Wang et al. (2022); Song et al. (2023)	ROA
Ali and Puah (2019); Wu and Yuan (2021); Lv et al. (2022); Wu and Zhang (2023)	ROE
Chen (2020); Koroleva et al. (2021); Yudaruddin (2023)	ROA & ROE
Horobet et al. (2021); Jadah et al. (2020)	ROA, ROE & NIM
Asterioua et al. (2021)	ROAA, ROAE & NIM
Tan (2016)	ROA, ROE, NIM & PBT
Saif-Alyousfi (2022)	ROA, ROE, NIM, PBT & NIR
Liu and Wang (2021); Zhang and Xue (2023)	Comprehensive indices (PCA/DEA integrating security, liquidity & profitability)

2.6 Determinants of Bank Profitability

The study by Ali and Puah (2019) utilizes a balanced panel data of 24 commercial banks from 2007 to 2015 to conduct a panel regression analysis, aiming to analyse the factors within the Pakistan banking sector that influence both profitability and stability. The findings of the profitability model reveal that the size of the bank, credit risk, funding risk, and stability all exert statistically significant influences on profitability. However, there is no statistically significant impact observed on profitability in relation to liquidity risk.

Jadah et al. (2020) intend to analyse the factors that influence bank profitability in Iraq using unbalanced panel data during 2005-2017, including determinants from the aspect of internal and external. The findings indicate that the profitability of Iraqi banks is positively affected by factors such as bank size, the ratio of equity to total assets and the ratio of total loans to total assets, the growth of GDP, and the effectiveness of government. Conversely, bank profitability is negatively influenced by credit risk, inflation, interest rate, unemployment, and political instability.

Koroleva et al. (2021) investigate the correlation between internal and external factors and the state-owned commercial banks' profitability. A model of regression with multiple variables is employed to analyse data from the top five Chinese state-owned commercial banks spanning from 2007 to 2019. The findings suggest that internal indicators such as size, credit quality, and liquidity have a significant positive impact on the profitability of these banks. Conversely, the profitability of banks is negatively impacted by external factors, as evidenced by the natural logarithm of GDP.

Horobet et al. (2021) examine the macroeconomic and the bank's own factors influencing banking profitability in the Central and Eastern Europe banking sectors by

employing a Generalized Method of Moments (GMM) approach and analysing data from 2009 to 2018. The profitability is found to be adversely impacted by various factors, including the unemployment rate, inflation, budget balance, non-governmental credit, non-performing loan rates, concentration rate, and capitalization rate.

Saif-Alyousfi (2022) employs GMM method to test the influencing factors of bank profitability across 47 Asian countries. He finds that cost-income ratio, nonperforming loans, credit to private sector and loan growth are negative to the bank profitability. However, liquidity risk, demand deposit, market risk, opportunity cost, capital adequacy ratio, bank size, bank concentration, GDP growth, inflation rate and stock market capitalization are positive to the bank profitability.

For O' Connell (2023), he aims to investigate the impact of factors specific to banks, industries, and macroeconomics on the profitability of commercial banks in the UK by using the GMM approach. Ultimately, he ascertains that the banks' capital and productivity positively impact profitability, while credit risk, deposits, liquidity, and expense control exert a negative influence. In addition, profitability factor from the aspect of industry is concentration, which can be assessed by five-bank asset concentration, has a negative effect on the profitability. As for the macroeconomic profitability determinants, there is a positive relationship between inflation, cyclical output, loan growth and profitability.

It is evident from the aforementioned literature that scholars have conducted numerous studies on the determinants influencing the profitability of commercial banks. Based on existing research, these determinants can be categorized into three main groups: firstly, internal factors pertaining to commercial banks such as loan-to-asset ratio, credit risk and bank size; secondly, macroeconomic factors including GDP growth and inflation rate;

thirdly, industry-specific factors like industry concentration and degree of competition. The following Table 2.3 shows the summary of the above literature review of determinants of bank profitability.

Table 2.3: Summary of the Determinants of Bank Profitability

Author (s) & Year	Country (Sample Period)	Methodology	Variables Considered	Key Findings
Ali & Puah (2019)	Pakistan (2007–2015)	Panel regression	• Bank size • Credit risk • Funding risk • Stability • Liquidity risk	• Bank size, credit risk, funding risk, and stability significantly affect profitability. • Liquidity risk has no significant effect.
Jadah et al. (2020)	Iraq (2005–2017)	Panel regression	• Internal: bank size, equity-to-assets ratio, loans-to-assets ratio. • External: GDP growth, government effectiveness, credit risk, inflation, interest rate, unemployment, political instability.	• Profitability is positively affected by bank size, equity ratio, loans ratio, GDP growth, and government effectiveness. • It is negatively affected by credit risk, inflation, interest rate, unemployment, and political instability.
Koroleva et al. (2021)	China (2007–2019)	Multiple regression	• Internal: size, credit quality, liquidity. • External: GDP	• Internal factors such as size, credit quality, and liquidity have a positive effect on profitability. • GDP has a negative effect.
Horobet et al. (2021)	Central & Eastern European (2009–2018)	GMM	• Macroeconomic: unemployment, inflation, budget balance, non-government credit. • Bank-level: NPLs, concentration rate, capitalization rate.	• Profitability is negatively affected by unemployment, inflation, budget deficit, non-governmental credit, non-performing loans, concentration, and capitalization.
Saif-Alyousfi (2022)	Asia (1995–2017)	GMM	• Internal: cost-income ratio, NPLs, credit to private sector, loan growth, liquidity risk, demand deposit, market risk, opportunity cost, capital adequacy, bank size, concentration. • External: GDP growth, inflation, stock market capitalization.	• Profitability is negatively affected by cost-income ratio, non-performing loans, private credit, and loan growth. • It is positively affected by liquidity risk, deposits, market risk, opportunity cost, capital adequacy, bank size, concentration, GDP growth, inflation, and stock market capitalization.

Table 2.3 continued

Author (s) & Year	Country (Sample Period)	Methodology	Variables Considered	Key Findings
O'Connell (2023)	UK (1998–2018)	GMM	• Bank-specific: capital, productivity, credit risk, deposits, liquidity, expense control. • Industry: five-bank asset concentration. • Macro: inflation, cyclical output, loan growth.	• Profitability is positively affected by capital, productivity, inflation, cyclical output, and loan growth. • It is negatively affected by credit risk, deposits, liquidity, expense control, and industry concentration.

2.7 Diversification of Income Structure

The income of commercial banks typically refers to the revenue generated from various business activities in their daily operations. According to the financial reports of Chinese commercial banks, the operating income of commercial banks can generally be categorized into interest income and non-interest income. In terms of interest income, customer loans and advances serve as crucial and traditional sources, whereas non-interest income encompasses fees and commissions, investment gains or losses, fair value changes in gains or losses, foreign exchange gains or losses, other businesses and asset disposals.

Compared to intermediate business, diversified income has a broader scope that extends beyond fees and commissions derived from intermediary banking services but also includes high-risk areas such as investments and foreign exchange. Therefore, diversification implies continuous innovation by commercial banks in non-interest related fields alongside reliance on traditional net interest margin-based marketing represented by conventional lending practices with the aim of reducing excessive dependence on traditional models while enhancing their own sustainable operational capabilities. By expanding channels for both interest and non-interest incomes, commercial banks can achieve a more

diverse revenue structure that not only creates new growth opportunities but also enhances risk resilience capabilities.

With the continuously increasing complexity of financial markets, commercial banks are confronted with an ever-changing operating environment and risk challenges. In this context, income diversification has emerged as one of the crucial strategic directions for adjustments in banks. By constructing effective indicators for income diversification, banks can not only better navigate market fluctuations but also enhance their competitiveness and profitability. The measurement of income diversification in commercial banks is primarily conducted using two methods: the Herfindahl index and entropy index, as commonly adopted in existing literature (Zhou and Liu, 2020). The Herfindahl index quantifies the degree of diversification by calculating the squared sum of each industry's proportionate income to total income, whereas the entropy index measures it by computing the entropy value based on each industry's proportionate income to total income. Since Chinese commercial banks primarily engage in financial services rather than direct production of other products, the Herfindahl index calculated based on interest and non-interest income ratios is widely applied to assess their revenue structure diversity (Zuo and Ma, 2019; Ran, 2019). A higher value indicates a deeper level of revenue structure diversity.

Mensi and Labidi (2015) investigate the moderating role of income diversification in the association between market power and financial stability. The study reveals that banks with limited market power in the MENA region demonstrate reduced resilience and heightened instability when their diversification strategies are insufficient or inefficient. Githaiga (2023) and Nguyen et al., (2023) previously employed income diversification as a moderating variable in examining the relationship between intellectual capital and bank

performance. The studies reveal that income diversification reduces the overall influence of intellectual capital on organizational performance. However, this moderating effect manifests differently across the various dimensions of intellectual capital: it enhances the impact of structural capital efficiency, diminishes the effect of human capital efficiency, and demonstrates no statistically significant moderation in relation to capital employed efficiency. The results suggest that income diversification operates as a dual-function mechanism, capable of either augmenting or constraining the financial benefits derived from intangible resources, thereby questioning the traditional view of a simple mediating function through diversification strategies.

Moreover, numerous scholars have conducted extensive research on the impact of income diversification on the profitability of commercial banks, however, the conclusions drawn from current literature are inconsistent. Brahmana et al. (2018) utilize financial information from Malaysian banks for the period 2005-2015 and employ fixed effects panel regression analysis to discover that income diversification enhances bank performance. Sharma (2018) conducts a sample survey by utilizing unbalanced panel data sets of 169 BRICS country banks during the period 2001-2015 and applies fixed effects models and system generalized method of moments to study, revealing a positive correlation in large and medium-sized banks while indicating negative implications for small banks. Zuo and Ma (2019), based on data from 28 listed Chinese banks, conduct empirical research using dynamic panel models and find that an increase in non-interest income ratio contributes to improving the profitability of commercial banks, with joint-stock commercial banks exhibiting the strongest effect.

Hu and Zhu (2018) classify interbank business income as non-interest revenue and identified a negative correlation between non-interest income and return on assets (ROA). However, this negative correlation may be attributed to the rapid expansion of commercial banks' interbank businesses, resulting in increased income volatility that subsequently diminishes profitability levels. Furthermore, He and Ma (2020) indicate the presence of a turning point in the impact of revenue diversification on bank performance, suggesting a nonlinear relationship between these variables. Another study conducted by Vidyarthi (2020), analysing data from publicly listed banks in India, reveals an inverted U-shaped association between revenue diversification and estimates efficiency parameters within the overall panel dataset. This implies that banks should adopt an optimal level of diversification strategy to enhance their profitability.

2.8 Bank Competition and Risk

2.8.1 Bank Competition

Bank competition refers to a market situation where financial institutions strive to surpass their rivals by introducing more innovative products, services, and technological solutions (Dilla et al., 2025). Under the impact of FinTech, the traditional competitive model based mainly on branch network size and interest rate differentials as the main sources of income is being reshaped (Wu and Zhang, 2023). Emerging as a new evaluative dimension are technology-driven “data assetization capabilities” and “ecosystem integration capabilities”, which are increasingly critical in the competitiveness of modern banks (Li et al., 2022).

Currently, the primary methods employ in academic research to measure bank competitiveness include the market concentration ratio, the Herfindahl-Hirschman Index

(HHI), and the Lerner Index. Talpur (2023) emphasizes that the concentration ratio is a commonly used indicator for assessing industry market structure, which includes measures such as the three-firm concentration ratio. This ratio is computed to illustrate the market control exerted by the top three banks. Nevertheless, the concentration ratio may lead to a misleading interpretation, as it only considers the market share held by the top three or five banks in the industry, while overlooking the distribution of market shares among the remaining banks. To address the limitations of the concentration ratio, the Herfindahl–Hirschman Index (HHI), serves as an alternative measure of market concentration (Torre Olmo et al., 2021; Dilla et al., 2024). It takes into account the market share of every bank in a country and is computed by summing the squares of these shares. Furthermore, several scholars have utilized the Lerner index as a measure to assess market power within the banking sector (Coccorese, 2014; Phan et al., 2019). It is characterized by the gap between the prices of outputs and their corresponding marginal costs, expressed in relation to the prices. However, due to the limited availability of relevant indicator data for certain banks, the calculation method simplifies to subtracting operating costs from operating income as a percentage of total operating income (Peress, 2010; Datta et al., 2011).

Xiong et al. (2021) note that during the early and mid-phases of FinTech development, the crowding-out effect may serve as the primary influencing factor. At this stage, the relationship between FinTech and commercial banks is predominantly characterized by one-way competition and substitution. However, as FinTech achieves substantial progress in the mid-to-late stages, commercial banks are expected to proactively implement strategies such as expediting the construction of their own FinTech platforms, acquiring existing platforms, or forming strategic alliances with FinTech firms, thus more effectively integrating into the technological transformation. Throughout this transition, the

technology spillover effect is anticipated to progressively intensify and ultimately become the prevailing influence. Wu and Zhang (2023) investigate how FinTech influences various categories of Chinese commercial banks by examining the mechanism of market competition. Their findings reveal that market competition exerts a statistically significant positive effect on the profitability of Chinese state-owned banks, suggesting that the market competition effect partially mediates the relationship between FinTech development and bank profitability. In other words, the advancement of FinTech has intensified competition within the banking sector, ultimately leading to adverse effects on the profit performance of Chinese state-owned banks. Zhang and Li (2025) find that the application of FinTech effectively alleviate the competitive pressure faced by banks in the local market. This alleviation effect is mainly achieved through three mechanisms: improving cost efficiency, optimizing the structure of human resources, and expanding business scope and customer base. Moreover, FinTech has a more significant impact on banks with lower state-owned equity, stricter regulations, and operations in informal financial markets.

2.8.2 Risk

Risk-taking denotes a firm's proactive decision to assume risks in pursuit of higher returns (Li et al., 2022). With the advancement of FinTech and the emergence of FinTech firms, traditional commercial banks are compelled to increase investment in service quality improvement to preserve market share and profitability amid competition from new entrants. In the pursuit of competitive advantage, certain banks may excessively prioritize business expansion and growth speed, often at the expense of effective risk governance. This heightened risk appetite further intensifies credit risk. Nevertheless, once a robust technological infrastructure is in place, FinTech adoption can significantly mitigate information asymmetry and lower operational costs. Since information asymmetry is a major

driver of credit risk, the evolution of FinTech has substantially strengthened banks' capacity to collect and analyse data, enabling a more comprehensive understanding of customer profiles. This, in turn, enhances credit risk management and boosts the profitability of commercial banks.

Regarding the level of risk-taking by banks, commonly used risk measurement indicators in academic research currently include the Z-score, expected default frequency, non-performing loan ratio, and loan loss provision coverage. The Z-score serves as a widely recognized measure of a bank's susceptibility to insolvency. It is calculated by adding the return on assets and the capital asset ratio, then dividing the result by the standard deviation of asset returns (Chen et al., 2022). However, considering the strategic importance and special status of commercial banks in China, along with the strict supervision imposed by the government on the financial system, the probability of bank failures remains extremely low (Tang et al., 2024). Additionally, because China's credit rating framework is still relatively underdeveloped, the expected default frequency may not accurately reflect the actual risk exposure of commercial banks. The non-performing loan ratio in commercial banks represents the proportion of non-performing loans relative to the total loan portfolio (Swandewi and Purnawati, 2021). The provision coverage ratio is calculated as the proportion of loan loss reserves relative to non-performing loans, reflecting the degree to which commercial banks are prepared to absorb potential losses arising from such loans (Alessi et al., 2021). Unlike the non-performing loan ratio, this indicator also accounts for the extent to which non-performing loans are protected (Li and He, 2021; Yu and Li, 2023).

The study by Cheng and Qu (2020) examine how bank FinTech affects credit risk using data from Chinese commercial banks between 2008 and 2017. Results show that state-

owned banks are more proactive in adopting FinTech, particularly in internet technology. Bank FinTech is found to significantly reduce credit risk, though the effect is weaker for large, state-owned, and listed banks. FinTech adoption via strategic partnerships between commercial banks and technology firms from 2005 to 2019 has been found to reduce credit risk and enhance operational performance. According to Guo et al. (2022), FinTech strengthens banks' innovation capabilities and competitive advantage. It directly mitigates credit risk and improves performance by promoting inclusive finance, enhancing management efficiency, and expanding intermediary business activities. Nationwide development of FinTech further contributes to the reduction of credit risk. Yu and Li (2023) find that the deepening application of FinTech leads to a non-linear evolution in the operational risks of commercial banks, characterized by an initial decline followed by a subsequent rise. Furthermore, regional commercial banks demonstrate higher sensitivity to FinTech-driven impacts compared to their national counterparts. Wu and Zhang (2023) examine how FinTech influences various types of commercial banks through its risk mitigation effect. Their findings reveal that FinTech exerts a significantly positive influence on risk management within joint-stock banks, city commercial banks, and rural commercial banks. Furthermore, a strong positive correlation is observed between the risk levels and profitability of these banks, suggesting that the risk mitigation effect partially mediates the relationship between FinTech adoption and improves profitability. This implies that FinTech development contributes to lowering operational risks, thereby enhancing profit performance in these banks. Nevertheless, such an effect remains statistically insignificant in state-owned banks.

2.9 Theoretical Studies of FinTech and Bank Profitability

2.9.1 Long Tail Theory

The Long Tail theory was introduced by Chris Anderson in 2004 and further expanded the theoretical framework in 2006 (Elberse, 2008). The concept of the long tail refers to the relatively flat region in a normal distribution curve, characterized by numerous small market shares that often receive limited attention. This theory posits that initial focus was primarily on mainstream markets, with less emphasis on the long tail market and its immense profit potential. The dominance of cost and efficiency in commodity trading led to this neglect. However, when there is a wide range of storage, distribution, and display channels available, production costs decrease significantly. Moreover, reduced marketing costs enable even seemingly low-demand products to find buyers if effectively promoted. Consequently, these products with initially low demand and sales volume can eventually capture substantial market shares where the “tail” benefits may surpass those of the “head”.

In terms of customer management, commercial banks tend to focus solely on the top 20% of high-value customers in accordance with the “80-20 rule”, while neglecting the financial service needs of the remaining 80% of customers (Wang et al., 2021; Guo et al., 2022; Jia and Liu, 2024). However, in recent years, due to the economic downturn, banks have experienced a deceleration or even contraction in their income growth rate. Consequently, small and medium-sized enterprises as well as middle and low-income groups, which were previously overlooked, have emerged as target segments requiring exploration (Song et al., 2023). According to the long tail theory, this overlooked long-tail customer segment has undeniably amassed a substantial market potential over time. Therefore, each commercial bank must shift its attention towards intermediate business and retail sectors that offer significant profitability and ample room for competition. Embracing

these long-tail customers will greatly support the future growth prospects of China's commercial banking industry (Hu et al., 2024).

The neglect of long-tail customers by traditional commercial banks hampers their ability to cultivate a customer base and generate profits, thereby significantly impeding the sustainable development of these banks. The emergence of FinTech has expanded the scope and reach of banking services, eliminating the constraints of time (Oyegbade et al., 2022). The advent of mobile internet and other technologies has rendered traditional counter services inefficient. Empowered by FinTech, commercial banks no longer need to employ numerous staff to serve long-tail customers. Instead, they can swiftly match users based on user portrait models. This not only resolves information asymmetry and reduces transaction costs but also enhances the efficiency of bank services while catering to diverse customer needs. Consequently, it effectively broadens the bank's coverage and customer base for small and medium-sized enterprises as well as low- and middle-income groups. Simultaneously, when commercial banks embrace FinTech development, they can engage in better financial innovation and serve these new customers across various scenarios, thereby expanding the types and boundaries of banking services. Therefore, commercial banks should focus on enlarging their customer base, transforming their service model, and better meeting the requirements of long-tail customers in order to promote growth in untapped markets while enhancing profitability (Xu et al., 2021; Liu et al., 2024).

2.9.2 Financial Innovation Theory

The theory of financial innovation was not developed by a single scholar but rather evolved gradually through multiple stages. Schumpeter initially introduced the concept of innovation in 1912, which laid a crucial foundation for the development of financial

innovation theory. In 1975, Silber further advanced the theory by proposing the constrained-induced financial innovation framework (Silber, 1983). The theory of financial innovation can be categorized into two dimensions: broad and narrow. Broadly speaking, financial innovation encompasses various innovative activities within the finance field, including innovations in financial institutions and systems. Narrowly defined, it specifically refers to innovations in financial instruments, products, and services. Financial innovation not only facilitates changes in existing financial institutions and products but also generates substantial profits for businesses (Nejad, 2022). In a highly competitive market, engaging in financial innovation enables financial institutions to expand their market presence and enhance profitability. Therefore, it is an important theoretical perspective that enterprises are driven by demand to achieve greater profits and further innovate.

Currently, the rapidly evolving financial market has witnessed the emergence of numerous new products and services. In addition to traditional competition, technology companies leverage advanced technologies such as blockchain and cloud computing to improve capital circulation efficiency while offering a more diverse range of financial products and services (Safiullah and Paramati, 2022). This phenomenon has resulted in traditional banks losing market share and customer resources due to what is commonly referred to as “digital disruption”. Consequently, under these circumstances, traditional intermediaries should learn from the experiences of technology companies by adopting advanced technologies themselves and undergoing revolutionary reforms in order to succeed in market competition.

Furthermore, the implementation and advancement of financial innovation necessitate a substantial initial investment in research and development, however, their

outcomes may not necessarily yield anticipated economic benefits (Rabbani, 2022; Saiyed, 2025). Simultaneously, technology-driven innovation within the financial sector entails heightened risks and uncertainties (Santorry, 2024). Certain novel FinTech products may present varying degrees of security and privacy concerns, particularly in payment and e-commerce domains where issues such as network security breaches and fraudulent activities might arise. Additionally, if innovation merely replicates successful models or products without possessing genuine creativity and distinctive features, it could potentially give rise to issues of homogeneity. In such instances, competition would primarily revolve around price and other non-innovative factors rather than offering unique value propositions.

Therefore, from an innovative perspective, the integration of emerging technologies with the financial system facilitates the transformation and upgrading of traditional financial institutions, thereby enhancing their overall competitiveness (Zuo et al., 2021). However, viewed from a disruptive standpoint, FinTech has engendered imbalances in the existing financial system that have impacted traditional financial institutions and given rise to novel forms of financial risks (Prasada et al., 2024). Simultaneously, it poses challenges to the extant regulatory framework for finance.

2.9.3 Financial Disintermediation Theory

The theory of financial disintermediation was first formally articulated by Hester in 1969. Financial disintermediation refers to the process in which, within the framework of financial regulations, suppliers circumvent the commercial banking system and directly allocate funds to demand-side entities and investors, thereby facilitating an external circulation of capital (Hester, 1969). With the evolution of financial markets, they will

gradually supplant the intermediaries' financial functions, displacing indirect financing and progressively disentangling fund allocation and financial services from commercial banks.

As the cornerstone of China's financial system, traditional commercial banks can effectively tackle market issues such as elevated transaction costs and information asymmetry owing to their societal standing and robust capital strength, thereby augmenting resource utilization efficiency. The development of internet finance and FinTech, however, has expedited the process of financial disintermediation (Zhang et al., 2022). For instance, on the financing side, businesses such as online loans, private equity financing, P2P lending and crowdfunding have expanded funding channels while exerting pressure on traditional credit services offered by commercial banks. On the investment side, new avenues like online investments, internet wealth management and financial planning have emerged to undermine commercial banks' deposit business. Furthermore, in terms of payment services, third-party payments providers along with online and mobile payment methods have captured a significant share of commercial banks' payment settlement market.

The rise of FinTech has expedited the disintermediation of finance, resulting in a gradual erosion of market share for bank-centric financial service intermediaries (Kaja et al., 2021; Dhaif, 2025). Consequently, this has led to diminished interest income and persistently squeezed profit margins, thereby exerting an impact on the conventional operational framework of commercial banks. In response to these challenges, commercial banks must embrace FinTech, drive digital transformation, and reconstruct the intermediary value by collaborating with FinTech companies to enhance financial services and innovation.

2.9.4 Technology Spillover Theory

The theory of the technology spillover can be traced back to Arrow's research in 1962, where he investigated the impact mechanism of technology spillovers on economic growth from the perspective of externalities (Audretsch et al., 2005). Building upon this foundation, Findlay further articulated the technology spillover mechanism of foreign direct investment in 1978 and systematically decomposed technology spillovers into three components: demonstration effect, imitation effect and competition effect (Görg and Greenaway, 2001). This work laid an important groundwork for the subsequent deepening and development of the theory.

Technology spillover refers to the phenomenon where practitioners with outstanding expertise in a particular field unconsciously and non-voluntarily disseminate their excellent skills, resulting in a series of positive effects that benefit other professionals in the same domain (Nie et al., 2022). This effect generally generates positive externalities because its ultimate goal is not to benefit the users of technology or enhance economic activities, but rather to create beneficial spill-over effects on socio-economic aspects. The main types of technology spillover effects include demonstration diffusion, market competition, talent mobility and enterprise synergy (You et al., 2025). FinTech relies on these aforementioned effects to positively impact commercial banks, leading to changes in their governance systems, business models and profitability.

