THE IMPACT OF GREEN FINANCE AND DIGITAL PLATFORMS ON CHINA'S ECONOMIC GROWTH

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THE IMPACT OF GREEN FINANCE AND DIGITAL PLATFORMS ON CHINA'S ECONOMIC GROWTH

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LIST OF SYMBOLS

β_k	Regression Coefficient of k in Lag Period
μ_i	Province Fixed Effects
λ_t	Time Fixed Effects
ϵ_{it}	Error Term

LIST OF ABBREVIATIONS

EG	Economic Growth
GB	Green Bonds
GC	Green Credit
EP	Electronic Payment
EC	Electronic Commerce
RD	R&D Investment
TI	Technological Innovation
MS	Money Supply
FE	Fiscal Expenditure
IR	Inflation Rate
FAI	Fixed Asset Investment
IS	Industrial Structure
C2C	Consumer-to-consumer
B2C	Business-to-consumer
GDP	Gross Domestic Product
EGT	Endogenous Growth Theory
IDT	Innovation Diffusion Theory
SDT	System Dynamics Theory
SDGs	Sustainable Development Goals
GTFP	Green Total Factor Productivity
DID	Differences-in-Differences
GVAR	Global Vector Autoregression
POLS	Pooled Regression Model
FE	Fixed Effects Model
RE	Random Effects Model
OLS	Ordinary Least Squares

KESAN KEWANGAN HIJAU DAN PLATFORM DIGITAL TERHADAP PERTUMBUHAN EKONOMI CHINA

ABSTRAK

Kajian ini meneliti kesan kewangan hijau dan platform digital terhadap pertumbuhan ekonomi China sepanjang tempoh 2013–2023, dengan menggunakan set data panel merangkumi 30 wilayah. Kajian ini berasaskan kepada teori pertumbuhan endogen, teori penyebaran inovasi, dan teori dinamik sistem yang bersama-sama menyediakan asas teori untuk memahami sumbangan kewangan hijau, platform digital dan inovasi teknologi terhadap pertumbuhan ekonomi yang mampan. Kewangan hijau (diukur melalui bon hijau dan kredit hijau) serta platform digital (diukur melalui pembayaran elektronik dan e-dagang) berfungsi sebagai pemboleh ubah bebas, manakala pertumbuhan ekonomi (diukur melalui KDNK) adalah pemboleh ubah bersandar. Inovasi teknologi (diukur melalui pelaburan R&D) dimasukkan sebagai pemboleh ubah interaksi. Menggunakan model kesan tetap dengan ralat piawai yang teguh, dapatan menunjukkan bahawa kedua-dua kewangan hijau dan platform digital memberikan kesan positif yang signifikan secara statistik terhadap pertumbuhan ekonomi. Selain itu, interaksi antara kewangan hijau dan inovasi teknologi turut menghasilkan kesan positif terhadap pertumbuhan ekonomi. Dari sudut teori, dapatan ini mengembangkan aplikasi teori kewangan dan inovasi dalam konteks pembangunan ekonomi mampan. Dari sudut praktikal, hasil kajian ini memberikan pandangan dasar yang berguna untuk memanfaatkan transformasi digital dan penyelidikan serta pembangunan dalam meningkatkan impak kewangan hijau terhadap pertumbuhan ekonomi. Para pembuat dasar digalakkan untuk membangunkan strategi dasar

interaktif yang menggabungkan kewangan hijau, platform digital dan inovasi teknologi bagi memacu pertumbuhan ekonomi mampan di China.

THE IMPACT OF GREEN FINANCE AND DIGITAL PLATFORMS ON CHINA'S ECONOMIC GROWTH

ABSTRACT

This study examines