Firstly, FinTech initially generated demonstration and dissemination effects through technological tools. With the rise of FinTech, commercial banks have begun researching and implementing solutions tailored to their own characteristics in order to enhance their daily operations management, which is influenced by the dissemination and demonstration effects

of FinTech companies. Furthermore, FinTech has significantly diminished the necessity of traditional banking branches for conducting financial transactions (Chen, 2020). Internet finance products such as Yu'E Bao and P2P have exerted an impact on commercial banks' payment settlements, lending activities and other business areas while challenging their monopoly position. To cope with intense competitive pressure, banks have had to contemplate transformation and improve their mindset. Additionally, constructing and developing FinTech also heavily relies on a substantial pool of matching tech talents (Wu and Kao, 2022). The two-way flow of talent can stimulate innovation drive within commercial banks and serve as the foundation for technological innovation and business process upgrades. Lastly, collaboration between commercial banks and FinTech companies can generate synergistic effects where both parties achieve mutual benefits through resource sharing and technological collaboration that surpasses expected profits (Fang and Wen, 2024).

2.9.5 Theoretical Framework and Hypotheses Development

According to the aforementioned theoretical analysis, Figure 2.1 presents the theoretical framework of this study. Based on the previously mentioned analysis of the long tail theory, the rapid development of FinTech has led to the emergence of numerous FinTech companies. These firms leverage advanced technologies such as big data to deliver diversified and personalized financial services to long-tail customers—segments traditionally overlooked by commercial banks. Consequently, they have rapidly captured market share, intensifying competition between FinTech firms and traditional banks. In response, banks have increasingly recognized the strategic importance of long-tail customers and have begun actively investing in FinTech to drive innovation in financial products and services. Utilizing technologies such as big data-based risk control systems, banks are now

able to efficiently manage large-scale small and micro customer segments, transforming them from cost centers into profit centers and thereby achieving economies of scale. Furthermore, the application of FinTech has expanded banks' revenue streams, facilitating a shift toward a more diversified income structure.

Drawing from the foundational concepts of financial innovation theory, the early phase of FinTech development involves significant initial investment in areas such as artificial intelligence algorithm development and the application of advanced technologies like blockchain. However, the benefits derived from these innovations typically manifest with a delay, resulting in a temporary mismatch between technological investment and expected returns. As these technologies mature, they not only facilitate the emergence of new financial products such as smart investment advisory services, but also significantly lower operational costs. This evolution ultimately contributes to an enhancement in the profitability of commercial banks.

Referring to the theory of financial disintermediation, FinTech platforms such as peer-to-peer lending and intelligent investment advisory services have accelerated the disintermediation of core banking functions like deposit-taking and lending by creating self-contained ecosystem models. This shift has undermined the traditional intermediary role of commercial banks, leading to deposit and loan outflows as well as a reduction in revenue. In response to this challenge, banks are proactively developing digital platforms and forming strategic partnerships with FinTech firms to reclaim their intermediary value within the financial system. Over the long term, the expansion of high-value-added services, such as AI-driven investment advisory solutions, is anticipated to steadily enhance the profitability of commercial banks.

According to the theory of technological spillover effects, the implementation of open technical standards has accelerated the diffusion of FinTech applications, reducing the level of product differentiation among banks and triggering intensified price competition, which in turn leads to a trend of diminishing marginal returns. As FinTech continues to evolve, banks progressively internalize external technologies, developing unique capabilities that enable a shift from homogeneous competition toward a more efficiency-driven competitive model. Concurrently, as the effects of technological spillover become evident, banks are enhancing their operational efficiency and risk management capacities through the adoption of advanced technological solutions. By collaborating with technology firms, banks can achieve complementary technological advantages and co-develop a robust FinTech ecosystem. Over the long term, the integration and application of FinTech are expected to substantially improve the profitability of commercial banks. Based on the above analysis, this thesis proposes the following hypothesis:

H1: From a dynamic perspective, there is a “U-shaped” relationship between FinTech and the profitability of commercial banks in China.

During the early stages of FinTech development, commercial banks commonly encountered pressures on profitability. Revenue diversification enhances their resilience by optimizing profit structures, thereby exerting a positive moderating effect. In addressing the challenges highlighted by the long-tail theory, diversified banks can leverage supply chain data accumulated through their enterprise customer ecosystems to reduce the trial-and-error costs associated with risk control modelling for small and micro enterprises, thus accelerating the realization of long-tail market value. According to financial innovation theory, the sunk cost burden resulting from technological investment can be mitigated

through cash flow synergies across diversified business lines. For instance, stable income generated from wealth management activities can support technology investments, establishing a cross-cycle adjustment mechanism described as “leveraging light-capital income to sustain heavy technology investment”. Financial disintermediation theory suggests that the diversion of payment and credit services by third-party technology platforms has led to a decline in traditional interest income. However, banks with diversified revenue structures can build resilience through non-interest income sources such as investment banking, custody services, and asset management, thereby partially offsetting the erosion of traditional intermediary functions. In the context of homogenized competition and price wars driven by technological spillovers, diversified banks utilize complex product portfolios to create barriers against technological imitation, effectively avoiding the predicament of standardized products. Based on the aforementioned analysis, this study puts forward the following research hypothesis:

H2: Commercial banks in China can mitigate the negative impact of the early stage of FinTech development on their profitability through income diversification.

Based on the above theoretical analysis, it is evident that during the early stages of FinTech development, FinTech firms and commercial banks engaged in competition for long-tail customer segments, particularly in areas such as deposit and loan services and third-party payment solutions. This dynamic further intensified the process of financial disintermediation. Concurrently, the widespread adoption of open-source technologies has led to the homogenization of standardized financial products, thereby heightening price and service-based competition across the industry. In response to these pressures, commercial banks have generally expanded their lending volumes and reduced interest rates, which,

while enhancing competitiveness, has also elevated operational risks and negatively affected existing profit margins (Wu and Zhang, 2023). Furthermore, FinTech fundamentally represents a form of technological innovation in the financial sector. While its development has driven the evolution of financial products and services, it has also introduced new forms of innovation risk. For instance, the integration of advanced technologies has imposed higher demands on banks' data storage and management systems, increasing the likelihood of data breaches and misuse. Additionally, the technology-driven transformation has strengthened interconnections among financial institutions, raising the probability of cross-institutional risk transmission and thereby amplifying systemic financial risks (Yu and Li, 2023). As a result, during the early phase of FinTech development, commercial banks have faced significantly heightened competitive pressures and increased risk exposure, ultimately leading to a decline in profitability.

With the deepening application of FinTech, commercial banks are now better equipped to promptly capture and analyse the personalized needs of long-tail customers. Given the extremely low marginal cost of digital products, the widespread adoption of FinTech has significantly strengthened banks' product development capabilities, enabling them to offer a broader range of financial products tailored to long-tail customers, thereby enhancing their market competitiveness. Simultaneously, by leveraging advanced technologies such as big data and cloud computing, banks can efficiently mine customer data, accurately assess credit risks, improve the transparency of information disclosure between parties, and reduce transaction costs. These improvements support commercial banks in more effectively fulfilling their role as financial intermediaries. Furthermore, FinTech facilitates automated and intelligent processes for risk identification, assessment, and control, enabling banks to construct precise and efficient risk management models that

effectively mitigate various types of risks. In addition, through the absorption of technological spillovers and enhanced collaboration with FinTech firms, commercial banks continue to elevate their technological capabilities and innovation capacity, further strengthening both their competitive edge and risk management proficiency. Consequently, as FinTech matures, the competitive pressures and risk levels confronting commercial banks are expected to decline significantly, leading to a corresponding improvement in profitability. Based on the aforementioned analysis, this study proposes the following research hypothesis:

H3: FinTech adoption can increase the profitability of commercial banks in China from the aspects of competition and risk.

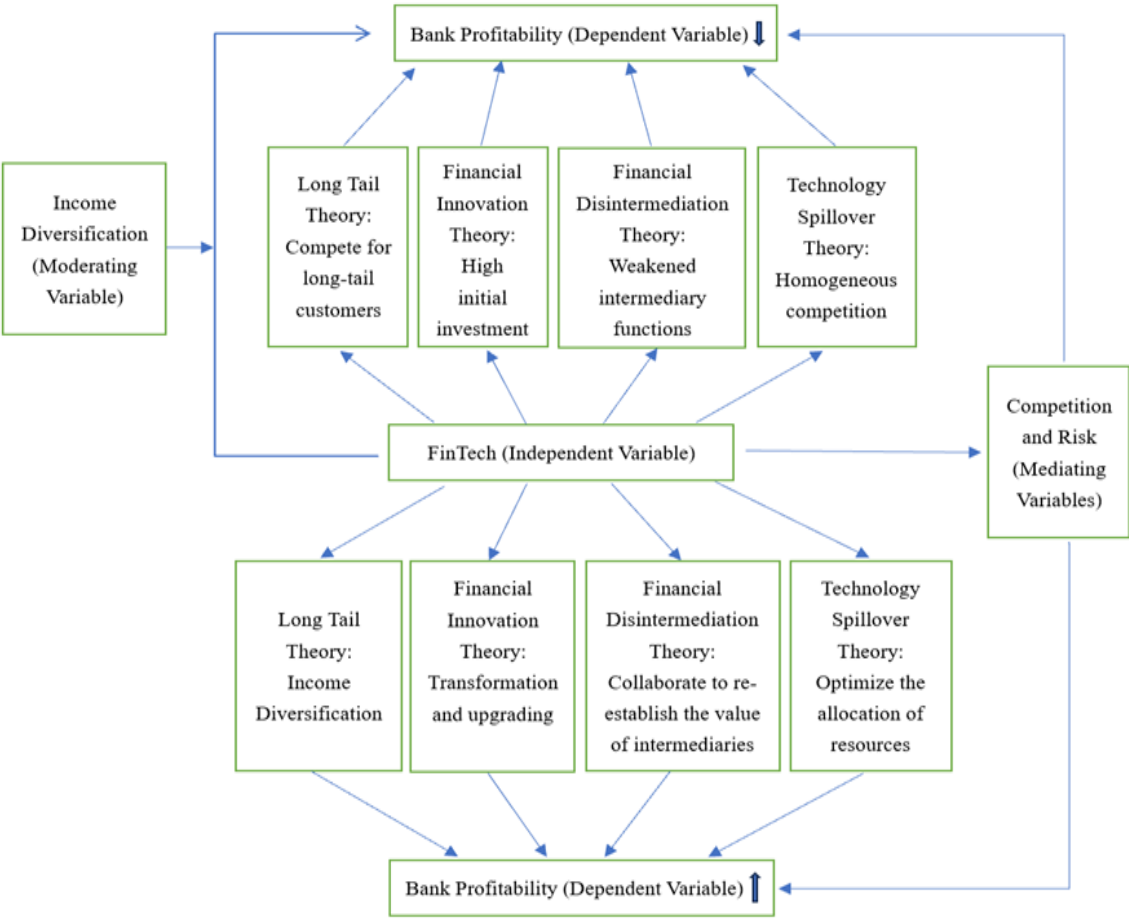


Figure 2.1: The Theoretical Framework

2.10 Empirical Studies of FinTech and Bank

Over the past few years, investment in FinTech has seen a marked rise, drawing considerable academic attention to its effects on the commercial banking sector. The empirical research in this domain can generally be grouped into several key categories, including studies centered on customer and service-related outcomes, examinations of banking performance, and evaluations of banking efficiency. With regard to customer and service-related outcomes, Chen et al. (2021) intend to analyse the influence of FinTech products (FTPs) on the operational effectiveness of Chinese commercial banks through employing quantitative methods with customized surveys from the perspective of customer and employee. The findings indicate that the perceived usefulness (PU) and difficulty use (PD) of FTPs positively and significantly impact the service quality provided by banks and enhance employee work efficiency. Moreover, there is a noteworthy positive relationship between the PU of FTPs and customer satisfaction and reduced expectation for assistance from bank employees. On the other hand, the PD of FTPs negatively affects customer satisfaction and lowers their expectations for assistance.

From the perspective of banking performance, Muthaura et al. (2021) conduct a regression analysis to examine the impact of FinTech on the performance of Kenyan commercial banks. The findings demonstrate that FinTech has enhanced the operational performance of Kenyan commercial banks by transforming their business models and alternative channels. The study conducted by Adiga et al. (2022) investigates the impact of FinTech on the performance of banks in Nigeria using the Auto Regressive Distributed Lag model. The findings demonstrate that FinTech significantly influences the ROA, ROE, interest income and non-interest income of Nigerian deposit banks. However, its effect on changes in interest income remains inconclusive. Baker et al. (2023) observe a positive

correlation between FinTech adoption and growth in deposits and net profits among banks in Amman and Abu Dhabi through employing both questionnaires and multiple linear regression analysis, underscoring the critical role of financial inclusion and automation in modern banking services. Yudaruddin (2023) identifies a dual impact: although FinTech startups present challenges to conventional banking institutions, they offer significant advantages to Islamic banks, particularly via innovations in peer-to-peer lending and digital payment systems, highlighting the differential influence of FinTech across banking sectors.

In contrast to prior studies that solely rely on financial indicators for instance ROA, ROE and other key financial metrics for assessing bank performance, Ogbuji et al. (2020) employ the CAMELS methodology to evaluate the performance of banks through the indicators of capital adequacy, assets quality, management efficiency, earnings, liquidity and sensitivity to market, and then examine the performance of FinTech implementation and conventional bank operation in Nigeria through a comparative analysis. Conclusions reveal that between 2012 and 2018, WEMA bank experienced better performance from its digital FinTech operations compared to its payment FinTech operations. Notably, digital FinTech operations have a consistently positive influence on the WEMA bank's overall performance during the period spanning from 2017 to 2018.

Additionally, some scholars have conducted extensive research on the impact of FinTech on banking efficiency. Wang et al. (2021) apply a DEA-Malmquist approach to demonstrate that the incorporation of FinTech contributes to increased profitability, financial innovation, risk management capabilities and cost savings within China's banking sector. Conversely, Lee et al. (2023) argue that FinTech development may diminish efficiency due to increased debt costs, with effects varying significantly across bank categories and regional

contexts. Xiong (2023), through the application of a three-stage super-efficiency SBM model, reveals that the involvement of FinTech personnel and the prolonged operation of FinTech subsidiaries positively influence efficiency, while large-scale investments could potentially hinder pure technical efficiency.

The summary of the related literature review of the empirical studies on FinTech and bank is shown in Table 2.4. In summary, existing research illustrates that FinTech has a complex and varied impact on commercial banks. While many studies indicate positive outcomes in terms of customer satisfaction, financial performance, and operational efficiency, others point to negative or context-dependent effects, influenced by factors such as the type of bank, market conditions, and the extent of investment in FinTech. However, overdependence on FinTech initiatives can lead to cost inefficiencies. Overall, the findings suggest that the influence of FinTech is not universal but rather situational, emphasizing the need for banks and regulatory bodies to carefully align technological innovation with long-term sustainability and effective risk control strategies.

Table 2.4: Summary of the Empirical Studies on FinTech and Bank

Author(s) & Year	Country (Sample period)	Methodology	Findings
Chen et al. (2021)	China	• Quantitative approach • Two self-designed questionnaires	• Perceived usefulness enhances service quality, employee efficiency, and customer satisfaction. • Perceived difficulty improves service quality but lowers satisfaction and expectations for assistance.
Muthaura et al. (2021)	Kenya (2014-2018)	• Regression analysis	• FinTech enhances performance by transforming business models and expanding alternative channels.
Adiga et al. (2022)	Nigeria (2005-2020)	• ARDL model	• FinTech significantly affects ROA, ROE, and non-interest income. • Effect on interest income is inconclusive. • Recommends adoption facilitation and stronger security.

Table 2.4 continued

Author(s) & Year	Country (Sample period)	Methodology	Findings
Baker et al. (2023)	Amman & Abu Dhabi (2012-2020)	• Questionnaires • Multiple linear regression analysis	• FinTech positively influences deposits and net profits, supporting inclusive approaches for long-term growth.
Yudaruddin (2023)	Indonesia (2004-2018)	• GMM	• Negative effect on conventional banks. • Positive effect on Islamic banks, especially in P2P lending and payments.
Ogbuji et al. (2020)	Nigeria (2012-2018)	• CAMELS methodology • Comparative analysis	• Digital FinTech operations improved WEMA Bank's overall performance, stronger than payment-related FinTech.
Wang et al. (2021)	China (2011-2020)	• DEA-Malmquist model • Fixed effect model	• FinTech improves profitability, innovation, risk management, lowers costs, and enhances service efficiency. • Outcomes vary across banks.
Lee et al. (2023)	China (2012–2019)	• DEA-Malmquist • Text mining • GMM	• Overall FinTech development reduces efficiency due to higher debt costs. • Urban/rural banks most affected, joint-stock least. • Regional differences observed.
Xiong (2023)	China (2019–2021)	• Super-efficiency SBM model • Tobit regression	• More FinTech personnel improve efficiency. • Investment increases scale efficiency but reduces technical efficiency. • Longer FinTech subsidiary presence boosts efficiency for joint-stock banks but lowers scale efficiency for state-owned banks.

2.11 Empirical Studies of FinTech and Bank Profitability

A comprehensive analysis of contemporary academic literature indicates that the rapid evolution of FinTech has substantially and fundamentally reshaped the traditional operational structures of commercial banking entities. As a technological advancement driving financial innovation, FinTech has not only enhanced the efficiency of financial resource allocation but also significantly reinforced the profitability of financial institutions. Li (2020) employs fixed effects and system GMM models to empirically examine the impact of FinTech on the profitability of 13 publicly listed banks in China. The findings demonstrate

that a positive correlation exists between advancements in internet, mobile payments, cloud computing, and ROA among commercial banks, which confirms that FinTech has a promoting effect on the profitability and development of these institutions. Yu and Yu (2021) concludes that FinTech exerts a positive impact on the profitability of Chinese commercial banks through empirical analysis, particularly for those with larger asset sizes where the promotional effect on profits is more pronounced. Li et al. (2022) demonstrates through empirical investigation that the revenue advantages of FinTech exceed its cost implications, suggesting that profitability can be enhanced through the optimization of payment processes and the adoption of innovative business models. The study conducted by Chhaidar et al. in 2022 emphasizes the interplay between investments in FinTech and the overall performance of European banks, as well as the impact of bank size on digital transformation outcomes. The findings suggest that elevated levels of digitization contribute to improved profitability. Furthermore, larger financial institutions derive greater benefits from FinTech adoption, with bank size serving as a moderating variable in this relationship. Consequently, enhanced investment in FinTech represents a viable strategy for boosting banking performance, particularly among large-scale banks.

Moreover, Nugroho and Sugiyanto (2023) investigate the effect of FinTech on bank profitability and examine the variations in profitability as FinTech evolves in Indonesia. Based on their research findings, it can be concluded that the phenomenon of FinTech innovation in the banking industry does not pose a disruption but rather presents opportunities for developing FinTech services and enhancing bank profitability. Additionally, Wang et al. (2024) conduct an empirical analysis of how FinTech innovation affects the commercial banks' sustainable profitability. The results suggest that FinTech advancements have substantially improved these commercial banks' operational efficiency

and profitability. More specifically, advancements in critical areas such as digital payment systems and blockchain technology are considered to be the core driving forces behind this positive change. Tong and Yang (2025) highlight that the integration of advanced technologies such as big data analytics and cloud computing allows commercial banks to better address customized customer demands, develop innovative financial solutions, expand credit access to small and medium-sized enterprises, and ultimately improve asset yield. Furthermore, the application of big data and blockchain enhances risk detection capabilities, minimizes potential threats, and strengthens institutional stability, which in turn supports greater profitability.

However, some scholars contend that the advancement of FinTech could potentially exert a detrimental influence on the profitability of commercial banks and present substantial challenges to their operations. According to Wang (2018), his study indicates that the development of FinTech will accelerate the process of interest rate marketization, leading to intensified competition among banks, thereby reducing bank profits and increasing their risk exposure levels. The research conducted by Li and He (2021) suggests that the proliferation of FinTech will intensify competition between commercial banks and non-bank institutions, yet it has not yielded the anticipated profitability effects. However, the widespread adoption of FinTech aids in enhancing banks' revenue levels. Furthermore, further advancements in FinTech may exert pressure on Chinese commercial banks' profit margins and increase their exposure to risks, while simultaneously presenting novel challenges for financial regulation. Mansour (2024) asserts that the competitive pressures introduced by FinTech exceed the positive effects of technological spillovers, ultimately leading to a decrease in the profitability of commercial banks.

Zhao et al. (2022) apply patent data and the FinTech development index to analyse the specific influence of FinTech innovation on the profitability of Chinese banking institutions. The results demonstrate that, on the whole, FinTech innovation exerts a negative effect on bank profitability and asset quality, with the adverse impact being particularly pronounced in large state-owned commercial banks. Corbet et al. (2023) develop a regression model to examine the impact of FinTech innovation on the profitability of listed banks in China. The findings indicate that there is a significant negative correlation between FinTech innovation and bank profitability. Furthermore, state-owned banks, joint-stock commercial banks and banks with a longer operating history are more substantially affected by the adverse effects of FinTech innovation compared to city commercial banks, rural commercial banks and banks with a shorter establishment period.

Elmahdy et al. (2025) utilize the GMM model to investigate the impact of FinTech on Egyptian bank profitability. Additionally, the study examines the mediating role of banks' operational efficiency and the moderating effect of bank size during the digital transformation process. The empirical findings indicate a significant negative correlation between FinTech adoption and bank profitability in the Egyptian market. This relationship may be ascribed to the high costs associated with digital transformation and the uncertainty of the macroeconomic environment. Moreover, the results reveal that banks' operational efficiency partially mediates the relationship between FinTech and profitability. However, bank size does not significantly moderate this relationship. Notably, because of the high volatility of returns, there is a significant negative correlation between bank size and profitability.

Moreover, several scholars have underscored that the relationship between FinTech and commercial banks extends beyond a straightforward linear connection, indicating a more complex and dynamic non-linear interaction. Lv et al. (2022) observe that the effect of FinTech on the profitability of the Industrial and Commercial Bank of China demonstrates a U-shaped trajectory, characterized by an initial decrease followed by a gradual recovery and upward trend. Wang and Zhu (2022) reveal that FinTech represents a positive impact on the operational efficiency of commercial banks as well as customer satisfaction. However, in the short term, investment in FinTech exhibits a certain degree of inhibitory effect on the profitability of Chinese listed commercial banks, particularly for small and medium-sized institutions which experience more pronounced effects compared to larger-scale commercial banks. For Song et al. (2023), they empirically examine how FinTech impacts the profitability of commercial banks through competition and technology spillover effects. The research findings indicate that in the immediate term, there exists an inverse relationship between FinTech advancement and the profitability of commercial banks. However, over time, the progress in FinTech positively contributes to enhancing the profitability of commercial banks. Additionally, the profitability of various categories of commercial banks is influenced differently by the emergence of FinTech, with small and medium-sized banks initially encountering temporary obstacles but having the potential to gain long-term advantages as FinTech advances. In general, widespread adoption and innovation in FinTech are expected to ultimately enhance the profitability of commercial banks.

Table 2.5 provides a summary of the aforementioned scholarly literature. A substantial body of scholarly work highlights the beneficial effects of FinTech on bank profitability (Li, 2020; Yu & Yu, 2021; Li et al., 2022; Chhaidar et al., 2022; Nugroho & Sugiyanto, 2023; Wang et al., 2024; Tong & Yang, 2025). These benefits are primarily

attributed to enhancements in operational efficiency, customer satisfaction, transaction processing speed, and the emergence of novel business models. Notably, large financial institutions derive the greatest advantages, largely due to their ability to capitalize on economies of scale. In contrast, a distinct line of research identifies negative consequences associated with FinTech integration (Wang, 2018; Li & He, 2021; Mansour, 2024; Zhao et al., 2022; Corbet et al., 2023; Elmahdy et al., 2025). These studies associate declining profitability with intensified market competition, narrowing profit margins, significant digital transformation expenditures, and adverse macroeconomic or regulatory environments. Moreover, a third group of studies uncovers complex, time-dependent patterns (Lv et al., 2022; Wang & Zhu, 2022; Song et al., 2023). These analyses suggest that while profitability may experience a temporary decline in the short term due to initial investment costs, it tends to improve over the long term as operational learning progresses, synergistic effects develop, and the scale of adoption increases. Smaller and mid-sized banks are particularly vulnerable to short-term financial pressures. Collectively, the literature indicates that the impact of FinTech on profitability is not uniform but rather mediated by a range of institutional and contextual factors, including bank size, cost structures, the competitive and regulatory landscape, and the temporal dimension.

Table 2.5: Summary of the Empirical Studies on FinTech and Bank Profitability

Author(s) & Year	Country (Sample period)	Methodology	Findings
Li (2020)	China (2007–2015)	• Fixed effects model • GMM	• A positive correlation between advancements in internet, mobile payments, cloud computing, and ROA. • FinTech improved profitability by restructuring assets, automating tasks, and enhancing customer experience.

Table 2.5 continued

Author(s) & Year	Country (Sample period)	Methodology	Findings
Yu & Yu (2021)	China (2010-2018)	• GMM	• Positive impact of FinTech on profitability. • Effect stronger for larger banks.
Li et al. (2022)	China (2011-2020)	• Fixed effects model	• FinTech enhances profitability through settlement efficiency and innovative business models. • Revenue effects > cost effects.
Chhaidar et al. (2022)	European (2010-2019)	• Ordinary least squares model	• FinTech positively impacts profitability. • Larger banks benefit more.
Nugroho & Sugiyanto (2023)	Indonesia (2012-2017)	• Descriptive quantitative approach • Multiple linear regression analysis	• FinTech innovation enhances profitability, not disruptive.
Wang et al. (2024)	China (2011-2021)	• Fixed effects model • GMM	• FinTech boosts efficiency and profitability, especially via payments and blockchain.
Tong & Yang (2025)	China (2013-2020)	• Fixed effect model	• FinTech improves profitability via technology adoption and better risk management.
Wang (2018)	China (2003–2016)	• Fixed effects model	• FinTech accelerates interest rate liberalization, intensifies competition, reduces profitability and raises risk.
Li & He (2021)	China (2011–2018)	• Fixed effects model	• Intensified competition reduces margins. • Revenue levels rise but profit pressure increases.
Mansour (2024)	China (2011–2018)	• Fixed effects model	• FinTech’s competitive pressures outweigh technological spillover benefits, reducing commercial bank profitability.
Zhao et al. (2022)	China (2003–2018)	• CAMELS methodology • GMM	• FinTech innovation generally harms bank profitability and asset quality, especially in large state-owned commercial banks.
Corbet et al. (2023)	China (2015–2020)	• Regression model	• Negative correlation between FinTech and bank profitability. • State-owned and long-established banks most affected.
Elmahdy et al. (2025)	Egypt (2015–2022)	• GMM	• FinTech adoption negatively affects profitability. • Operational efficiency partially mediates the relationship, but bank size does not significantly moderate it. • Bank size is negatively correlated with profitability.
Lv et al. (2022)	China (2011–2020)	• Error correction model • Granger cause	• FinTech has a “U”-shaped impact on the banks’ profitability.

Table 2.5 continued

Author(s) & Year	Country (Sample period)	Methodology	Findings
Wang & Zhu (2022)	China (2011–2020)	• Fixed effects model	• FinTech improves efficiency and satisfaction. • Short-term inhibitory effect on profitability, particularly for small and medium-sized banks.
Song et al. (2023)	China (2012–2021)	• Fixed effects model	• FinTech initially has a negative short-term impact on profitability but turns positive in the long run. • Different types of banks are affected differently.

2.12 Literature Gap

Through a comprehensive review of the existing literature, it becomes evident that both domestic and international academia predominantly focuses on profitability as the primary evaluation criterion for commercial banks. Consequently, many researchers tend to rely solely on indicators such as ROA or ROE when measuring their overall profitability. However, this narrow approach fails to fully capture the multifaceted aspects of commercial banks' performance in terms of liquidity, operational security, and future development potential in the context of FinTech adoption and advancement. As a result, current research findings are unable to effectively unveil the holistic impact of FinTech development on the banking industry. Therefore, this study aims to comprehensively examine three key dimensions: safety, liquidity and profitability of commercial banks by employing factor analysis to select seven secondary indicators that collectively construct a relatively comprehensive index capable of reflecting their overall profitability capability. This index will serve as the dependent variable enabling a more comprehensive and accurate measurement of commercial banks' comprehensive profitability capability.

Most scholars typically use city-level or provincial-level data from the Digital Inclusive Finance Index of Peking University to construct the FinTech index, yet this approach has certain limitations. In prior studies that utilized city-level or provincial-level data, the construction was predominantly based on the data of cities or provinces where bank headquarters were located. However, since the headquarters of major banks are concentrated in a few cities such as Beijing and Shanghai, this method leads to a lack of differentiation in the FinTech index and fails to accurately reflect the actual business operations of banks. In this study, by systematically collecting and organizing the number of institutional outlets for each bank in each province, and then integrating the provincial-level financial institutional outlet data with the Digital Inclusive Finance Index of Peking University through weighted processing, this method can not only more precisely depict the development status of FinTech among bank branches but also uncover the uneven development of FinTech across different regions.

In the study of the impact of FinTech on bank profitability, its positive effects are often emphasized. Specifically, banks can enhance their profitability by reducing costs, improving efficiency and mitigating risks through the application of FinTech. However, when examining the adverse effects brought about by FinTech, more attention is typically given to external shocks while less consideration is given to the erosion of bank profitability during the early stages of FinTech development. Therefore, this thesis aims to explore the non-linear impact on profitability by investigating variations in FinTech adoption levels among banks at different stages and find the specific inflection point of FinTech development. The objective is to provide a more comprehensive and precise research outcome.

Based on the analysis of literature quantity and content, it is evident that there exists a significant body of research investigating the impact of FinTech on bank profitability. However, these studies demonstrate noticeable homogeneity. Conversely, limited attention has been given to exploring the relationship between FinTech, income diversification and bank profitability. Therefore, it would be both innovative and valuable to examine these dimensions within a unified research framework, thereby expanding perspectives in related fields.

This study not only investigates the direct impact of FinTech on the profitability of commercial banks but also selects variables from the dimensions of competition and risk to explore the transmission mechanism through which FinTech affects the profitability of commercial banks. This approach contributes to a more comprehensive clarification of the relationship between FinTech and bank profitability, thereby enhancing the persuasiveness of the conclusions. Furthermore, in the group analysis, given the influence of the epidemic, the data is segmented into pre-epidemic and post-epidemic periods for comparative analysis, allowing for a deeper examination of how FinTech impacts the profitability of commercial banks under different economic conditions.

CHAPTER 3

METHODOLOGY

3.1 Introduction

This chapter primarily presents the research methodologies employed in this thesis, specifically addressing the resolution of issues raised in the preceding section. This segment is divided into four sections. Firstly, it provides an elaborate discussion on data types and sources. Secondly, it examines various categories of variables encompassing dependent variables, independent variables, moderating variables, mediating variables, and control variables. The third part offers a comprehensive introduction to panel data along with diverse forms of static panel data models such as Pooled Ordinary Least Squares model, Fixed Effects models, and Random Effects models. The final section focuses on elucidating specific model designs.

3.2 Data Description

Due to data availability, this thesis employs a balanced panel dataset comprising 50 listed commercial banks, including 15 listed on the both A-share and H-share market, 27 listed on the A-share market and 8 on the H-share market. Moreover, these banks comprise 5 large state-owned banks, 10 joint-stock banks, 24 city commercial banks and 11 rural commercial banks, they hold significant positions in the Chinese banking industry¹. As of the end of 2023, the total assets of these publicly listed banks had surpassed 289 trillion yuan, constituting approximately 70% of the overall asset base of Chinese commercial banks. This

¹ Please refer to Appendix A for the details.

data highlights the critical importance and considerable influence of these banks within the Chinese banking system, and confirms their representative status within the industry. On May 18, 2011, the People's Bank of China issued payment business licenses to 27 third-party payment companies. This event marked the beginning of the integration of the Internet and finance and signified that the third-party payment sector had been formally integrated into the government regulatory framework. Therefore, this thesis selects relevant data from these listed banks for the years between 2012 and 2023 as sample data. The data is sourced from Wind, CSMAR databases, China Banking and Insurance Regulatory Commission (CBIRC), and annual reports of various listed commercial banks.

Regarding the FinTech Index, this study primarily utilizes Digital Inclusive Finance Index, created by the Digital Finance Research Center at Peking University, to quantitatively evaluate the advancement of regional FinTech. In addition, macroeconomic indicators such as Gross Domestic Product (GDP) and inflation rate mainly come from official website published by China's National Bureau of Statistics. In the subsequent data analysis of this thesis, the statistical software Stata 18.0 is employed and in order to mitigate the adverse effects of sample outliers on regression estimation, all continuous variables are subjected to 1% winsorization at both the upper and lower tails.

3.3 Description of Variables

3.3.1 Dependent Variable

The profitability of commercial banks serves as a measure of their capacity to generate profits across various business areas, encompassing their ability to efficiently utilize funds and control costs. While conventional evaluation often relies on single indicators such as ROA or ROE, these fail to fully capture the comprehensive profitability

of commercial banks. To address this limitation, this study draws upon research methodologies employed by Liu and Wang (2021), Li (2023), Zhang and Xue (2023). Moreover, drawing upon the latest “Commercial Bank Performance Evaluation Measures” issued by China’s Ministry of Finance, the distinctive features of the Chinese banking industry, and the annual reports of commercial banks, this study establishes a comprehensive profitability index system for commercial banks based on three dimensions: safety, liquidity, and profitability, in alignment with the operational “three principles” guiding Chinese commercial banks.

Profitability indicators are crucial metrics utilized to assess the profit-generating capacity of commercial banks. This thesis examines four indicators: return on equity, return on assets, cost-to-income ratio and non-interest income ratio. Return on equity reflects the capital structure and profitability efficiency of commercial banks, with a higher value indicating effective utilization of shareholder funds for maximizing profits (Mudzakar and Wardanny, 2021). Return on assets represents the overall effectiveness of a commercial bank in utilizing its assets to generate profits and serves as a key indicator for evaluating profitability (Kurniawan, 2021). The cost-to-income ratio measures the proportion between costs incurred by a commercial bank and income generated, with a lower value indicating enhanced operational efficiency and robust profit potential (Ayinuola and Gumel, 2023). The proportion of non-interest income is the ratio of non-interest income to operating income of commercial banks (Abu Khalaf et al., 2024). It is an important indicator to measure the diversification of the bank’s income structure and can reflect the ability of the bank to obtain income other than interest income (Mehzabin et al, 2023). The higher this indicator is, the lower the bank’s sensitivity to interest rate fluctuations, and the more stable of the bank’s profitability.

In contrast, Return on investment (ROI) has limited applicability within the commercial banking industry. This metric is primarily used in project evaluation and corporate investment analysis, where the key concern is the return generated relative to the costs involved. However, commercial banks differ fundamentally from non-financial firms in their operational structure, as their primary role centers on interest income and financial intermediation rather than engaging in distinct investment projects. Consequently, ROI fails to accurately capture the overall profitability of banks and is rarely utilized by banking regulators or in academic research as a standard measure of financial performance. Thus, ROI does not incorporate the comprehensive profitability index.

Liquidity indicators gauge the extent of liquidity risk in commercial banks, which directly impacts their capacity to offer financing services to customers or fulfil deposit interest obligations, thereby significantly influencing their profitability. The loan-to-deposit ratio represents the proportion of a commercial bank's outstanding loans to its deposit balance (Shodroкова et al., 2023). This ratio not only reflects the equilibrium between loans and deposits but also indicates the efficiency of fund utilization within commercial banks (Kowoon et al., 2022). A higher ratio signifies increased potential for fund utilization through expanding loan size, thus bolstering profitability.

The safety indicators are utilized to evaluate the risk tolerance and safety level of commercial banks' balance sheets. Enhancing these indicators aids in mitigating risks faced by banks, upholding asset quality, reducing potential losses and risks, and fostering a more stable operational environment for banks, thereby augmenting profitability. This research employs the provision coverage ratio and non-performing loan ratio as metrics of safety. The provision coverage ratio is defined as the ratio of the balance of loan loss provisions to the

balance of non-performing loans, indicating the extent to which commercial banks cover potential losses from non-performing loans (Alessi et al., 2021). It serves as a critical indicator for assessing the risk-resisting capability of commercial banks. A higher ratio suggests that commercial banks have adequate reserves to address possible loan losses, thereby strengthening their capacity to withstand risks (Yu and Li, 2023). Nevertheless, an excessively high ratio might also impact profit distribution. The non-performing loan ratio of commercial banks reflects the percentage of non-performing loans in relation to total loans (Swandewi and Purnawati, 2021). A lower non-performing loan ratio generally signifies that a commercial bank possesses stronger risk management capabilities, can effectively control credit risks and losses, and aid in enhancing profitability (Atisu et al., 2024).

In conclusion, the indicators used to measure profitability can be presented in Table 3.1. The comprehensive profitability indicator for commercial banks in this thesis is primarily constructed using factor analysis. Firstly, the original data of the banks are standardized to eliminate the influence of differences in dimensions and numerical scales on various indices. Secondly, the processed data's applicability is verified, followed by conducting factor analysis. Subsequently, common factors are extracted where applicable, and their contribution ratio of variance is used as a weight. Finally, a weighted approach is employed as equation 3.1 to calculate index values and their respective proportions for each common factor in commercial banks, thereby providing a comprehensive evaluation of their profitability levels. PRO represents the comprehensive profitability of commercial banks. Factor 1, Factor 2 and Factor 3 denote the hypothetical extraction of three common factors, respectively. These three common factors are multiplied by their respective variance percentages after factor rotation. The sum of these results is then divided by the cumulative variance percentage to derive the composite indicator of profitability.

$$\text{PRO} = (\text{Factor 1} * \text{Proportion} + \text{Factor 2} * \text{Proportion} + \text{Factor 3} * \text{Proportion}) / \text{Cumulative Proportion}$$

Equation. 3.1

Table 3.1: Construction of Profitability Indicator for Commercial Banks

Indicator Type	Indicator Name	Indicator Symbol	Formula
Profitability Index	Return on equity	ROE	Net income / average equity*100%
	Return on asset	ROA	Net income / average assets*100%
	Cost-to-income ratio	CIR	Management costs / operating income*100%
	Non-interest income ratio	NIIR	Non-interest income / operating income*100%
Liquidity Index	Loan-to-deposit ratio	LTDR	Loans / deposits*100%
Safety Index	Provision coverage ratio	PCR	loan loss provisions / non-performing loans*100%
	Non-performing loan ratio	NPLR	Non-performing loans / total loans*100%

3.3.2 Independent Variable

The development status of FinTech in commercial banks serves as the core explanatory variable in this study. Currently, there are a limited number of institutions that have published FinTech indices. However, their authority is insufficient. Moreover, there is a scarcity of academic studies on the construction of FinTech indices. Presently, two main methods exist for constructing FinTech indicators. One approach involves utilizing Peking University's Digital Inclusive Finance Index, which assesses the development of digital finance based on coverage breadth, depth of usage and degree of digitization (Wang and Wu,

2018; Deng et al., 2021; Che, 2023; Song et al., 2023). This method offers objectivity and comprehensiveness.

Another method entails referring to Guo and Shen (2015) text mining approach for constructing an internet finance index. Then Wang (2018), Qiao and Huang (2019), as well as Wu and Zhang (2023) employ text mining techniques to construct a FinTech development index building upon the research conducted by Guo and Shen (2015). This method should build keywords from FinTech application scenarios firstly, then Python programming techniques are employed to conduct searches on Baidu by combining bank names with keywords and years to obtain page frequency data for each combination word. Additionally, factor analysis is utilized to construct to form a comprehensive FinTech index. This index construction method allows for building the index from the internal level of the banks, however, it exhibits a relatively high degree of subjectivity. If the selected keywords were to change, the FinTech index would fluctuate accordingly, potentially undermining the stability of the constructed index.

Therefore, taking into account the availability, objectivity and stability of the data, this study employs the Digital Inclusive Finance Index developed by the Digital Finance Research Center of Peking University to quantitatively assess the development level of regional FinTech referring to Wang and Wu (2018), Sheng and Fan (2020), Deng et al. (2021), Xiong et al. (2021), Che (2023), Song et al. (2023), Bu and Tang (2024), Wei and Yang (2024) and Tang et al. (2024). This index is constructed based on 33 indicators derived from three dimensions: the coverage of FinTech services, the depth of usage, and the degree of digitalization. It leverages the extensive transaction account data provided by Ant Group, China's largest FinTech company, to comprehensively depict the development status of

FinTech across provinces, cities and counties in China. As a leading enterprise in China's FinTech sector, Ant Group's products such as Alipay and Yu'E Bao exert significant influence in areas such as mobile payment and investment management. The robustness and reliability of its data sources provide a solid foundation for evaluating the development level of FinTech in the sample regions.

Most existing literature employs the Digital Inclusive Finance Index of the city where a bank's headquarters is located to measure the development level of FinTech (Song et al., 2023; Bu and Tang, 2024; Chen and Shen, 2024; Wei and Yang, 2024). However, during data analysis, it has been observed that many bank headquarters are concentrated in developed cities such as Beijing and Shanghai, whereas their operational branches are distributed across various cities throughout China. Since the primary business activities of banks are typically conducted at these branches, which are directly influenced by FinTech, relying solely on the inclusive finance index of the city where the headquarters is located may lead to an underrepresentation of the actual differences in FinTech levels among sample banks. Consequently, this approach fails to comprehensively reflect the true FinTech environment in which banks operate. To address this issue and account for regional variations in bank operations, this study utilizes financial license information from the National Financial Regulatory Administration of China. By incorporating the number of bank branches in each province as a weighting factor, the thesis calculates a provincial inclusive finance index, thereby providing a more precise representation of the FinTech environment surrounding bank operations. The specific formula is as follows.

$$FinTech_{i,t} = \sum_{p=1}^N FinTech_{p,t} \frac{Branch_{p,i}}{Branch_i} \quad \text{Equation 3.2}$$

Among these variables, $FinTech_{i,t}$ denotes the level of external FinTech development for bank i at time t ; $FinTech_{p,t}$ indicates the inclusive FinTech development index of province p at time t ; $Branch_{p,i}$ signifies the number of branches that bank i has in province p ; $Branch_i$ represents the total number of branch outlets of bank i across China; N stands for the total number of provinces in China. Furthermore, given the substantial disparity in scale between the Digital Inclusive Finance Index and the profitability of commercial banks, the derived index is normalized by dividing it by 100 for consistency in analysis.

3.3.3 Moderating Variable

The main sources of income for commercial banks are interest and non-interest income. Non-interest income consists of fee and commission income, as well as other non-interest income, including investment gains, fair value changes in financial instruments, foreign exchange gains, and other operating income (Zuo and Ma, 2019). In order to assess the diversity of a commercial bank's revenue structure, this study adopts the Herfindahl index for measurement. The Herfindahl-Hirschman Index (HHI), developed by Hirschman and Herfindahl, was initially designed as a comprehensive measure to assess industry concentration (Šestanovic et al., 2023). It has since been widely adopted by economists and government regulatory agencies to evaluate the degree of operational diversity within the banking sector. A higher value of this index indicates a more diversified revenue structure for commercial banks. The calculation formula is as follows:

$$HHI = 1 - \sum_{i=1}^n p_i^2 \quad \text{Equation 3.3}$$

where, the term p_i refers to the proportion occupied by the i -th business.

Therefore, based on the profit structure and Herfindahl index of commercial banks, the thesis constructs the revenue diversification index for commercial banks as follows.

$$DIV = 1 - (NET^2 + NII^2) \quad \text{Equation 3.4}$$

where, DIV denotes revenue diversification, NET represents the ratio of net interest income to operating income, NNI denotes the percentage of non-interest income to total operating revenue.

3.3.4 Mediating Variables

In order to verify whether the impact of FinTech applications on bank profitability is correlated with the level of banking industry competition and risk-taking, this study introduces the Lerner index and risk-taking level as measurement criteria. Firstly, Lerner index can be used to evaluate the concentration degree of market share in the banking industry, reflecting the external competitive environment that companies are facing. The calculation method simplifies to subtracting operating costs from operating income as a percentage of total operating income (Peress, 2010; Datta et al., 2011). A higher Lerner index indicates a more intense external competitive environment.

$$\text{Lerner} = (\text{operating income} - \text{operating costs}) / \text{total operating income} \quad \text{Equation 3.5}$$

As for banks' risk-taking levels, at present, the risk measurement indicators commonly adopted by scholars include the Z-score, expected default rate, non-performing loan ratio and provision coverage ratio. The Z-score is closely associated with the bankruptcy risk of commercial banks. However, given the unique and critical role of commercial banks in China, as well as the stringent regulatory oversight by the government over the financial sector, the likelihood of bank bankruptcies remains exceedingly low (Tang et al., 2024). Moreover, due to the underdeveloped nature of China's credit rating system,

the expected default rate struggles to accurately capture the risks faced by commercial banks. The provision coverage ratio represents the proportion of loan loss provisions relative to non-performing loans within commercial banks. Compared to the non-performing loan ratio, this indicator also considers the extent to which non-performing loans are covered (Alessi et al., 2021; Yu and Li, 2023). Consequently, it provides a more direct measure of the risk status of commercial banks. A higher provision coverage ratio indicates a stronger capacity for banks to withstand risks and implies lower levels of risk exposure. For ease of result interpretation and compressing the high coverage rate to a value close to 0 to minimize the impact of extreme values on the model, this study adopts the approach proposed by Yu and Li (2023) and utilizes the reciprocal of the provision coverage ratio, specifically, the ratio of non-performing loans to loan loss provisions. This indicator will be employed to assess the operational risks of commercial banks for empirical analysis in the subsequent chapter.

3.3.5 Control Variables

Referring to the previous literature review, when selecting control variables, considerations can be made at the level of commercial banks and macroeconomic development level. In terms of macroeconomic development, variables such as the growth rate of Gross Domestic Product (GDP) and Consumer Price Index (CPI) can be chosen to measure GDP and inflation (Saif-Alyousfi, 2022). The GDP growth rate is positively correlated with national economic development, a higher ratio indicates faster regional economic growth. The development of commercial banks is closely linked to a country's economy. Generally speaking, improving national economic development helps increase profitability for commercial banks. In a continuously growing external environment, commercial banks will have relatively stable room for expansion and enhance financial market vitality. This will also lead to increased demand for financial services from

consumers, thereby expanding business scale and improving profit levels for commercial banks. Therefore, this study has selected GDP growth rate as one of the control variables.

Additionally, under the circumstances of a stable economy and moderate inflation, an increase in the CPI is likely to result in higher loan interest rates. However, in the short term, the adjustment of deposit interest rates will lag behind that of loan interest rates. This may lead to an expansion of the interest margin for commercial banks, thereby increasing bank profits. Furthermore, as CPI rises, the real interest rate is expected to decline, which could encourage enterprises to expand their loan demand, further enhancing bank profitability. During periods of inflation, residents tend to allocate more of their assets into items such as gold, mutual funds and real estate. As a result, the commission-based businesses of commercial banks are likely to grow, leading to an increase in non-interest income. Henceforth, inflation levels are also likely to affect the profitability performance of commercial banks and should be included as another control variable representing the macroeconomic environment by measuring inflation rates using year-on-year growth rate of CPI.

Relevant to the study by Jadah et al. (2020), this thesis selects bank size, net interest margin and loan-to-asset ratio as control variables from the aspect of bank's own level. The scale of a bank's development is typically assessed based on its asset size. According to the principle of economies of scale, as a commercial bank's assets increase, marginal costs decrease, resulting in enhanced operational capabilities and a wider range of products and services, ultimately leading to improved profitability levels. However, beyond a certain threshold of assets, challenges such as escalating cost expenses, suboptimal resource utilization, and imperfect coordination gradually arise with further expansion. Consequently,

this leads to diminishing marginal returns or even negative values that adversely impact the bank's profitability levels. Therefore, it becomes imperative to select control variables for measuring banks' profitability levels in empirical research studies. Moreover, the substantial numerical values associated with total assets require logarithmic transformation for empirical analysis.

Net interest margin (NIM) refers to the ratio of a commercial bank's net interest income to its total interest-earning assets, reflecting the strength of its traditional lending and deposit-taking business operations (Puspitasari et al., 2021). A higher net interest margin usually indicates stronger profitability for the bank. This indicator is crucial in evaluating a bank's profit-making ability as it directly relates to its net interest income and serves as a basis for assessing operational efficiency and market competitiveness (Rahagi et al., 2023). Using net interest margin as a control variable can eliminate differences in operating levels among different banks, ensuring that other variables are compared based on similar operating levels. At the same time, since controlling the level of interest rates is difficult, using net interest margin as a control variable also helps eliminate the impact of such factors on results.

The loan-to-asset ratio (LTA) denotes the proportion of total loans to total assets, and a higher bank credit ratio indicates a larger share of the loan business (Dwitama and Hasanudin, 2024). However, in an environment characterized by interest rate marketization, this may result in a decline in banks' interest income. To address the pressure of diminishing profits due to narrowing interest spreads, banks need to enhance their non-interest income through intermediary activities and financial innovation. Simultaneously, a high credit ratio may be accompanied by an increase in non-performing loans and bad debt stock, both of which can have adverse effects on banks' profitability (Tang and Yang, 2025).

To summarize, from a macroeconomic perspective, this study selected control variables to capture the overall economic context. Specifically, the GDP growth rate (GGDP) was employed as an indicator of economic development, while the year-on-year growth rate of CPI (GCPI) served as a measure of inflation. At the bank level, this study incorporated bank size, net interest margin and loan-to-asset ratio as control variables reflecting individual characteristics. Furthermore, in the robustness test section, additional control variables were introduced, including industry-level market concentration ratio (CR4), bank-level asset-liability ratio (ALR), and a dummy variable (COV) representing the impact of the COVID-19 pandemic.

According to Horobet et al. (2021), Saif-Alyousfi (2022) and O'Connell (2023), from the perspective of the commercial banking industry, this research considers market concentration as a control variable. Given the heterogeneity of FinTech across different commercial banks, the primary focus lies on assessing competition levels within the banking industry at an industry-wide level. To measure market concentration, the study utilizes the ratio of total assets held by China's four major state-owned commercial banks (Bank of China, Agricultural Bank of China, Industrial and Commercial Bank of China, and China Construction Bank) to the total assets held by all banks nationwide. This metric serves as an indicator for market concentration due to these four commercial banks' significantly larger scale compared to other institutions in this sector. Moreover, their higher levels of concentration and market share in the financial market signify their stronger competitiveness within this industry and ability to enhance overall profitability.

Li et al. (2022) argue that the asset-liability ratio serves as a relatively critical control variable at the bank level. This variable represents the proportion of total liabilities to total

assets within a bank. A higher ratio signifies greater reliance on liability financing, which reduces the availability of equity capital and consequently increases liquidity risk. However, increased liabilities may also lead to higher potential returns. Conversely, a lower ratio suggests that the bank possesses ample equity capital and exhibits a stronger capacity to withstand risks, albeit at the cost of sacrificing some profitability.

This study also intends to examine whether the impact of FinTech on the profitability of commercial banks remains consistent before and after the COVID-19 pandemic, while incorporating a dummy variable to account for the shock caused by the epidemic. Specifically, it will establish 0 as the baseline value prior to 2020 and designate 1 as the time point following the occurrence of the epidemic in 2020. In addition, the emergence of the COVID-19 pandemic as a dummy variable has also exerted a certain adverse impact on the profitability of commercial banks (Yan and Jia, 2022; Wei and Yang, 2024). This impact primarily manifests in the reduction of effective credit demand, deterioration of asset quality, and contraction of net interest margin. The Table 3.2 presents the classifications and descriptions of the primary variables.

Table 3.2: Description of Variables

Variable Type	Variable Name	Variable Symbol	Formula
Dependent Variable	Comprehensive Profitability	PRO	Factor analysis to construct from profitability, security and liquidity
Independent Variable	FinTech Index	FinTech	Weighted Peking University Digital Financial Inclusion Index/100
Moderating Variable	Income Diversification	DIV	$1 - (NET^2 + NII^2)$

Table 3.2 continued

Mediating Variables	Lerner Index	Lerner	(Operating income - operating costs) / total operating income
	Risk Index	PCR	Non-performing loans / loan loss provisions
Control Variables	Macroeconomic Development	GGDP	Growth rate of GDP
	Inflation	GCPI	Year-on-year CPI growth rate
	Bank Size	LSIZE	The logarithm of total assets
	Net Interest Margin	NIM	Net interest income / average interest- bearing assets
	Loan-to-asset Ratio	LTA	Loans / total assets
Added Control Variables	Concentration Ratio	CR4	The ratio of total assets held by China's top 4 banks to total assets held by all banks in China
	Asset-liability Ratio	ALR	Total liabilities / total assets
	Epidemic Impact	COV	Equals 1 if the year is after 2019 and 0 otherwise

3.4 Static Linear Panel Models

3.4.1 Panel Data

Panel data, also referred to as longitudinal data, is a composite data structure that integrates time series and cross-sectional data. By collecting data on multiple individuals or entities at various points in time, a dataset with both temporal and cross-sectional dimensions is constructed. This type of data can be denoted by the double subscript variable y_{it} , where $i=1,2,...,N$ represents N distinct objects (such as countries, provinces, industries, companies or consumers) in panel data; $t=1,2,...,T$ represents the number of observation periods. This

data structure enables more effective capturing of individual differences and temporal trends while identifying and measuring effects that may not be discernible solely through cross-sections or time series analysis. Moreover, panel data often provides researchers with an ample number of sample points to enhance degrees of freedom and mitigate multicollinearity issues among explanatory variables for improved econometric estimation outcomes.

3.4.2 Pooled OLS, Fixed and Random Effects Models

The static panel data model refers to a scenario where the explanatory variables do not encompass lagged terms of the dependent variable. Its general structure is as follows.

$$y_{it} = \alpha + x_{it}\beta_{it} + u_{it} \quad \text{Equation. 3.6}$$

Among them, where $i = 1, 2, \dots, N$ and $t = 1, 2, \dots, T$. y_{it} represents the dependent variable, α denotes a constant term, x_{it} is a row vector of explanatory variables with dimensions $1 \times k$, while β_{it} refers to a column vector of regression coefficients with dimensions $k \times 1$. The random error term $u_{it} = v_i + \lambda_t + e_{it}$ represents the individual-specific random disturbance for individual i at time t ; v_i captures individual effects reflecting inherent differences among individuals; λ_t accounts for time effects capturing temporal variations; e_{it} denotes the residual disturbance term. These three components collectively constitute the composite residual structure in general static panel data models. Static panel data models typically encompass three types: Pooled Ordinary Least Squares (POLS) model, Fixed Effects model (FEM), and Random Effects model (REM).

The POLS model assumes homogeneity among individuals, implying that the regression coefficients for different individuals are identical. Consequently, panel data can be pooled together and estimated using Ordinary Least Squares (OLS) to determine the

parameters. Equation 3.6 represents the POLS model when u_{it} is a random error term with $Cov(u_{it}, x_{it}) = 0$.

In the context of econometric analysis of panel data, FEM is employed when the effect of explanatory variables remains constant across individuals and time, while accounting for incomplete information provided by these variables that may not include certain unobservable deterministic factors influencing the dependent variable. To address this limitation, virtual variables representing individual or time characteristics or intercept terms are incorporated in decomposition models to capture the missing deterministic information. Assuming that v_i and λ_t are estimable fixed parameters, and e_{it} is assumed to follow an independent and identically distributed (i.i.d.) distribution with a mean of zero and a variance of σ_e^2 , denoted as i.i.d. $(0, \sigma_e^2)$. Equation 3.7 represents FEM.

$$y_{it} = \alpha + v_i + \lambda_t + x_{it}\beta_{it} + e_{it} \quad \text{Equation 3.7}$$

where $i = 1, 2, \dots, N$ and $t = 1, 2, \dots, T$. The estimable parameters in this context encompass α , β_{it} , v_i , and λ_t . Herein, e_{it} denotes the residual of the FEM, while v_i and λ_t respectively represent individual and time effects.

In contrast to the FEM, the REM assumes that individual-specific effects are randomly and independently distributed from the explanatory variables. The fundamental concept is to consider the regression coefficients as stochastic variables. When v_i , λ_t and e_{it} are i.i.d. $(0, \sigma_v^2)$, i.i.d. $(0, \sigma_\lambda^2)$ and i.i.d. $(0, \sigma_e^2)$, respectively, with mutual independence, Equation 3.7 represents REM.

where $i = 1, 2, \dots, N$ and $t = 1, 2, \dots, T$. The composite residuals $v_i + \lambda_t + e_{it}$ comprise of latent cross-sectional error v_i , latent time error λ_t and stochastic disturbance term e_{it} .

Each of these three models possesses distinct advantages and disadvantages. The POLS model excels in its simplicity and interpretability, as it avoids the need to account for individual-specific or time-specific effects. However, this simplification may overlook crucial heterogeneity within the data at the individual or temporal level. In cases where significant heterogeneity exists among individuals, employing POLS model could lead to biased estimation. Furthermore, POLS model fails to capture the dynamic characteristics of individuals over time since it treats all time point data as independently and identically distributed. POLS model is most suitable when there is minimal variation among individuals or when studying individual-specific effects is not the primary focus.

When researchers acknowledge the presence of unobservable heterogeneity among individuals, the FEM emerges as a suitable choice. By accounting for omitted variables through fixing all time-invariant factors, this model effectively mitigates endogeneity issues without incorporating their effects into the random disturbance term. Moreover, it offers enhanced flexibility in analysis by accommodating not only individual fixed effects but also time fixed effects and two-way fixed effects (combining individual and time). However, due to its focus on within-individual variation, the FEM is unable to estimate the impact of time-invariant variables on outcomes, potentially overlooking significant explanatory factors.

The REM is suitable for researchers who posit that the heterogeneity among individuals follows a random pattern and aim to infer population parameters from empirical data. Moreover, it is often applicable in large-scale data analysis as it can effectively accommodate individual heterogeneity. Unlike the FEM, REM allows for individual-specific effects to be randomly distributed, thereby acknowledging the stochastic nature of individual differences rather than treating them as non-random fixed factors. However, when

utilizing the REM, it is essential to assume that individual-specific effects are uncorrelated with explanatory variables, which constitutes a strong and critical assumption. In cases where this assumption does not hold true in actual data, inconsistent estimation results may arise.

Selecting the appropriate panel data model holds paramount importance in research endeavours. If heterogeneity among individuals emerges as a pivotal factor, employing a POLS model may not be the optimal choice. Instead, FEM or REM might prove more suitable alternatives. Determining the most fitting model necessitates rigorous testing encompassing F-statistics, Lagrange Multiplier and Hausman statistics.

Firstly, the selection between POLS model and FEM can be determined through an F-test. The null hypothesis posits that there are no statistically significant differences among individuals, indicating the use of POLS model. The F-statistic is defined as below:

$$F = \frac{(S_r - S_u)/(N-1)}{S_u/(NT-N+k)} \quad \text{Equation 3.8}$$

The constrained model, denoted as S_r , represents the sum of squared residuals in the POLS model. The unconstrained model, denoted as S_u , represents the sum of squared residuals in the FEM. N denotes the number of individuals, T denotes the number of time periods, and k denotes the number of explanatory variables. The significance level of the F-value can be determined by consulting an F-distribution table or utilizing statistical software. Refer to the table and ascertain the information, if $F > F_{0.05}(N-1, NT-N-k)$, then nullify the initial hypothesis and consider employing FEM as a more suitable alternative. Otherwise, opt for POLS model. Or if the p -value of the F statistic is below a predetermined significance level (e.g., 0.05), it can reject the null hypothesis, indicating that the treatment factor levels

exert a statistically significant influence on the observers. Otherwise, it fails to reject the null hypothesis.

Secondly, the LM statistic proposed by Breusch and Pagan (1980) based on Lagrange Multiplier is employed as a means of testing and determining the appropriate choice between POLS model or REM. The null hypothesis posits that there are no significant differences among individuals, thereby indicating the suitability of POLS model. The LM statistic is defined as follows:

$$LM = \frac{NT}{2(T-1)} \left[\frac{\sum_{i=1}^N (\sum_{t=1}^T \hat{\varepsilon}_{it})^2}{\sum_{i=1}^N \sum_{t=1}^T \hat{\varepsilon}_{it}^2} - 1 \right]^2 \quad \text{Equation 3.9}$$

where $\hat{\varepsilon}_{it}$ represents the residuals obtained from the OLS estimation in Equation 3.5 of the POLS model, N denotes the total number of individuals and T stands for the number of time periods. If the LM test statistic exceeds the critical value corresponding to a given significance level (e.g., 0.05), then the null hypothesis should be rejected, and it is recommended to employ REM. Otherwise, POLS model should be selected.

Afterwards, conducting a rigorous Hausman test, the ultimate determination is made regarding whether to employ FEM or REM (Hausman, 1978). The crux of this examination lies in assessing the association between individual-specific effects and explanatory variables. In the presence of correlation, it tends to support the utilization of FEM. Conversely, in its absence, REM may be deemed more appropriate. The null hypothesis is therefore that the individual effects in the model are independent of the explanatory variables, suggesting that the model should be specified as REM. The Hausman test statistic, denoted as H , can be formulated as follows:

$$H = (b_{FE} - b_{RE})' [Var(b_{FE}) - Var(b_{RE})]^{-1} (b_{FE} - b_{RE}) \quad \text{Equation 3.10}$$

Among them, b_{FE} represents the estimator of the FEM, while b_{RE} denotes the estimator of the REM. $Var(b_{FE})$ and $Var(b_{RE})$ correspond to the variance matrices associated with these two estimators. The test statistic H follows a chi-square distribution with k degrees of freedom, where k represents the number of explanatory variables in the model. In practical applications, if the calculated H value exceeds a certain significance level (e.g., 5%) of the critical value of the chi-square distribution or if the robust Hausman test yields a p-value lower than a pre-set significance level (such as 0.05), then it is recommended to reject the REM and choose the FEM. Conversely, if it fails to reject the null hypothesis, then it is advisable to select the REM.

3.5 Empirical Model

With the rapid development and widespread application of FinTech, banks are facing unprecedented challenges and opportunities. FinTech introduces new business models, technological solutions, and market prospects to banks, which are anticipated to drive innovation and growth. However, during the initial stages of FinTech implementation, it may have an adverse impact on bank profitability due to increased costs, heightened risks, and intensified competition. Nevertheless, as the adoption of FinTech deepens, the cost of information transmission gradually decreases enabling banks to fully leverage existing technological foundations for developing novel products and services. Once FinTech applications reach a mature stage and establish a robust FinTech system, banks will enhance collaboration to collectively address common issues faced in this domain such as preventing financial frauds, improving customer experience while ensuring data security. Commercial banks engage in this practice with the aim of cost reduction, competition mitigation,

efficiency enhancement, improvement of service quality within the industry, and attainment of profitability.

Considering the significant impact of macroeconomic variables on the profitability of commercial banks, introducing time-fixed effects can effectively absorb the influence of macro-control variables. Accordingly, referring to Li and He (2021), Tian and Ge (2023), Wu and Zhang (2023), the individual fixed effects model is selected for this study. Additionally, this research introduces a quadratic variable of the FinTech index in the analysis to examine the non-linear association between FinTech development level and commercial banks' profitability. The following model is formulated:

$$PRO_{it} = \alpha_0 + \alpha_1 FinTech_{it} + \alpha_2 FinTech_{it}^2 + \alpha_3 GGDP_{it} + \alpha_4 GCPI_{it} + \alpha_5 LSIZE_{it} + \alpha_6 NIM_{it} + \alpha_7 LTA_{it} + v_i + e_{it} \quad \text{Equation 3.11}$$

where the i denotes commercial bank, while t denotes the year. The parameter α represents the estimated parameter of the model. The dependent variable PRO signifies the comprehensive profitability of commercial banks. FinTech is considered as a core explanatory variable for measuring financial technology index. GGDP represents the growth rate of gross domestic product, serving as an indicator of economic growth. GCPI represents year-on-year growth rate of consumer price index, which reflects inflation rate. LSIZE refers to the logarithm of total assets of commercial banks. NIM stands for net interest margin and LTA measures loan-to-asset ratio, representing the proportion of loans to total assets. Additionally, v_i denotes individual fixed effects and e_{it} refers to random error term.

Due to the nascent stage of development in FinTech, commercial banks are required to allocate a substantial amount of manpower and resources. In the short term, this can lead to elevated costs for commercial banks, impeding their ability to achieve anticipated profit

outcomes (Li and He, 2021; Wang and Zhu, 2022). However, as FinTech continues to be implemented, the operational framework of commercial banks will gradually undergo transformation, resulting in enhanced efficiency and sustained cost reduction (Wang et al., 2021). Consequently, the profitability of commercial banks is expected to escalate (Xiong et al., 2021; Song et al., 2023; Wu and Zhang, 2023). Therefore, coefficient α_1 may exhibit a negative trend while coefficient α_2 is likely to demonstrate positive tendency.

In macroeconomic terms, a higher level of macroeconomic development corresponds to an increased demand for financial intermediation services provided by commercial banks, resulting in a subsequent rise in their profitability (Che, 2023). The expected coefficient α_3 of GGDP is positive. Moreover, fluctuations in inflation rates can lead to variations in the interest of loan and credit scale of commercial banks. A higher but moderate inflation rate translates into elevated interest margin income for banks, thereby causing an increase in their profitability (Li et al., 2022). Hence, the coefficient α_4 representing the GCPI is positive.

From the perspective of commercial banks themselves, a larger asset size typically indicates higher profitability and risk-bearing capacity, thereby suggesting a positive expected coefficient α_5 for bank size. Net interest margin reflects the strength or weakness of a commercial bank's traditional lending and deposit business operation capability, with stronger profitability indicated by a larger net interest margin (Zuo and Ma, 2019). Therefore, the positive sign indicates the presence of a coefficient α_6 . Additionally, in the context of interest rate marketization, commercial banks' interest income from spreads gradually decreases. A higher loan-to-asset ratio suggests that a commercial bank's profits will shrink and non-performing loan ratios may increase, thus indicating an inverse relationship between loan-to-asset ratio and a commercial bank's profitability (Yang et al., 2019).

When adopting FinTech, commercial banks require substantial investment capital resulting in increased costs. Furthermore, FinTech also impacts the traditional operations of commercial banks leading to a decline in profits that may have short-term effects on their profitability. However, by implementing diversified income strategies and expanding their business scope and sources of revenue, commercial banks can reduce reliance on a single source of income such as interest rate spreads from deposits and loans. This approach helps balance cost increases caused by investments while reducing risks and mitigating any negative impact from adopting FinTech applications on the profitability of commercial banks. Therefore, during model establishment processes, diversification should be considered as a moderating variable.

$$PRO_{it} = \gamma_0 + \gamma_1 FinTech_{it} + \gamma_2 FinTech_{it}^2 + \gamma_3 FinTech_{it} \times DIV + \gamma_4 GGDP_{it} + \gamma_5 GCPI_{it} + \gamma_6 LSIZE_{it} + \gamma_7 NIM_{it} + \gamma_8 LTA_{it} + v_i + e_{it} \quad \text{Equation 3.12}$$

where DIV denotes income diversification, γ represents the model parameter that necessitates estimation.

In terms of competition, the rapid development of internet finance and FinTech has intensified the level of competition among commercial banks. Consequently, their deposit business is under tremendous pressure, disrupting the previously stable relationship between banks and enterprises and adversely affecting profitability (Guo and Shen, 2019; Wu and Zhang, 2023). Additionally, the emergence of new financial platforms has led to a loss of high-quality customers for commercial banks and even resulted in financial disintermediation, further suppressing profit improvement. Regarding risks, during the early stages of FinTech development when intense competition or irregular competition by non-bank institutions occurs, commercial banks may resort to lending at low interest rates for

high-risk loans to prevent a decline in business scale. This approach increases operational risks and impacts profitability levels. However, as FinTech matures, it can significantly alleviate information asymmetry issues and reduce default risks faced by commercial banks, thereby enhancing their profitability. Therefore, to investigate the impact of FinTech on commercial banks' profitability in terms of competition and risk, the following mediating effect model can be constructed based on the relevant research of Yu and Yu (2021), Li et al. (2022), Wu and Zhang (2023).

$$PRO_{it} = \alpha_0 + \alpha_1 FinTech_{it} + \alpha_2 FinTech^2_{it} + \alpha_3 GGDP_{it} + \alpha_4 GCPI_{it} + \alpha_5 LSIZE_{it} + \alpha_6 NIM_{it} + \alpha_7 LTA_{it} + v_i + e_{it} \quad \text{Equation 3.13}$$

$$Lerner_{it} = \delta_0 + \delta_1 FinTech_{it} + \delta_2 FinTech^2_{it} + \delta_3 GGDP_{it} + \delta_4 GCPI_{it} + \delta_5 LSIZE_{it} + \delta_6 NIM_{it} + \delta_7 LTA_{it} + v_i + e_{it} \quad \text{Equation 3.14}$$

$$PCR_{it} = \eta_0 + \eta_1 FinTech_{it} + \eta_2 FinTech^2_{it} + \eta_3 GGDP_{it} + \eta_4 GCPI_{it} + \eta_5 LSIZE_{it} + \eta_6 NIM_{it} + \eta_7 LTA_{it} + v_i + e_{it} \quad \text{Equation 3.15}$$

$$PRO_{it} = \theta_0 + \theta_1 FinTech_{it} + \theta_2 FinTech^2_{it} + \theta_3 MED_{it} + \theta_4 GGDP_{it} + \theta_5 GCPI_{it} + \theta_6 LSIZE_{it} + \theta_7 NIM_{it} + \theta_8 LTA_{it} + v_i + e_{it} \quad \text{Equation 3.16}$$

where Lerner and PCR are mediating variables that represent competition and risk, respectively. MED indicates mediating variables of Lerner or PCR. α , δ , η and θ are the model parameter that requires estimation.

In the mediation effect model test, it is essential to initially establish the significance of the estimated coefficient α_1 and α_2 for the FinTech index and its square index as a

prerequisite for confirming the existence of mediation effects. Subsequently, sequentially examine the significance of coefficients δ_1 and δ_2 , η_1 and η_2 for FinTech and FinTech square on each mediator variable in Equations 3.14 and 3.15, along with coefficients θ_3 for mediator variable in Formula 3.16. If all relevant coefficients attain statistical significance, proceed with further analysis. If any fail to reach statistical significance, directly assess whether the product of that mediator variable coefficient exhibits statistical significance and continue analysis under conditions where this product achieves a significant level. If it still fails to reach statistical significance, it can be concluded that there is no mediation effect present. Finally, evaluate the direct effect θ_1 of FinTech index and θ_2 of FinTech square index on commercial banks' comprehensive profitability in Equation 3.16. If results demonstrate statistical significance, it indicates a direct impact of FinTech index on bank's comprehensive profitability. Conversely, if results lack statistical significance, besides the intermediary conduction pathway, it suggests that FinTech index does not exert a direct impact on commercial banks' profitability.

3.6 Diagnostic Tests

3.6.1 Multicollinearity Test

Multicollinearity refers to the presence of strong linear relationships among independent variables in a multiple regression model (Shrestha, 2020). This issue can substantially increase the standard errors of regression coefficients, rendering parameter estimates highly sensitive to minor fluctuations in the sample data and thereby undermining the stability and reliability of model estimation (Oke et al., 2019). Moreover, multicollinearity can lead to variance inflation in statistical tests, complicating the rejection of the null hypothesis and potentially resulting in erroneous conclusions (Kim, 2019). Simultaneously, the signs and magnitudes of regression coefficients may diverge from

theoretical expectations, diminishing the model's explanatory capacity. Nevertheless, multicollinearity typically does not have a pronounced impact on the predictive accuracy of the dependent variable.

Common methods for detecting multicollinearity include the correlation coefficient matrix and the variance inflation factor (VIF) (Kyriazos and Poga, 2023). The correlation coefficient matrix calculates the Pearson correlation coefficients between pairs of independent variables to generate a matrix, which helps determine whether there is a high degree of linear correlation. Generally, if the absolute value of the correlation coefficient exceeds 0.8, it may indicate a potential collinearity issue; if it exceeds 0.9, it suggests a severe collinearity problem (Kim, 2019). This method is straightforward and intuitive, making it suitable for initially screening the linear relationships between variables. However, it cannot effectively capture complex collinearity involving multiple variables.

The VIF involves conducting a regression analysis by treating one independent variable as the dependent variable and the remaining independent variables as predictors. It calculates the coefficient of determination (R^2) and then derives the VIF value based on this (Gokmen et al., 2022). The VIF quantifies the extent of variance inflation caused by collinearity. A VIF value greater than 10 typically indicates that the variable has a significant multicollinearity issue (Shrestha, 2020; Chan et al., 2022). VIF is particularly useful for diagnosing complex collinearity among multiple variables by providing a precise measure of the degree of collinearity for each variable. In practical applications, combining the correlation coefficient matrix with the VIF method enhances the comprehensiveness and accuracy of multicollinearity diagnosis, thereby improving the reliability of statistical models.

3.6.2 U-test

In regression analysis, there may exist a non-linear relationship between the explanatory variable and the explained variable. To address this issue, a squared term is typically introduced into the model to test for the presence of a U-shaped relationship between the two variables. A U-shaped relationship refers to a non-linear trend where the association between the independent variable (X) and the dependent variable (Y) initially decreases and subsequently increases. Specifically, this manifests as a negative and statistically significant coefficient for the first-order term, while the coefficient for the second-order term is positive and statistically significant. However, relying solely on the significance of the second-order term coefficient is insufficient to fully establish the existence of a U-shaped relationship (Yu and Li, 2023; Bu and Tang, 2024). Consequently, specific statistical methods are required for rigorous testing.

Lind and Mehlum (2010) introduced a U-test method specifically designed to detect U-shaped or inverted U-shaped relationships. This method assesses the presence of a U-shaped relationship by determining whether the extreme point lies within the data range and whether the slopes at both ends of the data interval exhibit opposite signs. Specifically, the procedure involves three main steps: first, testing the statistical significance of the quadratic term's coefficient to ensure it is significantly positive; second, evaluating the slopes at the lower and upper bounds of the data. If the slope at the lower bound is significantly negative and the slope at the upper bound is significantly positive, this provides evidence for the existence of a U-shaped relationship. Additionally, the turning point must fall within the confidence interval and remain within the observed data range to confirm the validity of the U-shaped relationship.

By adopting the U-test method, it is possible to rigorously ensure that the curve presents a U-shaped pattern across the entire range of the independent variable. At the same time, this approach can prevent incorrect conclusions arising from the extreme point falling outside the data range. This method offers more stringent statistical support for the existence of a U-shaped relationship by integrating the test of the significance of the quadratic term with the analysis of the slope direction at the interval endpoints. Compared with traditional methods, the U-test places greater emphasis on the integrity of the curve shape, thereby enhancing the reliability of the test results.

3.6.3 Robustness Test

In empirical research, factors such as data quality, model specification and external shocks can significantly influence the robustness of research conclusions. Consequently, researchers typically conduct robustness test to systematically validate the reliability of core findings. As a critical component of empirical analysis, robustness testing evaluates the stability of key conclusions under varying conditions by modifying model specifications, variable definitions or sample ranges (Cameron and Trivedi, 2005). Its primary objective is to eliminate spurious correlations arising from data noise or specific model assumptions, mitigate potential biases and ensure that research outcomes remain unaffected by measurement techniques or sample selection, thereby enhancing the generalizability and credibility of the conclusions (Khan et al., 2021). Moreover, multi-dimensional robustness tests can effectively address potential concerns and reinforce the academic rigor of the study.

Common robustness test methods include, but are not limited to: altering or substituting the measurement approaches for core variables (e.g., replacing the dependent or independent variables), modifying the regression model (e.g., switching from a static panel

model to dynamic panel GMM or replacing a linear model with a Logit model), adjusting the sample scope (e.g., altering the time window, excluding outliers or samples from specific regions, or extending the time span), addressing endogeneity issues (e.g., employing lagged regressions or instrumental variable methods), and conducting stability checks by incorporating control variables or modifying functional forms (e.g., introducing quadratic terms to examine non-linear relationships) (Xiong et al., 2021; Song et al., 2023; Bu and Tang, 2024).

CHAPTER 4

RESULTS AND DISCUSSIONS

4.1 Overview

The structure arrangement of this chapter is as follows. Section 4.2 provides a concise summary, with an emphasis on restating the study's objectives. Section 4.3 describes how to build the dependent variable of comprehensive profitability by using factor analysis. Section 4.4 details the findings of the descriptive statistics and Section 4.5 shows the results of correlation analysis and multicollinearity test that are conducted. Section 4.6 presents the selection and test of static panel models. Section 4.7 offers the results of basic regression and proves the non-linear relationship between FinTech and bank profitability. To explore the relationship between the two more comprehensively, this thesis investigates the moderating role of income diversification in Section 4.8 and the mediating roles of competition and risk in Section 4.9. Taking into account of the differences in regional scopes, asset scales and the effect of COVID-19 pandemic, this study will employ grouping analysis in Section 4.10. Section 4.11 and Section 4.12 conduct endogeneity test and robustness test to demonstrate the reliability and robustness of the results.

4.2 Introduction

Due to the rapid development of FinTech in China in recent years, the interest margin of commercial banks has gradually narrowed, creating an urgent need to identify new profit models. This study primarily investigates the impact of FinTech on the profit acquisition of commercial banks and examines the moderating role of income diversification in the relationship between FinTech and profitability. Additionally, it explores the specific mechanisms through which FinTech affects profitability via competition and risks. The

study uses data from 2012 to 2023, applies tail trimming to the variables, and employs static panel models for model testing to select the most appropriate model. Prior to regression analysis, descriptive statistics, correlation analysis and multicollinearity test are conducted. Following the completion of regression analysis, endogeneity test and robustness test are performed to further validate the accuracy of the regression results.

4.3 Construction of Comprehensive Profitability Index

In the preceding chapter, it was explained that the construction of the comprehensive profitability index is grounded in the three core operating principles of commercial banks: security, liquidity and profitability. Based on these principles, for profitability, four specific indicators were chosen: return on assets (ROA), return on equity (ROE), cost-to-income ratio (CIR) and non-interest income ratio (NIIR). For liquidity, the loan-to-deposit ratio (LTDR) was selected. Regarding security, the non-performing loan ratio (NPLR) and provision coverage ratio (PCR) were chosen. In this thesis, the profitability index is constructed using factor analysis. Prior to performing factor analysis, the Bartlett test is conducted to verify the significance level and KMO value, thereby assessing whether the selected variable data are appropriate for factor analysis.

The results of the data test are presented in Table 4.1. The KMO value of the dataset is 0.651, exceeding the threshold of 0.6², which suggests that the data are appropriate for factor analysis. Furthermore, the *p*-value of Bartlett's sphericity test is 0.000, significantly

² According to Dehisat and Awang (2020), Jusoh et al. (2022) and Razali et al. (2023), A KMO value greater than 0.6 is generally considered acceptable.

lower than the critical value of 0.05, indicating statistical significance. These findings collectively confirm that the indicators are suitable for factor analysis.

Table 4.1: KMO Test and Bartlett Test of Sphericity

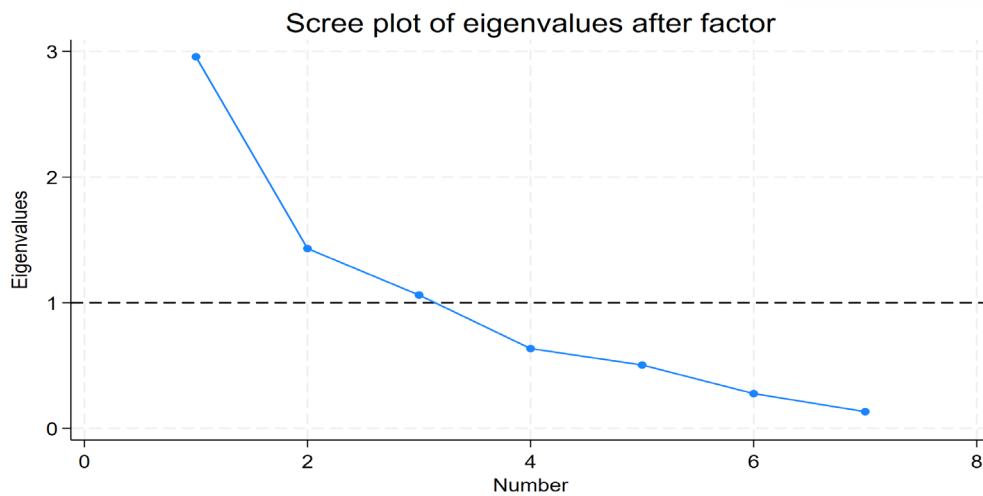
KMO	0.651	
Bartlett Test of Sphericity	Chi-square	1749.844
	Degrees of freedom	21
	p-value	0.000

When using the method of factor analysis, factors with eigenvalue greater than 1 should be selected. This thesis will analyse the initial eigenvalues and cumulative contribution rates generated by the variance decomposition of the profitability indicators, and select the ones that meet the requirements and summarize them. As shown in Table 4.2, the factors with initial eigenvalues greater than 1 mainly include three, namely Factor 1, Factor 2 and Factor 3, and their corresponding initial eigenvalues are 2.95781, 1.43134, and 1.06124, respectively. These three factors can explain 42.25%, 20.45%, and 15.16% of the total variance, respectively. Therefore, the first three factors explain 77.86% of all variances, indicating that the extracted three common factors can represent 77.86% of the information of the original seven indicators with less data information loss. They can better explain the initial data and evaluate the comprehensive profitability of commercial banks.

Table 4.2: Total Variance Explanation

Factor	Eigenvalue	Difference	Proportion	Cumulative
Factor 1	2.95781	1.52647	0.4225	0.4225
Factor 2	1.43134	0.37010	0.2045	0.6270
Factor 3	1.06124	0.42596	0.1516	0.7786
Factor 4	0.63528	0.13092	0.0908	0.8694
Factor 5	0.50436	0.22740	0.0721	0.9414
Factor 6	0.27696	0.14393	0.0396	0.9810
Factor 7	0.13302	—	0.0190	1.0000

Furthermore, the number of selected common factors can be determined based on the fluctuation trend depicted in Figure 4.1. As shown in the figure, the first three points have values greater than 1, indicating that the eigenvalues of the first three common factors exceed 1 and exhibit relatively significant fluctuations. Starting from the fourth common factor, the trend becomes largely stable with minimal fluctuation. Consequently, three common factors are selected.

**Figure 4.1:** Scree Plot

Although the common factors extracted through factor analysis capture most of the information from the initial variables, their meanings remain ambiguous and require clarification. Consequently, the factor loadings of the three common factors are rotated to enhance the interpretability of these factors, thereby enabling a more in-depth and precise analysis. After conducting factor rotation using the method of Orthogonal Varimax of Kaiser Off, it can be seen from Table 4.3 that Factor 1 has a large loading on ROA and ROE. These two ratios have the greatest contribution rate to Factor 1. Therefore, Factor 1 is mainly explained by the variables ROA and ROE. Regarding Factor 2, the contribution rates of NPLR and PCR are the greatest and it can be explained by these two indicators. Factor 3 has a large loading on LTDR, NIIR and CIR, they can be classified as one category to explain Factor 3. Additionally, the uniqueness of all variables is lower than 0.6³, indicating that the factor model has a strong explanatory ability for the variables. Therefore, it can be ultimately concluded that there are three comprehensive factors affecting the comprehensive profitability of commercial banks.

Table 4.3: Rotated Factor Loadings and Unique Variances

Variable	Factor 1	Factor 2	Factor 3	Uniqueness
LTDR	-0.2542	-0.1239	0.7809	0.3102
NPLR	-0.4426	-0.7989	0.0173	0.1656
PCR	0.1733	0.8743	-0.0781	0.1994
CIR	-0.4991	0.4337	-0.5621	0.2468
NIIR	-0.1655	0.0670	0.7918	0.3412
ROA	0.8869	0.2291	-0.0783	0.1547
ROE	0.8339	0.3305	-0.2524	0.1316

³ As Schreiber (2021) asserts, the threshold for uniqueness should be maintained below 0.6.

Furthermore, after rotating the factors, according to the data presented in Table 4.4, the variance contribution rate of each factor can serve as the weight for calculating the comprehensive profitability index. A weighted summation can then be performed. Consequently, the comprehensive profitability indicator (PRO) for commercial banks can be constructed by using Equation 4.1 as below. Notably, some negative values may appear in the final calculated comprehensive profitability indicator. To address this issue, the absolute value of the minimum value can be shifted to ensure that the final results are positive. This ensures that the data characteristics remain unaltered and does not interfere with the assessment of the causal effect (Bai, 1995).

$$\text{PRO} = (\text{Factor 1} \times 0.2927 + \text{Factor 2} \times 0.2532 + \text{Factor 3} \times 0.2327) / 0.7786 \quad \text{Equation. 4.1}$$

Table 4.4: The Contribution Rate of Variance After Factor Rotation

Factor	Variance	Difference	Proportion	Cumulative
Factor 1	2.04909	0.27670	0.2927	0.2927
Factor 2	1.77239	0.14348	0.2532	0.5459
Factor 3	1.62891	—	0.2327	0.7786

4.4 Descriptive Statistical Analysis

Table 4.5 displays the descriptive statistics of the key variables in this study. A descriptive statistical analysis was performed on the data of 50 sample banks selected from 2012 to 2023, yielding the mean, median, standard deviation, minimum and maximum values for each variable. As shown in Table 4.5, the maximum value of the dependent variable composite profitability of commercial banks is 3.686, the minimum value is 0.578 and the mean value is 2.500. These results suggest significant disparities in profitability among different types of commercial banks. The mean value of the independent variable,

FinTech, is 2.890, with a corresponding maximum of 4.519 and a minimum of 0.942. The maximum value is approximately five times the minimum, indicating that while China's FinTech level is steadily increasing, there are substantial regional disparities in its development.

For control variables, the minimum value of the macro-control variable GGDP is only 2.740, which occurred in 2020 due to the economic slowdown caused by the COVID-19 pandemic. Based on the year-on-year growth rate of CPI, China's inflation level exhibited mild fluctuations during the sample period, consistent with the typical inflation target range set by monetary policy. The standard deviation of the micro control variable LTA is 9.020, which indicates a relatively high degree of dispersion. This suggests significant variation in the loan-to-asset ratio among different commercial banks. Furthermore, the minimum value of LTA is 25.441 and the maximum value is 65.241, reflecting the inclusion of banks with varying scales and risk preferences in the sample. After applying the logarithmic transformation to the bank SIZE indicator, its mean becomes 3.979 with a standard deviation of 0.709, indicating moderate variability in this variable. Additionally, the mean value of the control variable NIM is 2.329. Given the current low-interest-rate environment, NIM tends to be generally low across banks, yet there are notable differences in NIM among various commercial banks.

Based on the descriptive statistics of the moderating variable DIV, with a mean of 0.301, a minimum of 0.043 and a maximum of 0.494, it can be inferred that some banks in the sample still rely entirely on traditional deposit-loan spread operations, while others have diversified income sources, achieving a diversification ratio close to 50% and adopting diversified business strategies. Moreover, the mean of the mediating variable Lerner

suggests that the entire banking industry remains competitive. The maximum and minimum values of PCR are 1.162 and 0.077, respectively. The substantial difference between these two values suggests that there are considerable variations in the risk-taking levels among commercial banks.

Table 4.5: Descriptive Statistics for Variables

Variable	N	Mean	p50	SD	Min	Max
PRO	600	2.500	2.556	0.570	0.578	3.686
FinTech	600	2.890	2.977	0.971	0.942	4.519
FinTech ²	600	9.295	8.862	5.452	0.887	20.424
GGDP	600	8.273	8.440	2.993	2.740	13.390
GCPI	600	1.900	2.000	0.744	0.200	2.900
LTA	600	47.933	48.752	9.020	25.441	65.241
LSIZE	600	3.979	3.847	0.709	2.794	5.535
NIM	600	2.329	2.258	0.538	1.310	3.885
DIV	600	0.301	0.314	0.115	0.043	0.494
Lerner	600	0.460	0.443	0.126	0.213	0.772
PCR	600	0.432	0.426	0.144	0.077	1.162

Figure 4.2 illustrates the relationship between the development level of FinTech and the comprehensive profitability of commercial banks. In this study, the development level of FinTech is categorized into 10 groups using the quantile method, and the average value of the corresponding comprehensive profitability index for commercial banks is calculated for each group. As shown in the figure, with the gradual enhancement of regional FinTech development, the comprehensive profitability of commercial banks initially decreases and subsequently increases. Notably, when the FinTech development level surpasses the 70% quantile, the comprehensive profitability of commercial banks, as indicated by the

profitability PRO, begins to recover significantly. This suggests that at a more advanced stage of FinTech development, it may exert a positive and promoting influence on the performance of commercial banks.

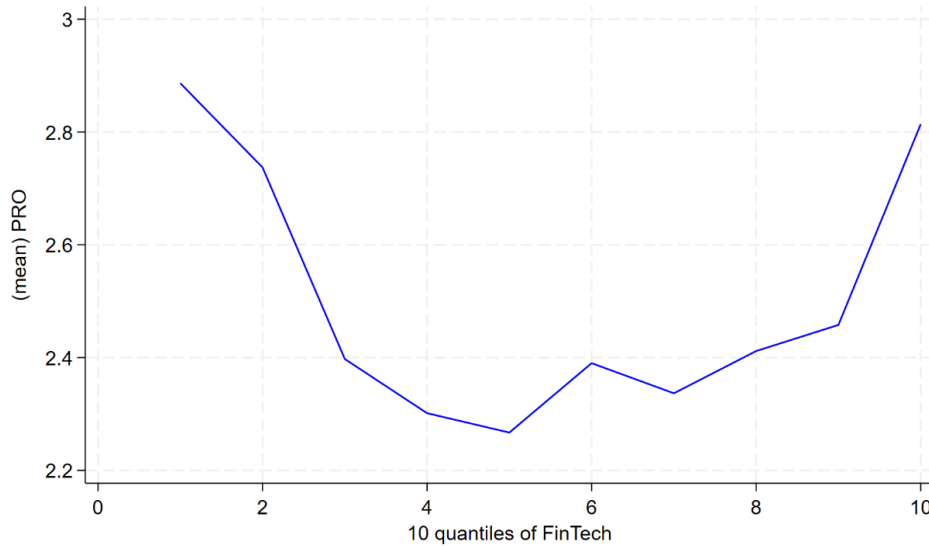


Figure 4.2: The Development Level of FinTech and Profitability

4.5 Correlation Analysis and Multicollinearity Test

4.5.1 Correlation Analysis

This study employs the Pearson correlation coefficient method to examine the relationship between the primary variables. The results of the test are presented in Table 4.6. As shown in this table, the correlation coefficient between the initial development of FinTech and the comprehensive profitability of commercial banks is -0.101, preliminarily suggesting a potential negative weak correlation between the two, which aligns with the earlier discussion in this thesis. However, the quadratic term of FinTech also exhibits a negative correlation with profitability, contradicting the prior description. Since the correlation test only provides a rudimentary analysis of variable values to detect potential

severe multicollinearity among variables, it does not establish a definitive causal relationship. Furthermore, without accounting for the control of other factors, inconsistent signs may emerge. Consequently, constructing an appropriate regression model for more precise regression analysis is essential to minimize estimation errors (Chan et al., 2021). Furthermore, the control variables, moderating variable and mediating variable Lerner exhibit a positive correlation with the comprehensive profitability of commercial banks, the mediating variable PCR shows a negative correlation with the banks' profitability. With the exception of the correlation coefficients for the linear term and quadratic term of FinTech, all other correlation coefficients are below 0.8, suggesting that the model does not suffer from severe multicollinearity.

Table 4.6: Correlation Matrix

Variable	PRO	FinTech	FinTech ²	GGDP	GCPI	LSIZE	NIM	LTA	DIV	Lerner	PCR
PRO	1										
FinTech	-0.101	1									
FinTech ²	-0.044	0.987	1								
GGDP	0.071	-0.362	-0.367	1							
GCPI	0.115	-0.453	-0.464	-0.025	1						
LSIZE	0.222	0.240	0.228	-0.101	-0.128	1					
NIM	0.116	-0.658	-0.632	0.188	0.363	-0.403	1				
LTA	0.020	0.413	0.441	-0.179	-0.132	0.242	-0.098	1			
DIV	0.329	0.440	0.418	-0.134	-0.160	0.562	-0.519	0.182	1		
Lerner	0.141	-0.188	-0.174	0.083	0.064	-0.047	0.053	-0.204	-0.070	1	
PCR	-0.548	0.091	0.020	-0.063	-0.099	0.202	-0.261	0.195	0.209	-0.040	1

4.5.2 Multicollinearity Test

This thesis further employs the Variance Inflation Factor (VIF) for testing, if the VIF values of all variables are below 10, it is generally accepted that there is no significant multicollinearity among the variables (Shrestha, 2020; Chan et al., 2022). As shown in the data presented in the table below, the VIF values for all variables are less than 10, with the mean VIF value being as low as 1.710. Consequently, the VIF test results confirm that there is no significant multicollinearity issue among the selected variables, allowing the regression analysis to proceed to the next step.

Table 4.7: VIF Test

Variable	VIF	1/VIF
FinTech	3.160	0.316
NIM	2.540	0.394
DIV	1.780	0.563
LSIZE	1.610	0.621
LTA	1.500	0.666
GCPI	1.360	0.735
GGDP	1.230	0.815
PCR	1.180	0.845
Lerner	1.060	0.941
Mean VIF	1.710	

4.6 The Selection and Test of the Model

For the selection of the three models in static panel regression, the F-test is initially employed to decide between the POLS and the FEM. Based on the results presented in the table below, the F-statistic equals 10.15, with Prob > F = 0.0000. This leads to the rejection

of the null hypothesis, indicating that the FEM is more appropriate for the regression analysis. Subsequently, the Breusch-Pagan Lagrangian Multiplier (BPLM) test is utilized to determine whether to choose the POLS or the REM. The test result shows Prob > chibar2 = 0.0000, leading to the rejection of the null hypothesis and thus selecting the REM for further regression analysis. Finally, the Hausman test is conducted to make a definitive choice between the FEM and the REM. The result indicates a p-value of 0.0015, which is less than the significance level of 0.05, resulting in the rejection of the null hypothesis. Consequently, the FEM is chosen for the final regression analysis. Furthermore, the results of the heteroscedasticity test reveal a p-value of 0.0000, which strongly rejects the null hypothesis and indicates the presence of significant heteroscedasticity, specifically, substantial variation in the error term variances across different banks. Similarly, the serial correlation test also yields a p-value of 0.0000, strongly rejecting the null hypothesis and suggesting the existence of serial autocorrelation. This implies that a bank's current profitability is highly correlated with its profitability in the previous period. To address the potential estimation bias caused by both heteroscedasticity and serial autocorrelation, this study employs clustered robust standard errors at the bank level within the FEM framework. This approach enhances the efficiency of parameter estimates and improves the reliability of statistical inference.

Table 4.8: The Regression Analysis Results

Variable	(1) POLS	(2) RE	(3) FE	(4) FE (Clustered by bank)
FinTech	-1.336*** (0.134)	-1.264*** (0.106)	-1.362*** (0.118)	-1.362*** (0.158)
FinTech ²	0.254*** (0.024)	0.238*** (0.019)	0.238*** (0.019)	0.238*** (0.028)
GGDP	0.022*** (0.007)	0.018*** (0.006)	0.019*** (0.006)	0.019*** (0.004)
GCPI	0.129*** (0.032)	0.106*** (0.025)	0.107*** (0.025)	0.107*** (0.019)

Table 4.8 continued

Variable	(1) POLS	(2) RE	(3) FE	(4) FE (Clustered by bank)
LSIZE	0.292*** (0.033)	0.338*** (0.069)	0.900*** (0.274)	0.900* (0.485)
NIM	0.213*** (0.057)	0.260*** (0.056)	0.301*** (0.059)	0.301** (0.116)
LTA	-0.009*** (0.003)	-0.012*** (0.003)	-0.012*** (0.003)	-0.012 (0.009)
_cons	2.328*** (0.328)	2.225*** (0.380)	0.148 (1.061)	0.148 (1.913)
Observations	600.000	600.000	600.000	600.000
R^2	0.254		0.297	0.297
R^2_a	0.245		0.225	0.289
F-Test		F (49, 543) = 10.15	Prob > F = 0.0000	
BPLM Test		chibar2 (01) = 574.64	Prob >chibar2= 0.0000	
Hausman Test		chi2 (7) = 23.37	Prob > chi2 = 0.0015	
Heteroskedasticity Test		chi2 (50) = 2344.16	Prob > chi2 = 0.0000	
Serial Correlation (F-stat)		F (1, 49) = 144.44	Prob > F = 0.0000	

Notes: Asterisks ***, **, and * denote significance levels at 1%, 5% and 10%, respectively. The values in parentheses represent robust standard errors.

4.7 Basic Regression Results

From the regression results in Table 4.8, the coefficient of the linear term of the FinTech development level has a significant negative impact on the profitability of commercial banks at the 1% significance level. The empirical results align with the research findings of Xiong et al. (2021), Li and He (2021), and Corbet et al. (2023). From a theoretical perspective, this negative relationship is plausible during the early stages of FinTech development. Firstly, banks typically face substantial adjustment costs during digital transformation, such as investments in technical infrastructure, system upgrades, talent recruitment, and compliance expenditures, all of which can compress profit margins in the short term. Secondly, according to the theory of financial disintermediation, FinTech firms exert a substitution effect on traditional banking activities in areas such as payment and

settlement, wealth management, and micro-lending, thereby reducing banks' interest spreads and intermediary business opportunities. Furthermore, drawing on the long-tail theory, FinTech companies leverage big data and intelligent risk control to penetrate the long-tail customer segment, capturing market share previously overlooked by banks and intensifying competitive pressures within the industry.

Specifically, in the nascent phase of FinTech development, internet finance models such as third-party payment and P2P online lending emerged vigorously. FinTech companies, leveraging big data and artificial intelligence technologies, developed innovative wealth management products that offered higher yields and superior user experiences, significantly diverting traditional bank deposits (Chen et al., 2019). In addition, traditional banks, constrained by information asymmetry and relatively high-risk control costs, primarily serve high-quality enterprises and large customers, resulting in a notable shortage of credit supply to long-tail customers (Yao and Yang, 2022). By collaborating with internet platforms, FinTech companies have established an integrated intelligent risk control system based on big data (Qi et al., 2022). This system incorporates multidimensional data, including users' transaction behaviours, consumption records and social networks, effectively mitigating the information asymmetry between lenders and borrowers. As a result, it enables accurate and real-time credit assessment and granting for long-tail customers (Hsu and Li, 2019; Ji et al., 2024). This model has allowed FinTech enterprises to rapidly expand their market share in areas such as micro and small loans and consumer credit, exerting a significant diversion effect on traditional banking credit businesses (Song and Appiah-Otoo, 2022). Therefore, the diversion of deposit business and intensified competition in loan business have squeezed the net interest margin space for commercial banks (Tang et al., 2024). Moreover, as evidenced by the mobile payment data presented in Chapter 1, the volume of non-bank

mobile payments significantly surpasses that of commercial banks, thereby impacting their payment and settlement operations (Tong and Yang, 2025).

Simultaneously, commercial banks must undertake substantial early-stage investments in technological infrastructure during the development of FinTech, leading to a temporary rise in costs (Yang and Masron, 2023). In addition, in the early stage, FinTech companies were categorized as technology firms rather than financial institutions and thus were not subject to the traditional financial regulatory framework. This regulatory approach was characterized by prioritizing development over regulation, resulting in a regulatory framework that consistently lagged behind market innovations (Bu et al., 2022). It was not until the issuance of the first national regulatory document, the “Guiding Opinions on Promoting the Healthy Development of Internet Finance” in 2015, that the regulatory responsibilities for businesses such as P2P lending and Internet payment services were explicitly delineated (Gao, 2022). Platforms were prohibited from establishing capital pools or engaging in self-financing activities, thereby laying the groundwork for an initial “bottom-line regulation” framework. Consequently, during this period, FinTech companies, leveraging their technological innovation capabilities and exploiting regulatory loopholes, presented a comprehensive challenge to the traditional profit models of banks (Kong and Loubere, 2021).

Although commercial banks have attempted to transform their business models, leverage technological innovation to enhance traditional products and services, collaborate more closely with FinTech companies and improve the efficiency of banking operations, they began adopting FinTech solutions relatively late. On the one hand, they must bear the substantial costs associated with their digital transformation initiatives. On the other hand,

they face declining revenues due to competitive pressures exerted by FinTech firms (Li et al., 2023). Consequently, in the short term, the integration of FinTech is likely to negatively affect the profitability of commercial banks.

The coefficient of the quadratic term of the FinTech development level is 0.238, which is highly significant at the 1% level. This suggests that the continued advancement of FinTech has the potential to boost the profitability of commercial banks. This aligns with the preceding discussion and is also consistent with the empirical findings of Lv et al. (2022), Song et al. (2023) and Bu & Tang (2024). This transformation can be interpreted through the lenses of financial innovation theory and the theory of technological spillover effects. As the regulatory framework becomes increasingly robust and the market transitions into a phase of deep adjustment, the banking sector has moved from passive adaptation to proactive integration of FinTech. Through technological cooperation and independent research and development, banks have widely applied emerging technologies such as big data, artificial intelligence, and blockchain to key links such as credit approval, risk control, and payment and settlement, significantly alleviating the problem of information asymmetry and effectively reducing operational costs. Concurrently, ongoing technological advancements have driven the refinement and upgrading of business models and product architectures, giving rise to new sources of revenue and producing notable spillover effects.

2016 is widely recognized as the “year of regulation” for FinTech in China, signalling a pivotal shift in regulatory policies from initial inclusiveness to a balanced focus on regulated development and risk prevention and control (Li, 2020). For instance, in 2017, the People’s Bank of China (PBOC) established the FinTech Committee with the aim of coordinating FinTech regulation and advancing the application of regulatory technology

(Yazar, 2020). Additionally, in 2019, the central bank launched a regulatory sandbox pilot program, enabling commercial banks to test new products under certain regulatory exemptions (Chang and Hu, 2019). This initiative provides a direct communication channel between technology companies and regulatory authorities while also offering research and development funding support from the government. Furthermore, at the national strategic level, the “FinTech Development Plan (2019 - 2021)” and the “FinTech Development Plan (2022 - 2025)” have been successively issued, proposing the establishment of a fundamental regulatory rule system for FinTech (Che, 2023). Key deployments include data element applications, new infrastructure construction and prudential regulatory tasks.

Meanwhile, through the introduction of the “Interim Measures for the Business Activities of Online Lending Information Intermediary Institutions” and new regulations for online micro-lending, special rectification efforts have been undertaken to address internet finance risks, which bring an end to the disorderly and unregulated expansion of FinTech (Li and Qian). In 2020, the “Interim Measures for the Supervision and Administration of Financial Holding Companies” were introduced, incorporating large technology firms such as Ant Group into the regulatory framework and explicitly requiring them to comply with capital adequacy ratios and risk isolation standards (Ding et al., 2021). In terms of consumer rights protection, the safeguarding of consumers’ rights and interests has been further reinforced through enhancements in data security legislation and the law on the protection of financial consumers’ rights and interests.

As regulatory policies become increasingly stringent, the industry has entered a phase of adjustment, presenting banks with an opportunity to proactively integrate FinTech into their operations (Murinde et al., 2022). During this period, banks have been transitioning

from a passive role to a more active and strategic one, notably enhancing their core competitiveness through a comprehensive set of strategic measures. At the strategic level, commercial banks have transcended the traditional paradigm of competition and cooperation by proactively establishing in-depth partnerships with leading technology companies (Wang and Nor, 2022). For instance, in 2017, China Construction Bank entered into a strategic cooperation agreement with Ant Financial Services Group. Both parties collaborated to promote the sharing of credit information, integrate payment systems, explore an online-offline integrated service model, and thereby achieve technological synergy and scenario interoperability while effectively minimizing redundant investments. Meanwhile, the FinTech subsidiaries of banks have emerged as a critical vehicle for achieving technological self-reliance and controllability (Zhang et al., 2022). Initially, these subsidiaries focused primarily on the intelligent upgrading of their parent banks' internal systems. Later, they progressively expanded their technical capabilities to external markets. In terms of technological applications, commercial banks have deeply integrated cutting-edge technologies such as big data, artificial intelligence and blockchain into areas like credit approval processes, trade finance and biometric authentication, thereby significantly reducing business processing times and enhancing operational efficiency (Muganyi et al., 2022). At the organizational mechanism level, commercial banks aim to transcend the limitations of traditional systems (Chen et al., 2021). For instance, subsidiaries have implemented market-oriented compensation systems to attract top-tier technology talent. Meanwhile, institutions such as China Merchants Bank and Bank of China have elevated technology empowerment to a core strategic priority, underscoring the critical urgency and importance of “technology-driven business transformation”.

Consequently, once FinTech reaches a certain stage of maturity, commercial banks upgrade FinTech products, increase investment in FinTech, strengthen strategic partnerships with FinTech companies, and fully exploit the synergies between finance and technology. These actions will help reduce operating costs and improve efficiency, thereby enhancing bank profitability. Therefore, the coefficient of the linear term for the explanatory variable FinTech is negative, while the coefficient of the quadratic term is positive. This suggests that in the early stages of FinTech development, the profitability of commercial banks decreases. However, as the level of FinTech continuously improves, their profitability begins to increase. This implies that the relationship between FinTech and the overall profitability of commercial banks is not a simple linear one but rather a nonlinear relationship, potentially exhibiting a U-shaped curve, thereby validating hypothesis 1.

From the perspective of control variables at the macro level, the coefficients of the GDP growth rate and the year-on-year CPI growth rate are positive, with values of 0.019 and 0.107, respectively, and are significant at the 1% level. This suggests that a higher GDP growth rate and a moderate inflation rate contribute to enhancing the overall profitability of commercial banks within a favourable macroeconomic environment. Specifically, an increase in GDP growth tends to boost loan demand, leading to an expansion in banks' credit business and a corresponding rise in interest income. Moreover, in a robust macroeconomic context, bank asset quality improves, resulting in fewer non-performing loans and increased intermediate business income from investment and wealth management services. These factors collectively enhance bank profits. Additionally, moderate inflation may reduce the real interest rate, thereby lowering commercial banks' deposit costs while enabling flexible adjustments to lending rates. Consequently, the interest margin for commercial banks widens, further increasing their income.

From the perspective of controlling variables at the micro level, the coefficients of LSIZE and NIM for commercial banks are positive, specifically 0.900 and 0.301, and the significance is at the 10% and 5% level, respectively. This suggests that an increase in the asset size and net interest margin of commercial banks positively promotes their profitability. In line with the theory of economies of scale, as the asset size of commercial banks expands, their average operating costs decrease while their risk resistance capacity increases. Consequently, the scale effect enhances the overall profitability of banks. A higher net interest margin corresponds to greater net interest income for commercial banks, which tends to encourage them to focus on traditional businesses with lower risks, thereby boosting bank profits. Conversely, the coefficient of the LTA is -0.012 and is not statistically significant, indicating that the profit model of China's banking industry is undergoing a structural transformation. The traditional profit model, which relied on the expansion of asset scale, is gradually losing its effectiveness. Banks are no longer merely pursuing loan growth but are increasingly focusing on loan quality and the diversification of revenue sources. Consequently, the insignificance of the LTA coefficient actually reflects the profound impact of FinTech in reshaping the profit mechanisms of the banking industry.

Based on the preceding regression analysis results, in conjunction with the quadratic term parameter estimation and marginal effect analysis of FinTech, the nonlinear influence mechanism of FinTech development on the comprehensive profitability of commercial banks was systematically examined using Stata software. As depicted in Figure 4.3, there exists a significant U-shaped relationship between FinTech and PRO, with the lowest point or inflection point located at $\text{FinTech} = 2.86$. Additionally, the inflection point can be calculated based on the coefficients of the linear and quadratic terms. From a theoretical perspective, it is derived as Equation 4-2. The result obtained from the theoretical calculation

aligns closely with the result estimated by Stata software. Given that the minimum and maximum values of FinTech are 0.94 and 4.52, respectively, these values correspond to the horizontal axis positions marked by the grey dotted lines on either side of the inflection point in Figure 4.3. This indicates that the actual observation range of FinTech spans from 0.94 to 4.52, encompassing the inflection point at 2.86. Consequently, this threshold holds practical explanatory power, demonstrating that the impact of FinTech on PRO exhibits a dynamic characteristic of initial inhibition followed by promotion.

$$\text{Inflection point} = -\frac{-1.362}{2 \times 0.238} \approx 2.86 \quad \text{Equation 4.2}$$

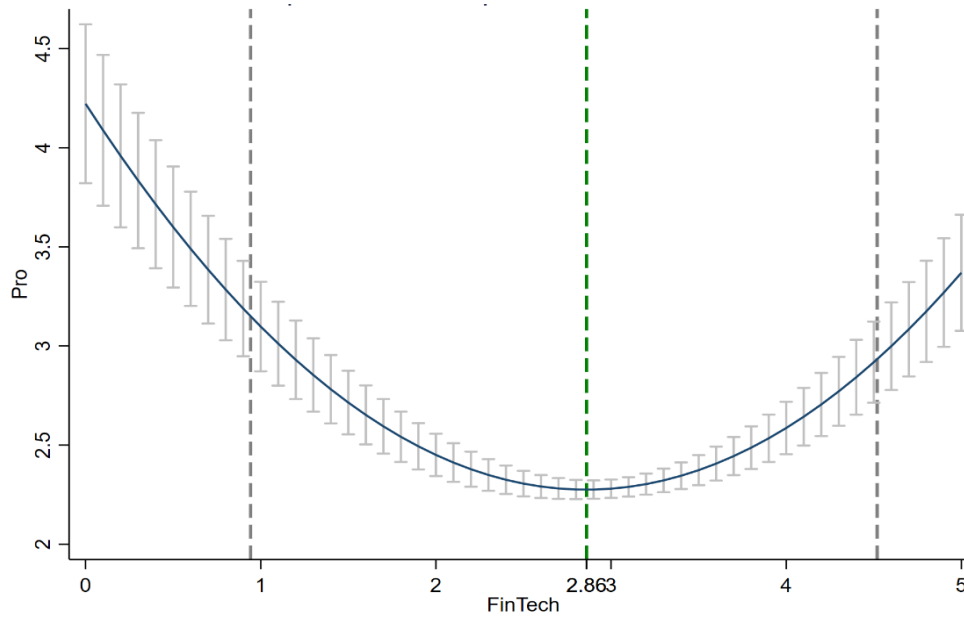


Figure 4.3: The U-shaped Relationship between FinTech and PRO

To further validate the reliability of the inflection point, this study employed the Bootstrap method, conducting 1,000 repeated samples, yielding a standard error of 0.14 that can be seen from the Table 4.9, which is relatively small. This suggests that the fluctuation

range of the estimated inflection point value is minimal, indicating high estimation accuracy. Moreover, the z -value is 20.04, exceeding the critical value of 1.96, and the p -value is 0.00, all of which confirm the statistical significance and robustness of the inflection point estimation. Meanwhile, the Bootstrap results indicate that the 95% confidence interval is [2.58, 3.14]. This interval lies entirely within the range of FinTech values, which spans from the minimum value of 0.94 to the maximum value of 4.52.

Table 4.9: Bootstrap Results

Variable	Observed Coefficient	Bootstrap Standard Error	[95% Confidence Interval]	z -value	p -value
FinTech Inflection Point	2.86	0.14	[2.58, 3.14]	20.04	0.00

Furthermore, the marginal effect graph, by illustrating the instantaneous impact of varying levels of the independent variable on the dependent variable, effectively visualizes the dynamic changes in the nonlinear relationship. As shown in Figure 4.4, the marginal effect curve equals zero at the inflection point and gradually transitions from negative to positive values. This finding confirms a U-shaped relationship between FinTech and PRO. Specifically, when the marginal effect curve is below the inflection point, its negative value implies that an additional unit of FinTech leads to a reduction in PRO. For instance, as indicated in Table 4.10, when FinTech reaches its minimum value of 0.94, each incremental unit of FinTech results in a significant decrease of 0.91 units in PRO. Conversely, when the marginal effect curve surpasses the inflection point, the marginal effect shifts from negative to positive, indicating that FinTech begins to positively enhance PRO. In this case, when FinTech reaches its maximum value of 4.52, each additional unit of FinTech contributes to a substantial increase of 0.79 units in PRO.

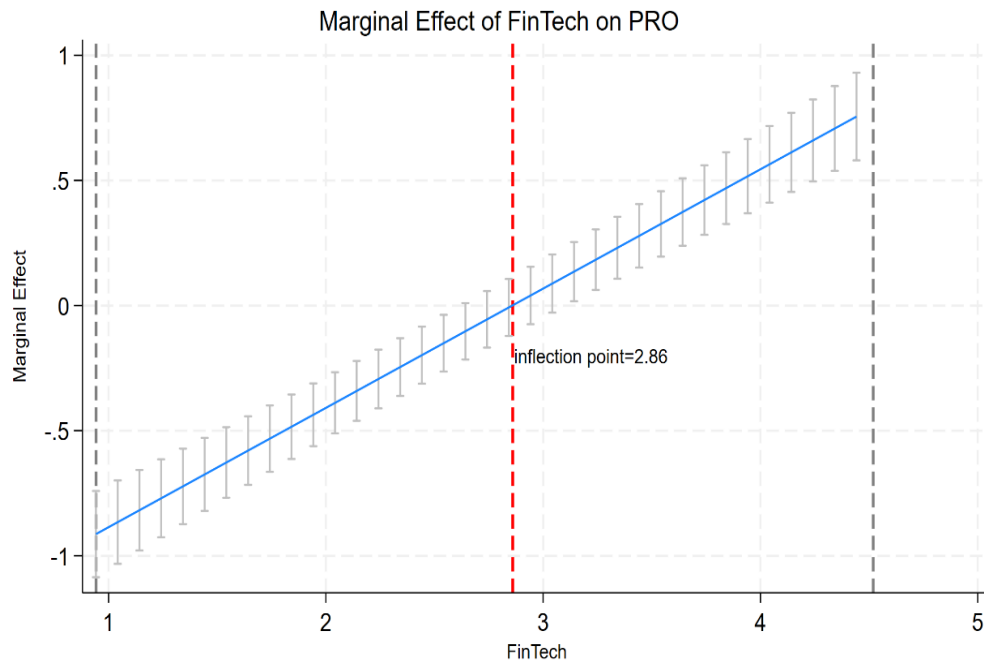


Figure 4.4: The Marginal Effect of FinTech on PRO

Table 4.10: Marginal Effect Results

FinTech	Marginal Effect	Standard Error	[95% Confidence Interval]	<i>p</i> -value
Min 0.94	-0.91	0.08	[-1.09, -0.74]	0.00
Max 4.52	0.79	0.09	[0.61, 0.97]	0.00

To verify the U-shaped relationship between FinTech and PRO more accurately, drawing on the research of Yu and Li (2023), and Bu and Tang (2024), this study employs the U-test to further examine the U-shaped relationship. Based on the U-test results presented in the following table, the *t*-value is 8.650 and the *p*-value is approximately 0.000. These results strongly reject the null hypothesis of monotone or an inverse U-shaped relationship, confirming the existence of a U-shaped relationship. The U-shaped test estimates the extreme point at 2.857, which falls within the 99% Fieller interval [2.544, 3.188]. This indicates that the location of the extreme point is both statistically significant and precise,

aligning closely with the analytical findings discussed earlier. Additionally, given the slope's lower bound of -0.913 and upper bound of 0.792, the sign of the value transitions from negative to positive, further demonstrating a decreasing trend to the left of the extreme point and an increasing trend to the right, thus reflecting a pattern of first decreasing and then increasing.

Table 4.11: U-test Results for the FinTech Extreme Point

Variable	Observed Coefficient	99% Fieller Interval	<i>t</i> -value	$p > t $
FinTech Extreme Point	2.857	[2.544, 3.188]	8.650	0.000

Table 4.12: U-test Results for the FinTech and PRO

Name	Lower bound	Upper bound
Interval	0.942	4.518
Slope	-0.913	0.792
<i>t</i> -value	-10.394	8.649
$p > t $	0.000	0.000

4.8 The Moderating Effect of Income Diversification

To investigate the moderating role of income diversification in the relationship between FinTech development and the profitability of commercial banks, this study introduces an interaction term comprising the income diversification index and the FinTech development index into the regression model. The second column of Table 4.13 presents the regression results after incorporating the moderating variable DIV. From these results, it is evident that the impact of FinTech development on the overall profitability of commercial banks remains significant, with no change in the direction of the effect. The coefficient of

the interaction term between FinTech and income diversification is 0.718, which is significantly positive at the 1% level. This indicates that the moderating effect is both significant and positive, suggesting that income diversification plays a constructive role in enhancing the influence of FinTech on the profitability of commercial banks. Furthermore, when the coefficient of the linear term of FinTech is negative, implying a detrimental effect of FinTech on bank profitability, income diversification, as a critical moderating variable, can mitigate the adverse impact associated with the initial adoption of FinTech. This empirical finding provides strong support for hypothesis 2 proposed in the preceding section.

The moderating effect can be interpreted through multiple theoretical lenses. First, according to the long-tail theory, banks can reduce their dependence on traditional deposit-loan spreads by adopting a diversified revenue strategy. By expanding non-interest income businesses such as wealth management and transaction banking, banks are better positioned to serve the long-tail markets represented by small and medium-sized enterprises and retail customers, thereby mitigating the impact of financial disintermediation on traditional credit operations. At the same time, revenue diversification represents a concrete application of financial innovation theory at the level of business structure, reflecting a strategic shift in banks from passively responding to technological changes to proactively shaping new growth trajectories. Second, the theory of technology spillover suggests that FinTech integration enables banks to develop and market a broader range of financial products with greater efficiency and at reduced costs. Consequently, during the early stages of FinTech development, when its impact on profitability may be negative, revenue diversification can help offset the decline in traditional business and accelerate the commercialization of new technologies, thereby effectively mitigating short-term adverse effects.

Table 4.13: Regression Results of the Moderating Effect of Income Diversification

Variable	(1) PRO	(2) PRO
FinTech	-1.362*** (0.158)	-1.512*** (0.149)
FinTech ²	0.238*** (0.028)	0.213*** (0.026)
GGDP	0.019*** (0.004)	0.015*** (0.003)
GCPI	0.107*** (0.019)	0.079*** (0.019)
LSIZE	0.900* (0.485)	0.769 (0.464)
NIM	0.301** (0.116)	0.351*** (0.099)
LTA	-0.012 (0.009)	-0.009 (0.009)
DIV*FinTech		0.718*** (0.098)
_cons	0.148 (1.913)	0.511 (1.834)
Observations	600.000	600.000
R ²	0.297	0.406
R ² a	0.289	0.398

Notes: Asterisks ***, **, and * denote significance levels at 1%, 5% and 10%, respectively. The values in parentheses represent robust standard errors.

Specifically, the analysis can be conducted from the following perspectives. Firstly, by adopting an income diversification strategy, commercial banks can substantially decrease their over-reliance on net interest income, thus enhancing the robustness and resilience of their financial structure. Traditionally, commercial banks have primarily relied on the interest spread between deposits and loans as their main revenue source. However, with declining interest rates and challenges such as payment disintermediation and intensified credit competition driven by the rapid advancement of FinTech, these factors may collectively compress the net interest income of commercial banks. Consequently, through the implementation of an income diversification strategy, commercial banks can boost non-

interest income streams, including fees, commissions and investment returns, thereby reducing dependency on a single income source and alleviating the adverse effects stemming from the evolution of Internet finance and FinTech (Zhang and Li, 2025).

Secondly, the diversification of income sources can substantially enhance banks' capacity to meet the diversified needs of customers. Traditional banks often concentrate primarily on deposit and loan businesses while prioritizing the acquisition and retention of high-quality customers. However, in the context of the rapid advancement of FinTech, customer demands have become increasingly intricate and multifaceted. To strengthen market competitiveness, commercial banks must not only stabilize their traditional businesses but also fully leverage FinTech tools to actively explore and serve long-tail customer segments, thereby enhancing customer loyalty and achieving cross-selling through integrated one-stop services. Consequently, by offering multi-tiered and multi-type services, banks can better align with the varied needs of different customer groups. Achieving this objective requires the optimization and diversification of the income structure. Moreover, commercial banks can design and provide customized solutions tailored to the individualized needs of customers, further facilitating the diversification of income sources. In summary, commercial banks can harness the power of FinTech to empower non-traditional business areas, expand diversified income streams, refine the income structure and ultimately enhance profitability.

Finally, banks can strengthen their risk management capabilities by diversifying income sources. Specifically, commercial banks can offer customers a wide range of services, including bank card handling fees, cross-border payment processing, insurance agency sales, fund consignment services, bond underwriting and securities investment,

thereby achieving risk diversification. In the era of rapidly advancing FinTech, a diversified income structure not only enables banks to manage and optimize assets and risks more effectively but also enhances their profitability in a sustainable manner.

4.9 Analysis of the Influencing Mechanism

4.9.1 The Mediating Effect of Competition

This section further explores the specific mechanisms through which FinTech development affects the profitability of commercial banks, focusing on the dimensions of competition and risk by employing mediating effect analysis. Table 4.14 displays the mediating effect regression results with Lerner as the competitiveness indicator. The first column in the table represents the benchmark regression result, the second column reflects the impact of FinTech development on Lerner after incorporating the mediating variable, and the third column illustrates the influence of the mediating variable Lerner on bank profitability. The regression results indicate that the coefficient of the linear term for the impact of FinTech on Lerner is -0.121 and is significantly negative. Given that the Lerner index is inversely related to competition, higher Lerner values signify weaker competition. It suggests that in the early stages of FinTech development, the competitiveness of commercial banks declines, leading to intensified competition within the industry. However, the quadratic coefficient indicating the influence of FinTech on Lerner is significantly positive, with a value of 0.012. This suggests that, over time and from a long-term perspective, the development of FinTech is likely to enhance market competitiveness.

This is primarily due to the fact that during the early stages of FinTech development, the advent and widespread adoption of new technologies dismantled the market entry barriers for traditional financial institutions. Consequently, more FinTech enterprises were

able to enter the financial sector, competing with commercial banks across asset management, liability operations and intermediary services, thereby intensifying market competition (Li et al., 2022; Li et al., 2023; Wei and Yang, 2024; Dilla et al., 2025). Compared to traditional banks, FinTech companies are better positioned to meet the personalized and diversified needs of customers while focusing on long-tail clients often overlooked by conventional banking institutions, thus capturing market share and elevating competitive intensity (Song et al., 2023). However, in the long term, the high research and development costs associated with FinTech, coupled with significant technical barriers, make it challenging for smaller enterprises to emulate and compete. As regulatory bodies enhance license management, data privacy protection and capital adequacy ratio requirements, many small and medium-sized FinTech firms struggle to contend with large enterprises and commercial banks, leading to a reduction in market competition (Harasim, 2021; Xiong et al., 2021). In the later stages of FinTech evolution, to further expand market share and competitiveness, commercial banks and major FinTech companies are likely to collaborate and integrate, achieving complementary strengths and synergistic effects. This process increases market concentration while diminishing the level of competition (Guo et al., 2022; Elsaid, 2023).

From the analysis results in column (3), it is evident that the coefficient of Lerner is 1.010 and significant at the 1% level, suggesting that Lerner has a substantial positive impact on the profitability of commercial banks. Specifically, the level of competitiveness plays a crucial role in determining the pricing power of commercial banks to some extent. Banks with higher competitiveness can enhance their profitability by expanding the net interest margin (Olmo et al., 2021). Moreover, competitive banks are typically larger in scale, enabling them to attract more customer resources, diversify income sources, and leverage

economies of scale to reduce unit costs (Wei and Yang, 2024). Additionally, competitive banks often possess robust risk management capabilities, allowing them to establish comprehensive risk management systems that strengthen risk identification and control, thereby ensuring stable bank operations (Guo et al., 2022). Furthermore, compared with the benchmark regression results in the first column, the coefficient of the linear term of FinTech decreases from -1.362 to -1.240, while the coefficient of the quadratic term decreases from 0.238 to 0.226. Although the absolute values of these coefficients decrease, their significance remains unchanged, indicating the presence of a mediating effect. This suggests that the influence of FinTech on the profitability of commercial banks is partially mediated through the variable of competitiveness, which validates hypothesis 3.

Table 4.14: Regression Results of the Mediating Effect of Competition

Variable	(1) PRO	(2) Lerner	(3) PRO
FinTech	-1.362*** (0.158)	-0.121*** (0.035)	-1.240*** (0.144)
FinTech ²	0.238*** (0.028)	0.012** (0.005)	0.226*** (0.026)
GGDP	0.019*** (0.004)	0.002* (0.001)	0.017*** (0.004)
GCPI	0.107*** (0.019)	0.001 (0.006)	0.106*** (0.019)
LSIZE	0.900* (0.485)	0.158 (0.108)	0.741 (0.444)
NIM	0.301** (0.116)	0.002 (0.027)	0.299** (0.116)
LTA	-0.012 (0.009)	0.001 (0.002)	-0.013 (0.009)
Lerner			1.010*** (0.363)
_cons	0.148 (1.913)	0.002 (0.442)	0.146 (1.785)
Observations	600.000	600.000	600.000
R ²	0.297	0.096	0.333
R ² _a	0.289	0.085	0.324

Notes: Asterisks ***, **, and * denote significance levels at 1%, 5% and 10%, respectively. The values in parentheses represent robust standard errors.

4.9.2 The Mediating Effect of Risk

Table 4.15 presents the regression results with the inclusion of the risk as intermediary variable. The first column indicates the benchmark regression results, the second column reflects the regression results regarding the impact of FinTech on risks, and the third column illustrates the regression results concerning the influence of risks on the profitability of commercial banks. The regression results in the second column reveal that the coefficient of the linear term of FinTech is 0.399, while the coefficient of the quadratic term is -0.076, both significant at the 1% level. This suggests that the effect of FinTech on the operational risks of commercial banks follows a trend of initially increasing and subsequently decreasing.

In the early stages of FinTech development, the emergence of numerous FinTech companies intensified market competition, leading to an increase in the risk exposure of commercial banks, as previously discussed. Additionally, during this period, the introduction of emerging technologies may have introduced uncertainties and security challenges, such as cybersecurity risks and customer privacy breaches, which could contribute to an escalation in the risks faced by commercial banks (Yan and Lian, 2024). Furthermore, in the initial phase, financial regulation was relatively delayed, and the quality of FinTech enterprises varied significantly, thereby increasing the risks associated with cooperation for commercial banks (Elia et al., 2023).

However, as FinTech continues to develop, the technological capabilities of FinTech companies have become increasingly mature. These companies have deepened their collaborations with banks, enabling financial institutions to offer a broader range of products and services to customers. This not only satisfies the diverse needs of customers but also

introduces diversified profit models for banks while reducing their reliance on and risks associated with traditional businesses (Li et al., 2025). Moreover, banks leverage advanced technologies such as intelligent risk control systems, anti-fraud mechanisms, digital identity verification and encryption techniques to mitigate risks. Additionally, through the application of big data and artificial intelligence, banks enhance their internal risk management capabilities (Sajid et al., 2023). With the maturation of the FinTech market and advancements in regulatory technology, regulatory agencies continuously update and refine policies governing FinTech firms and commercial banks. Such measures strengthen oversight and effectively reduce the operational risks faced by commercial banks (Zhao et al., 2023; Li et al., 2025), aligning with the theoretical expectations outlined in the earlier sections of this thesis.

From the perspective of control variables, the coefficients of GGDP and GCPI are significantly negative at the 1% level. This suggests that as the macroeconomic development improves, the likelihood of risks for commercial banks also diminishes. Conversely, the coefficient of LTA is significantly positive, indicating that an increase in the credit rate is associated with a higher default risk for banks.

From the regression results in column (3), PCR is significantly negative at the 1% level, suggesting that higher bank risk is associated with poorer profitability. After incorporating the PCR variable, the direct effect of FinTech on the profitability of commercial banks becomes statistically insignificant. This suggests that risk-taking serves as the key mechanism through which FinTech influences bank profitability, indicating that the PCR variable plays a fully mediating role in this relationship. In summary, FinTech exhibits a nonlinear impact on PRO through the mediating mechanism of PCR. In the early

stages, it exacerbates banks' operational risks, thereby inhibiting PRO, whereas in the long term, it mitigates these risks, thus enhancing PRO. This empirical evidence provides robust support for hypothesis 3, originally formulated in the preceding section.

Table 4.15: Regression Results of the Mediating Effect of Risk

Variable	(1) PRO	(2) PCR	(3) PRO
FinTech	-1.362*** (0.158)	0.399*** (0.041)	-0.300 (0.247)
FinTech ²	0.238*** (0.028)	-0.076*** (0.007)	0.036 (0.044)
GGDP	0.019*** (0.004)	-0.004*** (0.001)	0.007** (0.003)
GCPI	0.107*** (0.019)	-0.029*** (0.006)	0.029* (0.016)
LSIZE	0.900* (0.485)	-0.046 (0.116)	0.777** (0.342)
NIM	0.301** (0.116)	-0.042 (0.026)	0.189** (0.078)
LTA	-0.012 (0.009)	0.005*** (0.002)	0.002 (0.006)
PCR			-2.664*** (0.450)
_cons	0.148 (1.913)	0.118 (0.465)	0.461 (1.351)
Observations	600.000	600.000	600.000
R ²	0.297	0.359	0.600
R ² a	0.289	0.352	0.595

Notes: Asterisks ***, **, and * denote significance levels at 1%, 5% and 10%, respectively. The values in parentheses represent robust standard errors.

In summary, Table 4.16 displays the results of the hypotheses testing. The findings indicate that all three hypotheses formulated in this study are supported by empirical evidence. Specifically, H1 is confirmed, revealing a U-shaped relationship between FinTech development and the profitability of commercial banks in China: during the early stages of FinTech adoption, profitability is negatively affected by heightened competition and adjustment costs; however, as FinTech matures and its integration into banking deepens, the

impact becomes increasingly positive. H2 is also validated, demonstrating that income diversification acts as a moderating factor, enabling banks to counteract the initial adverse effects of FinTech development and thereby improve overall profitability. Furthermore, H3 is substantiated, with the results showing that FinTech adoption enhances bank profitability through both competitive dynamics and improved risk management, offering insights into the underlying mechanisms of this relationship. Collectively, these findings provide robust support for the study's theoretical framework and highlight the multifaceted and dynamic role of FinTech in shaping banking profitability in China.

Table 4.16: Summary of Hypotheses Testing Results

Hypothesis	Statement	Expected Sign	Empirical Result	Decision
H1	From a dynamic perspective, there is a “U-shaped” relationship between FinTech and the profitability of commercial banks in China.	–, +	U-shaped relationship (negative in early stage, positive in later stage)	Supported
H2	Commercial banks in China can mitigate the negative impact of the early stage of FinTech development on their profitability through income diversification.	+	Positive and significant moderation	Supported
H3	FinTech adoption can increase the profitability of commercial banks in China from the aspects of competition and risk.	+	Significant mediation effect confirmed	Supported

4.10 Grouping Regression Analysis

4.10.1 Grouping by Business Regional Scopes

Affected by historical evolution, shareholder backgrounds, regional economic levels and variations in regulatory policy requirements, there are notable differences in the

organizational structure, profit levels and development models of Chinese commercial banks. These factors also result in distinctions in their business scopes. Consequently, commercial banks exhibit differing perceptions and attitudes toward FinTech, leading to varied responses. In this study, commercial banks are categorized based on their business regional scopes into national banks and regional banks. National banks comprise large state-owned commercial banks and joint-stock banks, while regional banks encompass urban commercial banks and rural commercial banks.

From the regression results, the regression coefficient of FinTech on the comprehensive profitability of national banks is -0.578, and the quadratic term coefficient is 0.100. While the regression coefficient of FinTech on the profitability of regional banks is -1.694, and the quadratic term coefficient is 0.287. The results of these two groups also show a U-shaped curve trend, and both have passed the statistical significance test at the 1% level. Since the trend of the regression coefficients of the two groups is the same, the Chow Test is used for the difference test of coefficients between groups. The value of the Chow Test is 7.330, and the p-value is 0.000, indicating that there are differences between the groups. By comparing the regression coefficients of the two groups, it can be known that in the short term, the negative impact of FinTech on the profitability of regional banks is greater than that of national banks, and in the long term, the positive impact of FinTech on the profitability of regional banks is also more obvious than that of national banks.

From the perspective of the reason of above result is that national banks possess greater inertia in their organizational structures and business processes. Given their large scale, they prioritize stable operations and risk control, which mitigates the adverse effects of FinTech (Chen and Shen, 2024). Moreover, national banks have invested in FinTech

relatively early but are now encountering diminishing marginal returns from technology spillovers, leading to a deceleration in revenue growth (Bu and Tang, 2024). In contrast, regional banks have weaker foundations, making it challenging for them to replicate technologies from leading banks due to high development costs. Consequently, they are more significantly impacted by FinTech companies in the short term (Yu and Li, 2023). However, as FinTech continues to evolve, regional banks leverage their provincial and municipal bases to integrate financial applications with local advantages. This enables them to enhance their retail businesses more efficiently while reducing labour costs, thereby significantly improving their profitability in the long run.

Table 4.17: Regression Results of the Country and Local Commercial Banks

Variable	(1) Country	(2) Local
FinTech	-0.578*** (0.150)	-1.694*** (0.205)
FinTech ²	0.100*** (0.031)	0.287*** (0.033)
GGDP	0.017*** (0.004)	0.016*** (0.005)
GCPI	0.062** (0.028)	0.114*** (0.025)
LSIZE	-0.140 (0.707)	1.288** (0.618)
NIM	0.202 (0.172)	0.325*** (0.119)
LTA	0.008 (0.009)	-0.015 (0.010)
_cons	2.966 (3.515)	-0.415 (2.150)
Observations	180.000	420.000
R ²	0.387	0.320
R ² _a	0.362	0.309
Chow Test	7.330	
p-value	0.000	

Notes: Asterisks ***, **, and * denote significance levels at 1%, 5% and 10%, respectively. The values in parentheses represent robust standard errors.

4.10.2 Grouping by Asset Scales

On this basis, this study conducts a more detailed classification of commercial banks according to their asset scales and customer scales, categorizing them into large state-owned commercial banks, joint-stock commercial banks, city commercial banks and rural commercial banks. It further investigates the impact of FinTech on the profitability of these four types of banks. The regression results indicate that FinTech significantly affects the profitability of all four bank categories at least at the 10% significance level, with the same directional trend—first decreasing and then increasing. This thesis employs the Chow Test to examine the coefficient differences between groups. The test results show that the Chow Test value is 4.110, with a p-value of 0.000, suggesting significant differences among the four types of banks. From the coefficient of the linear term of FinTech, it can be observed that the negative impact of FinTech development is most pronounced for city commercial banks, followed by rural commercial banks, while its effect on joint-stock banks is the least.

For the underlying cause of the above phenomenon is that city commercial banks generally have smaller business scales and narrower scopes compared to state-owned large commercial banks and joint-stock banks, as well as relatively weaker financial strength, they were significantly impacted by the competition from FinTech companies in the early stage. Moreover, due to factors such as the “digital divide” in rural areas, rural residents showed limited engagement with FinTech products, which resulted in a relatively minor impact of FinTech on the profitability of rural commercial banks (Xiong et al., 2021). Consequently, the negative effects of the early development of FinTech on bank profitability were more pronounced in city commercial banks. In contrast, most joint-stock commercial banks initiated their FinTech transformations earlier and invested more heavily in relevant scientific research. Some even established specialized FinTech centers to efficiently and

strategically build a comprehensive FinTech application system. As a result, during the early stages of FinTech development, joint-stock commercial banks experienced less external impact from FinTech.

From the quadratic coefficient of FinTech, it can be inferred that the development of FinTech has the most pronounced positive impact on the profitability of city commercial banks, followed by rural commercial banks and then state-owned large commercial banks, while it shows no significant effect on joint-stock commercial banks. This ranking aligns with the discussions presented earlier in the text. City commercial banks typically concentrate on local markets, enabling them to adapt FinTech applications more swiftly and meet customer needs promptly. Consequently, the positive influence of FinTech on their profitability is the most significant. Moreover, FinTech bridges gaps in traditional services in rural areas, reaching a broader base of underserved customers. Thus, the advancement of FinTech also exerts a relatively substantial positive effect on the profitability of rural commercial banks. While joint-stock commercial banks cannot compare with state-owned large commercial banks in terms of financial strength and scale, however, they have more advanced business concepts and innovative spirit and respond to the development of FinTech more actively (Shi et al., 2024). Thus, its growth in benefits has slowed down compared to the short term.

Table 4.18: Regression Results of Different Types of Commercial Banks

Variable	(1) SOCB	(2) JSCB	(3) CCB	(4) RCB
FinTech	-0.779*** (0.151)	-0.448* (0.211)	-1.867*** (0.258)	-1.397*** (0.324)
FinTech ²	0.094** (0.022)	0.083 (0.048)	0.286*** (0.035)	0.214** (0.084)
GGDP	0.022*** (0.003)	0.017** (0.007)	0.021*** (0.007)	0.010 (0.007)

Table 4.18 continued

Variable	(1) SOCB	(2) JSCB	(3) CCB	(4) RCB
GCPI	0.096** (0.032)	0.050 (0.046)	0.124*** (0.031)	0.079** (0.028)
LSIZE	0.972 (0.924)	-0.261 (0.897)	1.902** (0.731)	2.801 (1.585)
NIM	-0.027 (0.118)	0.268 (0.208)	0.381** (0.147)	0.457** (0.147)
LTA	0.026 (0.022)	0.007 (0.013)	-0.009 (0.011)	-0.015 (0.021)
_cons	-2.792 (5.069)	3.193 (4.340)	-2.780 (2.534)	-5.587 (5.691)
Observations	60.000	120.000	288.000	132.000
R^2	0.661	0.313	0.373	0.299
R^2_a	0.616	0.270	0.357	0.260
Chow Test		4.110		
p -value		0.000		

Notes: Asterisks ***, **, and * denote significance levels at 1%, 5% and 10%, respectively. The values in parentheses represent robust standard errors.

Based on the aforementioned analysis, the impact of FinTech development on the profitability of different types of commercial banks exhibits distinct heterogeneity. Specifically, regional banks are more significantly affected by FinTech development compared to national banks. A further detailed analysis indicates that urban commercial banks are most impacted by FinTech, followed by rural commercial banks, then state-owned large commercial banks, and lastly joint-stock commercial banks.

4.10.3 Grouping by the COVID-19 Pandemic

Furthermore, from the perspective of public health events, this thesis investigates the role of the COVID-19 pandemic in shaping the impact of FinTech on the profitability of commercial banks using phased regression analysis. The regression results indicate that the coefficient of the linear term of FinTech is negative, while the coefficient of the quadratic term is positive both before and after the pandemic, confirming that FinTech continues to

exert a U-shaped nonlinear effect on the profitability of commercial banks. The Chow Test yields a p-value of 0.000, suggesting significant differences in the relationship between FinTech and bank profitability before and after the pandemic. Specifically, the regression coefficients reveal that the coefficient of the linear term of FinTech is -0.931 pre-pandemic and -3.059 post-pandemic, indicating an intensified inhibitory effect of early-stage FinTech development on bank profitability during the pandemic period. This can be attributed to the decline in offline banking activities and the surge in demand for online services triggered by the outbreak of the COVID-19 pandemic. Given the constraints imposed by traditional business frameworks and processes, commercial banks may struggle to adapt swiftly, enabling FinTech companies to capitalize on market opportunities and capture the customers and market share of commercial banks, thereby reducing their profitability (Wei and Yang, 2024). Additionally, the need for commercial banks to accelerate digital transformation and increase technological investment during the early stages of the pandemic leads to a rise in short-term costs, further suppressing profitability.

From the perspective of the quadratic coefficient of FinTech, it increased from 0.199 before the epidemic to 0.396 after the epidemic. The post-epidemic coefficient was approximately double the pre-epidemic value, indicating a significant enhancement in the profit-generating capability per unit increase in FinTech after the epidemic. Post-epidemic developments in FinTech enabled commercial banks to optimize their online channels and services, thereby improving customer experience (Anifa et al., 2022). Furthermore, the external influence of FinTech encouraged commercial banks to develop more innovative financial products and services, leading to an increase in non-interest income (Li et al., 2021; Tang et al., 2024). Additionally, the competitive and cooperative relationships among financial institutions became more integrated post-epidemic. Commercial banks deepened

their collaborations with FinTech companies through resource sharing and complementary strengths. This partnership facilitated joint financial innovation initiatives, expanded market share, and achieved mutual benefits and win-win outcomes (Guo et al., 2022).

Table 4.19: Regression Results Considering the Impact of the Epidemic

Variable	(1) Year<2020	(2) Year>=2020
FinTech	-0.931*** (0.255)	-3.059** (1.389)
FinTech ²	0.199*** (0.053)	0.396** (0.197)
GGDP	0.010 (0.012)	0.017*** (0.005)
GCPI	0.129** (0.058)	0.061** (0.025)
LSIZE	-0.265 (0.490)	2.556*** (0.893)
NIM	0.280** (0.105)	0.264 (0.163)
LTA	-0.010 (0.008)	0.010 (0.009)
_cons	3.913* (2.093)	-3.623 (4.849)
Observations	400.000	200.000
R^2	0.405	0.367
R^2_a	0.394	0.344
Chow Test		2.130
p -value		0.000

Notes: Asterisks ***, **, and * denote significance levels at 1%, 5% and 10%, respectively. The values in parentheses represent robust standard errors.

4.11 Endogeneity Test

4.11.1 Introducing the One-period Lag of FinTech

Due to the potential existence of a two-way causal relationship, commercial banks may adopt FinTech strategies to enhance profitability, thereby introducing endogeneity issues into the analysis. To address this concern, this study draws on methodologies from Jin et al. (2020), Xiong et al. (2021), Tian and Ge (2023), Gu (2023), Bu and Tang (2024) and

Tang et al. (2024). Specifically, this thesis conducts regression analysis by substituting the lagged one-period value of FinTech development for its contemporaneous value. This substitution is justified because current profitability cannot influence the prior period's FinTech development level, thus mitigating the endogeneity problem. The regression results indicate that the linear term of the lagged one-period FinTech development level is negative, while the quadratic term is positive, and both are significant at the 1% significance level. Consequently, the relationship between commercial bank profitability and FinTech development still exhibits a U-shaped curve, aligning with the benchmark regression findings. These results confirm the robustness of the previous conclusions. To some extent, this method resolves the two-way causality issue in the model.

Table 4.20: Regression Results of Endogeneity Test

Variable	(1) PRO
FinTech _{t-1}	-1.411*** (0.196)
FinTech _{t-1} ²	0.240*** (0.033)
GGDP	0.024*** (0.004)
GCPI	0.118*** (0.018)
LTA	-0.007 (0.009)
LSIZE	1.575*** (0.582)
NIM	0.292** (0.122)
Constant	-2.720 (2.206)
Observations	550.000
R^2	0.274
R^2_a	0.265

Notes: Asterisks ***, **, and * denote significance levels at 1%, 5% and 10%, respectively. The values in parentheses represent robust standard errors.

4.11.2 Introducing Dynamic Panel GMM

To address the potential issue of temporal autocorrelation in the regression results, which refers to the possibility that the profitability of commercial banks in the prior period may influence the current profit level, this study incorporates the one-period lagged value of PRO into a dynamic panel model. The system GMM model is then employed to estimate the parameters and mitigate the endogeneity problem. As shown in Table 4.21, the p-value of AR (1) is 0.000, which is less than 0.1, while the p-value of AR (2) is 0.256, exceeding 0.1. This indicates the presence of first-order autocorrelation but the absence of second-order autocorrelation. Furthermore, the Hansen test is conducted, yielding a result of 0.142, which exceeds 0.1. This confirms the validity of the instrumental variables and rules out over-identification issues. Based on the test results for AR (1), AR (2) and Hansen test, the requirements of the GMM model are satisfied, allowing the regression results to be interpreted.

The GMM regression results reveal that the coefficient of the one-period lagged PRO is significantly positive at the 1% level, suggesting that when the current profit level of commercial banks is high, they can allocate part of their profits toward capital accumulation, thereby enhancing their risk-resistance capabilities. Additionally, a higher profit level boosts the confidence of shareholders, customers and investors, facilitating greater capital inflows and investments, which in turn improves future profitability. Moreover, the regression results indicate that the coefficient of the linear term of FinTech is significantly negative, whereas the coefficient of the quadratic term is significantly positive, reflecting an initial inhibitory effect followed by a promotional effect. This finding reinforces the robustness of the earlier results.

Table 4.21: Results of Dynamic Panel GMM Regression Analysis

Variable	(1) PRO
PRO _{t-1}	0.848*** (0.064)
FinTech	-0.265* (0.155)
FinTech ²	0.067** (0.026)
GGDP	0.032*** (0.004)
GCPI	0.075*** (0.013)
LTA	0.000 (0.002)
LSIZE	0.030 (0.023)
NIM	0.004 (0.044)
_cons	-0.052 (0.346)
N	550.000
AR (1)	0.000
AR (2)	0.256
Hansen	0.142

Notes: Asterisks ***, **, and * denote significance levels at 1%, 5% and 10%, respectively. The values in parentheses represent robust standard errors.

4.12 Robustness Test

Robustness testing is an essential component of empirical research, serving to validate the reliability and persuasiveness of research findings. Common robustness testing methods include substituting the dependent or independent variables, altering the regression model, incorporating additional control variables, modifying the sample size or time window, among others. To further examine the reliability of the regression results regarding the impact of FinTech on the profitability of commercial banks, this study conducts robustness tests by replacing the dependent variable, adding control variables and adjusting the sample size. The analysis focuses on whether the direction and significance of the regression results

for key variables remain consistent. Consistency with the original regression results indicates robustness, whereas inconsistency suggests potential sensitivity or instability in the regression.

4.12.1 Replacing the Dependent Variable

To test the robustness of the model, this study substitutes the dependent variable PRO with ROA, ROE and the logarithm of net profit (lnNP) for separate regressions. As presented in Columns (1), (2) and (3) of Table 4.22, the regression coefficients of the linear term of the independent variable FinTech are significantly negative at the 1% level, while the coefficients of the quadratic term of FinTech are significantly positive at the same level. This indicates that the effect of FinTech on commercial banks' profitability still exhibits a U-shaped trend of initially decreasing and subsequently increasing, which is largely consistent with the benchmark regression results. Furthermore, the sign patterns of the primary control variables remain aligned with the original findings. Despite minor changes in the significance levels of some control variables, the overall results maintain robustness.

Table 4.22: Robustness Test Results of Changing the Dependent Variable

Variable	(1) ROA	(2) ROE	(3) lnNP
FinTech	-0.385*** (0.067)	-9.220*** (1.052)	-0.369*** (0.114)
FinTech ²	0.053*** (0.012)	1.191*** (0.192)	0.056*** (0.020)
GGDP	0.005*** (0.002)	0.112*** (0.024)	0.012*** (0.004)
GCPI	0.009 (0.007)	0.291** (0.115)	0.050** (0.019)
LTA	-0.003 (0.004)	-0.154*** (0.052)	-0.011 (0.008)
LSIZE	0.125 (0.165)	4.063 (2.636)	2.585*** (0.332)
NIM	0.231*** (0.038)	2.353*** (0.550)	0.322*** (0.085)

Table 4.22 continued

Variable	(1) ROA	(2) ROE	(3) lnNP
_cons	0.601 (0.650)	13.546 (10.626)	-5.811*** (1.281)
Observations	600.000	600.000	600.000
R ²	0.649	0.710	0.576
R ² a	0.644	0.706	0.571

Notes: Asterisks ***, **, and * denote significance levels at 1%, 5% and 10%, respectively. The values in parentheses represent robust standard errors.

4.12.2 Adding Control Variables

In order to address the potential issue of omitted variable bias, the thesis extended the original model by incorporating additional control variables based on a review of existing literature. Specifically, at the industry level, the study included CR4, which represents industry concentration and is calculated as the ratio of the assets of the top four commercial banks in terms of asset size to the total assets of all banks in China. At the bank level, the thesis added the asset-liability ratio (ALR), and it also introduced a dummy variable for the impact of the epidemic (COV) (Li et al., 2022; Wu and Zhang, 2023; Tang et al., 2024; Wei and Yang, 2024). The regression results presented in Table 4.23 indicate that the coefficient of the linear term of FinTech is -0.894, while the coefficient of the quadratic term is 0.200, and both are significant at the 1% level. These findings align with the main effect regression results discussed earlier in the text. Regarding the control variables, the signs and significance levels of the original control variables remain consistent with the main regression. Among the newly added control variables, ALR exhibits no significant relationship, CR4 shows a significantly positive relationship at the 5% level, and COV demonstrates a significantly negative relationship at the 5% level. Consequently, through the

robustness test conducted by adding these control variables, the results further substantiate the robustness of the model and conclusions presented in this study.

Table 4.23: Robustness Test Results of Adding Control Variables

Variable	(1) PRO
FinTech	-0.894*** (0.290)
FinTech ²	0.200*** (0.049)
GGDP	0.019*** (0.005)
GCPI	0.101*** (0.020)
LSIZE	1.011* (0.526)
NIM	0.345*** (0.119)
LTA	-0.011 (0.010)
ALR	0.045 (0.043)
CR4	0.078** (0.031)
COV	-0.241** (0.095)
_cons	-9.684** (4.674)
Observations	600.000
R ²	0.333
R ² a	0.322

Notes: Asterisks ***, **, and * denote significance levels at 1%, 5% and 10%, respectively. The values in parentheses represent robust standard errors.

4.12.3 Deleting the Samples of H-share Banks

This thesis initially selected 50 listed commercial banks as samples, comprising 15 both A-share and H-share listed banks, 27 A-share listed banks and 8 H-share listed banks. However, for the purpose of this test, the 8 pure H-share listed banks were excluded from the sample. Table 4.24 presents the regression results after removing the H-share listed banks.

The results indicate that the coefficient of the linear term of FinTech is -1.289, while the coefficient of the quadratic term is 0.205, both of which are significant at the 1% level. This approach further validates the robustness of the benchmark regression presented in the preceding section.

Table 4.24: Robustness Test Results of Deleting H-share Listed Banks

Variable	(1) PRO
FinTech	-1.289*** (0.143)
FinTech ²	0.205*** (0.028)
GGDP	0.014*** (0.004)
GCPI	0.087*** (0.017)
LSIZE	1.074* (0.579)
NIM	0.114 (0.111)
LTA	0.006 (0.009)
_cons	-0.773 (2.326)
N	504.000
r ²	0.312
r ² a	0.302

Notes: Asterisks ***, **, and * denote significance levels at 1%, 5% and 10%, respectively. The values in parentheses represent robust standard errors.

CHAPTER 5

CONCLUSION AND RECOMMENDATIONS

5.1 Introduction

This chapter offers a comprehensive summary of the research and presents its conclusions. It begins by summarizing the key findings, followed by an exploration of their policy implications. Additionally, this chapter critically examines the limitations of the current research and suggests potential directions for future studies. Thus, the structure layout of this chapter includes the following sections: Section 5.2 details the research conclusions, Section 5.3 discusses the policy implications, Section 5.4 assesses the research limitations and Section 5.5 outlines future research directions.

5.2 Summary of the Research Findings

This study selects the sample period from 2012 to 2023 and constructs a static panel regression model for 50 different types of listed banks. Through model selection tests, the fixed-effects model is chosen for regression analysis. The dependent variable is constructed using factor analysis, integrating three dimensions including profitability, liquidity, and security into a comprehensive profitability index for commercial banks. The independent variable is based on provincial-level data from the Peking University Digital Inclusive Finance Index, weighted by the number of bank branches in each province. Control variables include macroeconomic indicators such as GDP growth rate and year-on-year CPI growth rate, as well as micro-level factors like the loan-to-asset ratio, net interest margin and the logarithm of asset size. These variables are selected to examine the impact of FinTech on the profitability of commercial banks. Additionally, this study incorporates income diversification as a moderating variable, and competition and risk as mediating variables into

the existing model to explore their roles in the relationship between FinTech and bank profitability. Furthermore, considering that commercial banks may be influenced by factors such as business scope, asset size and the pandemic, grouping regression analysis is conducted. Based on the aforementioned analyses, the following findings are drawn.

Firstly, there exists a U-shaped nonlinear relationship between the development of FinTech and the comprehensive profitability of commercial banks. Specifically, during the early stages of FinTech development, it exerts an inhibitory effect on profitability, whereas once it surpasses a certain threshold, it plays a promoting role. In the initial phase, due to the unclear development goals and directions of commercial banks, coupled with substantial technological investment costs and the encroachment on banking business by non-bank FinTech enterprises, FinTech negatively impacted the profitability of banks. However, as FinTech continues to evolve and its application deepens, commercial banks have gradually transformed their business concepts, enhanced technological innovation and strengthened cooperation with FinTech companies, thereby enabling FinTech to exert a positive influence on bank profitability.

Secondly, income diversification played a significant positive regulatory role in mitigating the negative impact on the profitability of commercial banks during the early stages of FinTech development. By leveraging FinTech, commercial banks can improve their operational efficiency and service quality, enhance customer experience, focus more on product innovation, reduce reliance on the interest rate spread between deposits and loans, continuously optimize their revenue structure and expand income sources, thereby strengthening their overall profitability.

Furthermore, regarding the influencing mechanism, the development of FinTech impacts the overall profitability of commercial banks via competition and risk channels. In the early stages of FinTech development, the rapid emergence of FinTech companies competed with commercial banks in deposit-taking, lending and intermediary services. By capturing long-tail customers those commercial banks had overlooked and market shares, they intensified market competition. To remain competitive, commercial banks were compelled to lower the qualification thresholds for loan customers or engage in high-risk, high-return businesses, which consequently increased their risks. Thus, during the early phase of FinTech development, heightened competition and elevated risks contributed to a decline in the profitability of commercial banks. As FinTech gradually matured and collaboration with FinTech firms deepened, the competitiveness of commercial banks improved. Moreover, technological advancements alleviated information asymmetry, enhanced operational efficiency and strengthened risk management capabilities. Consequently, the maturity of FinTech not only bolstered the competitiveness of banks but also mitigated their operational risks.

In addition, this thesis performs a grouping analysis, and the results demonstrate that the development of FinTech exerts heterogeneous effects on the profitability of different types of commercial banks. Specifically, FinTech has a stronger impact on regional banks compared to national banks. Further analysis reveals that FinTech's influence on the profitability of urban commercial banks is the most pronounced, followed by rural commercial banks, then state-owned large commercial banks, while its effect on joint-stock commercial banks is relatively weaker. Moreover, taking into account the impact of the COVID-19 epidemic, this study divides the sample into pre-epidemic and post-epidemic periods for separate regressions. The regression results indicate that the influence of FinTech

on the profitability of commercial banks becomes more significant after the onset of the epidemic.

5.3 Conclusion of the Study

In recent years, China's FinTech sector has experienced rapid growth, presenting both challenges and opportunities for traditional commercial banks. The rise of external FinTech has impacted the traditional operations of commercial banks, compelling them to embrace and leverage FinTech advancements while transforming their original business and profit models. Consequently, commercial banks have intensified their investment in FinTech research and development, integrated FinTech solutions with traditional services, strived to enhance operational efficiency, deliver high-quality services, mitigate bank risks and strengthen profitability.

This study demonstrates that FinTech development has a U-shaped relationship with the profitability of Chinese commercial banks. Initially, profitability is hindered by substantial implementation costs and intensified market competition. However, as FinTech becomes deeply integrated into banking operations, it enhances operational efficiency, strengthens competitive positioning, and improves risk management. A critical mechanism in mitigating early-stage profitability pressures is income diversification, which facilitates sustained revenue growth and financial stability. Furthermore, the research identifies competition and risk dynamics as key pathways through which FinTech impacts bank performance. Heterogeneous responses across different types of banks suggest that regional and smaller institutions are particularly susceptible to technological disruptions. Importantly, the positive influence of FinTech is more evident in the post-pandemic period, underscoring its role in building institutional resilience. Collectively, these findings indicate that FinTech

should be regarded as a long-term catalyst for structural transformation rather than a short-term profit instrument. For banking executives, this highlights the necessity of continuous investment in digital innovation combined with prudent risk management. From a policy standpoint, fostering a supportive environment for FinTech development must be accompanied by strong regulatory oversight to prevent systemic vulnerabilities.

5.4 Contributions of the Study

Based on the research findings and conclusion, this study makes several meaningful contributions to both literature and practical applications in the field of FinTech and banking. First, it extends the existing literature by constructing a comprehensive profitability index that integrates three critical dimensions: profitability, liquidity, and safety, thereby addressing the limitations of conventional single indicators such as ROA or ROE. Second, it provides robust empirical evidence of a non-linear, U-shaped relationship between FinTech development and bank profitability, highlighting the transitional dynamics of technological adoption, from early-stage challenges to long-term performance gains. Third, the research clarifies the mechanisms through which FinTech influences bank profitability, identifying the mediating roles of competition and risk, as well as the moderating effect of income diversification. Finally, by analysing heterogeneities across different bank types and time periods (pre- and post-pandemic), the study reveals differential impacts of FinTech, thereby enriching current research and offering strategic and regulatory insights for banking professionals and policymakers.

5.5 Policy Recommendations

After conducting research and analysis on this thesis and summarizing the relevant conclusions and contributions, it is evident that commercial banks must not only address the challenges and impacts posed by FinTech but also fully leverage FinTech capabilities to expedite their digital transformation. This transformation will enable them to reshape their business models and enhance their profitability. However, given the relatively traditional and rigid business structures of commercial banks, deficiencies in adapting to FinTech may gradually become apparent during implementation. In their development journey, commercial banks should adopt a prudent approach, continuously monitor and mitigate potential risks associated with FinTech, while simultaneously aligning with evolving regulatory requirements. Based on the findings and practical insights presented in this study, the following recommendations are proposed for the future development direction of commercial banks.

5.5.1 Provide Robust Policy Support for FinTech

Government support can encourage commercial banks to pursue more FinTech innovations, enabling them to better meet the ever-evolving market demands and drive economic innovation and development. Specifically, the government can introduce policies such as FinTech development plans and regulatory frameworks to guide the orderly technological innovation, business model transformation and risk management of commercial banks. Based on the theoretical and empirical findings in this thesis that FinTech exhibits a U-shaped curve effect, which means initially inhibiting and subsequently promoting the profitability of commercial banks, thus government departments can design phased support strategies. For banks in the technology input phase, fiscal incentives like tax breaks for R&D expenses and special innovation subsidies can be implemented to alleviate

short-term pressures caused by rising costs and declining profitability. Meanwhile, for banks in the mature application stage, clear evaluation criteria for technology output should be established to encourage them to share their advanced solutions with smaller and medium-sized banks, thereby fostering resource sharing and enhancing the overall technological capabilities of the industry. Additionally, the government must address the competitive challenges posed by technological advancements by strengthening FinTech infrastructure, developing a national information-sharing platform, reducing redundant R&D investments, and promoting high-quality, efficient growth in the financial sector (Li et al., 2022).

In addition, the classification regression analysis of Chinese commercial banks presented in this thesis reveals that FinTech has a more pronounced impact on the profitability of regional banks, specifically rural and urban commercial banks. Based on this finding, the government could establish a dedicated FinTech empowerment fund for regional banks, with a focus on supporting rural and urban commercial banks in developing intelligent financial products tailored to regional economic characteristics. The operation of the fund could adopt a “government-guided, market-driven” approach, establishing a dual evaluation system that integrates “technology maturity” and “market conversion rate”. Additionally, the fund could provide technical support and personnel training to regional banks, thereby narrowing the gap between regional and national banks, promoting balanced financial market development, and enhancing the inclusiveness and accessibility of financial services (Bu and Tang, 2024).

5.5.2 Strengthen the Supervision of FinTech Innovation

FinTech, while revolutionizing financial services, also introduces specific risks. Strengthening supervision not only mitigates financial risks but also boosts the confidence

of market participants and fosters the innovation of FinTech. Consequently, regulatory bodies such as the People's Bank of China, the National Financial Regulation Administration and the securities regulatory authority should enhance their oversight and coordination in the realm of FinTech. This includes reinforcing top-level design and strategic planning, refining the regulatory framework for FinTech, establishing a robust financial risk assessment mechanism, and collaboratively constructing a conducive ecosystem for the development of FinTech (Xiong et al., 2021; Tang et al., 2024). Additionally, the government can mandate that entities like FinTech companies and commercial banks strengthen information disclosure and public communication, promptly sharing relevant information with both regulatory authorities and the general public to deepen understanding and oversight of the FinTech sector. As suggested by Bu and Tang (2024), regulatory institutions could establish a "regulatory sandbox" for FinTech, enabling commercial banks to test new technologies within a controlled environment. This approach encourages banks to pursue reform and innovation while enhancing collaboration with international FinTech regulatory bodies, drawing on global best practices to elevate the regulatory standards of China's FinTech sector.

5.5.3 Consider FinTech as a Long-term Strategy

According to the data regression analysis in Chapter Four, during the nascent stage of FinTech development, it exerts a negative influence on the profitability of commercial banks. However, as FinTech progresses further, it starts to positively promote the profitability of commercial banks. Consequently, despite potential declines in operating performance during the early stages due to substantial capital investment and external shocks, commercial banks must accurately understand the essence of FinTech, adopt it as a long-term strategic focus, enhance their level of FinTech investment, and fully leverage FinTech

to boost their innovation capabilities (Kayed et al., 2025). In the context of intense market competition, banks should integrate emerging technologies such as big data and artificial intelligence into their operations, optimize and upgrade traditional products and services, facilitate the modernization of banking business and services, and construct a multifunctional, integrated financial service platform. On this foundation, they should pursue diversified application innovations, refine the institutional architecture of commercial banks, and optimize their overall product and service portfolio (Gu, 2023).

Furthermore, commercial banks must prioritize the cultivation of FinTech talents by developing hierarchical and categorized talent development plans. For example, they can implement large-scale training programs for foundational talents, specialized enhancement programs for core talents, and cognitive improvement initiatives for executive teams. Additionally, new employees should receive basic FinTech knowledge training, middle-level managers should undergo FinTech management training, and senior leaders should participate in FinTech trend analysis and regulatory technology training. Moreover, banks need to optimize the ratio of traditional IT personnel to data professionals while enhancing their ability to attract high-end talents such as data analysis experts, algorithm engineers and artificial intelligence specialists (Song et al., 2023). Strengthening the FinTech talent pool will not only accelerate the digital transformation of commercial banks but also drive the advancement of FinTech capabilities.

5.5.4 Adjust the Income Structure to Mitigate the Adverse Effects of FinTech

From the regression results of the moderating effect, it is evident that income diversification plays a positive moderating role when FinTech negatively affects the profitability of commercial banks. Therefore, commercial banks should strategically

leverage the advantages of income diversification by optimizing their revenue structures and enhancing the proportion of non-interest income. Historically, commercial banks have heavily depended on the interest margin between deposits and loans as their primary revenue source, leading to a relatively simplistic income structure. However, with intensifying competition in the financial sector and the continuous innovation of FinTech-driven third-party platforms, the market share of commercial banks has been progressively eroded. Consequently, commercial banks must transform their business philosophies and profit models while actively optimizing their operational and revenue structures.

Commercial banks can facilitate the diversified development of financial innovation services by offering a wide range of wealth management products, providing professional investment advisory services, expanding electronic channels such as mobile banking and third-party payment platforms, and enhancing international financial services like cross-border payments and foreign exchange trading. This not only enables commercial banks to more effectively adapt to market trends and meet customer needs but also significantly diversifies their sources of non-interest income. Simultaneously, commercial banks should pursue diversified operations across different user segments, establish customer-centric business management models, and align back-end research and development with overall market needs. Through deep integration of customer information and leveraging cloud data analytics to match customer risk-return preferences, they can develop targeted products for various customer types, enabling precise business execution, optimizing revenue structures, and mitigating the adverse impact of FinTech on profitability (Zuo and Ma, 2019).

5.5.5 Enhance Strategic and In-depth Cooperation with FinTech Enterprises

From the regression results of the influence mechanism, in the process of FinTech affecting profits through competition, the early development of FinTech intensified market competition. Traditional commercial banks often prioritized serving large customer groups, neglecting small and medium-sized customers and underestimating the significance of long-tail customers. Consequently, when FinTech companies entered the market, they leveraged advanced technologies to provide personalized services for small and medium-sized customers, further intensifying competition. In response to this challenge, commercial banks can collaborate with FinTech companies (Mansour,2024). Commercial banks possess strengths in funding, resources, reputation and customer base, while FinTech companies excel in equipment and technological innovation. Through collaboration, both parties can achieve complementary advantages and enhance overall market efficiency.

Specifically, integrating the advanced technologies of FinTech companies into the products and services of commercial banks can enhance usability and service quality, attracting more customers and increasing revenue for the banks. Furthermore, collaborative innovation and R&D efforts between both parties can be pursued. By leveraging the cutting-edge technologies of FinTech companies in the R&D of new commercial banking businesses, and combining the technological strengths of FinTech firms with the operational expertise of commercial banks, innovative technical solutions can be developed to support commercial banking operations. Additionally, FinTech companies can utilize the regulatory advantages of commercial banks to extend the boundaries of financial services, acquire more customers and build market trust through bank channels, thereby reducing operational costs and achieving broader market coverage and business innovation. Consequently, strengthening cooperation between the two sides can fully leverage the long-tail effect, improve service

efficiency, optimize customer experience, and achieve mutual benefit and win-win outcomes (Hun et al., 2024). Moreover, commercial banks can provide services such as fund custody and payment settlement for FinTech companies, which not only helps commercial banks enhance their FinTech capabilities but also assists in expanding their business scope and boosting profitability.

5.5.6 Strengthen Risk Management and Early Warning

In the preceding chapter, risk was incorporated as a mediating variable in the regression analysis. The regression results indicate that with the advancement of FinTech, risk exhibits a trend of initially rising and subsequently declining. In the early stages of FinTech development, regulatory delays and uncertainties associated with emerging technologies lead to an increase in risk. Consequently, during this initial phase, commercial banks can integrate traditional risk management practices with innovative technological tools to achieve more efficient cost control and risk management. Additionally, establishing a specialized department for FinTech risk prevention and control can help monitor potential risks continuously, implement proactive defence strategies, and systematically summarize experiences. Furthermore, commercial banks should closely track government policies and regulatory measures, rigorously enforce risk prevention plans prescribed by authorities, enhance information transparency, ensure the legality and compliance of innovations and technical applications, and foster a balanced approach between FinTech innovation and risk management.

In the later stages of FinTech development, banks should fully leverage the technological benefits of FinTech, such as employing big data and cloud computing to construct risk defence models, gather diverse information datasets, and utilize these data to

strengthen risk identification and assessment capabilities (Tong and Yang, 2025). This enhances sensitivity to risks, enabling commercial banks to develop predictive, contextualized, data-driven, and intelligent risk warning systems, thereby accurately detecting and mitigating potential risks, ensuring the secure and stable operation of banks, and promoting the sustainable growth of the banking sector and financial system.

5.5.7 Develop FinTech with Differentiation

According to the grouping regression analysis, the impact of FinTech on the profitability of commercial banks varies depending on their business scope, asset scale, and customer base. Consequently, different types of commercial banks should adopt differentiated and characteristic development strategies based on their specific circumstances and market demands. National commercial banks, which possess substantial financial resources and a stable customer base, can independently construct a FinTech ecosystem through methods such as self-research and development (Xiong et al., 2021). Appropriately establish subsidiaries or acquire non-financial institutions to achieve diversified mixed operations, leverage advanced information technologies such as big data and artificial intelligence to expand non-interest income businesses. Moreover, deeply innovate in traditional financial product and service models, thoroughly explore customer needs, precisely target customer segments, and provide more personalized financial products and services. Among these, the competitive edge of joint-stock banks lies in their willingness to innovate. They are pioneers in digital and intelligent transformation, capable of converting FinTech advancements into new application scenarios, thereby leading other commercial banks in technological innovation.

In contrast, regional banks lack advantages in terms of funding, customer base and scale, making them more vulnerable to the impact of FinTech. To address this, they can leverage government support and various preferential policies, enhancing their FinTech capabilities by strengthening ties with the government and securing assistance in funding and technology research and development. Furthermore, regional banks can draw upon the FinTech transformation experiences of national banks, promote regional cooperation, share FinTech resources, and collectively enhance competitiveness (Bu and Tang, 2024). Additionally, they can collaborate with FinTech companies to integrate advanced emerging technologies into their business operations, thereby improving profitability. Leveraging their regional advantages and familiarity with local enterprises, regional banks can tailor their development strategies and personalized services to better serve local residents and businesses. Therefore, the focus of regional banks' development should center on localized advantageous products and services, fully utilizing their regional strengths to achieve differentiated operations.

5.5.8 Accelerate the Construction of Digital Infrastructure

Based on the grouping regression analysis according to epidemic factors, the regression results indicate that the influence of FinTech on the profitability of commercial banks has significantly intensified post-epidemic. This finding demonstrates that the epidemic has expedited the digital transformation of commercial banks and highlighted the strategic importance of FinTech in addressing public health crises. Following the outbreak, numerous commercial banking operations have transitioned from offline to online platforms and mobile terminals, while customer behaviours have undergone substantial changes. These developments necessitate that commercial banks reinforce their online service capabilities, expand non-contact service scenarios such as mobile banking and intelligent investment

advisory services, reduce reliance on physical branches, prioritize the development of an online ecosystem, and enhance digital infrastructure. Furthermore, by establishing a dynamic database of customer behaviours, commercial banks can monitor shifts in consumer habits, predict demand through technological tools, and introduce context-specific financial products.

Additionally, with the rise in online transactions, the profit model of commercial banks has gradually shifted from reliance on interest margin income to greater emphasis on fee-based intermediary services. Consequently, commercial banks must innovate in intermediary businesses to overcome profit constraints imposed by traditional interest margins and reconstruct their profit models. For instance, commercial banks can leverage open banking frameworks to generate commissions and handling fees by offering payment and settlement services to third-party platforms and supporting cross-border e-commerce activities. Moreover, the epidemic has spurred the emergence of numerous new business models. Commercial banks can collaborate with Internet hospitals, remote office platforms, and other digital entities to develop a “finance + scenario” integrated APP. By constructing ecological circles, these banks can offer consumers a broader range of life services.

5.6 Limitations of the Study

Due to the extensive number of commercial banks in China, most of which are unlisted, the disclosure of relevant information and data is insufficient. This poses significant challenges in obtaining comprehensive research data. Consequently, this study selects data from 50 listed banks for empirical analysis using a balanced panel. However, it should be noted that these bank data do not fully represent all commercial banks in China. Furthermore, the data used in this study spans from 2012 to 2023, excluding the most recent two years.

Given the constantly evolving financial market environment and the dynamic influence of FinTech on the profitability of commercial banks, the research conclusions require continuous updates and innovations. Therefore, these factors may introduce certain biases into the empirical results and research conclusions.

FinTech is in a state of continuous evolution and transformation. Due to the relatively late development of FinTech in China, there remains a lack of unified standards for defining its concept and measuring its development index. Most scholars rely on external perspectives to construct the FinTech index, primarily through the Digital Inclusive Finance Index compiled by Peking University. Another approach involves establishing a keyword library related to FinTech and using Baidu Index to measure word frequency, thereby constructing the FinTech index specific to commercial banks. However, both methods exhibit certain limitations. The first focuses solely on external factors when analysing the impact of FinTech on commercial banks, while the second relies heavily on the selected keyword, which introduces subjectivity during the selection process. Changes in keywords can lead to fluctuations in the FinTech index, potentially reducing its accuracy and stability. Moreover, given the nascent stage of FinTech development in China, some relevant data such as investment in FinTech by commercial banks, the proportion of FinTech talent, and the progress of FinTech product development have only been disclosed in recent years. This makes it increasingly challenging to construct a robust FinTech index from the perspective of commercial banks themselves.

This thesis measures income diversification or the development of intermediate business in a relatively simplistic manner and does not provide a detailed analysis of the specific types of income structures or intermediate businesses. Due to data availability

constraints, it is unable to empirically examine the moderating effects of specific income sources or types of intermediate business on the relationship between FinTech and bank profitability. Furthermore, while this study investigates the impact mechanisms of FinTech on commercial bank profitability through the ways of competition and risk, it has yet to fully explore other potential channels and mechanisms that may also play a role.

5.7 Recommendations for the Future Studies

Considering the discussion on research deficiencies presented in the preceding text, this section anticipates future research directions in the related fields of FinTech and commercial banks. In future studies, based on data availability, efforts should be made to expand the sample size of banks and collect relevant indicator data from the past two years, or utilize unbalanced panel data for analysis. Regarding the measurement of commercial bank profitability indicators, more precise, objective, and comprehensive methods should be employed. For the measurement of FinTech indicators, reliable and scientific data and methodologies should be developed at the individual level, such as capital investment by commercial banks in FinTech, the proportion of FinTech talent within banks, and collaboration between banks and FinTech companies.

With the ongoing convergence and integration of FinTech and commercial banks, the influence of FinTech on commercial banks will transition from external factors to internal dynamics. The digital transformation of commercial banks will become one of the most critical application areas for FinTech development. Consequently, as this trend progresses, research focus will shift from examining FinTech as an external factor impacting the profitability of commercial banks to analyse how improvements in the digital capabilities of commercial banks affect their performance. Additionally, from a technical perspective,

in-depth investigations can explore how specific technologies like big data, cloud computing, and blockchain influence the profitability of commercial banks, while also assessing the long-term effects and potential risks associated with technology adoption. From an environmental standpoint, comparisons of the profit impacts of FinTech on commercial banks under varying policy and market conditions across countries can help identify the optimal balance between technological empowerment and risk management. In addition to examining the impact of FinTech on the profitability of commercial banks, it is also feasible to investigate the influence of FinTech on commercial banks across various dimensions, including operational efficiency, credit risk management, retail banking services, green credit initiatives, financial stability, social benefits, overall performance and sustainable development.

In addition, in studies where income diversification acts as a moderating variable, the diversity of income sources warrants further consideration. A scientific and rigorous approach should be employed to classify and measure the specific types of income sources, thereby facilitating more in-depth empirical analysis. Alternatively, other variables could also be explored as potential moderating factors, such as bank size and bank prosperity index. Regarding the influence mechanism, beyond competition and risks, additional channels such as cost structures, operational efficiency and intermediary services should be incorporated to uncover alternative transmission pathways. This would not only enrich the theoretical framework but also provide better guidance for practical applications.

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APPENDICES

Appendix A: Summary of Sample Chinese Listed Commercial Banks

Table 1: Sample of Chinese Listed Commercial Banks

Type	A-share Market	H-share Market
Large State-owned Commercial Banks	Industrial and Commercial Bank of China; China Construction Bank; Agricultural Bank of China; Bank of China; Bank of Communications	Industrial and Commercial Bank of China; China Construction Bank; Agricultural Bank of China; Bank of China; Bank of Communications
Joint-stock Banks	Post Savings Bank of China; China Merchants Bank; China Minsheng Bank; China CITIC Bank; China Everbright Bank; China Zheshang Bank; Industrial Bank; Shanghai Pudong Development Bank; Ping An Bank; Hua Xia Bank	Post Savings Bank of China; China Merchants Bank; China Minsheng Bank; China CITIC Bank; China Everbright Bank; China Zheshang Bank
City Commercial Banks	Bank of Zhengzhou; Bank of Chongqing; Bank of Qingdao; Bank of Beijing; Bank of Shanghai; Bank of Jiangsu; Bank of Ningbo; Bank of Nanjing; Bank of Hangzhou; Bank of Changsha; Bank of Guiyang; Bank of Chengdu; Bank of Xi'An; Qilu Bank; Bank of Suzhou; Xiamen Bank; Bank of Lanzhou	Bank of Zhengzhou; Bank of Chongqing; Bank of Qingdao; China Bohai Bank; Shengjing Bank; HuiShang Bank; Bank of Tianjin; HARBIN Bank; Jiangxi Bank; Bank of Jiujiang
Rural Commercial Banks	Chongqing Rural Commercial Bank; Shanghai Rural Commercial Bank; Jiangsu Zijin Rural Commercial Bank; Jiangsu Suzhou Rural Commercial Bank; Wuxi Rural Commercial Bank; Jiangyin Rural Commercial Bank; Zhejiang Shaoxing Ruifeng Rural Commercial Bank; Changshu Rural Commercial Bank; Zhangjiagang Rural Commercial Bank; Qingdao Rural Commercial Bank	Chongqing Rural Commercial Bank; Gangzhou Rural Commercial Bank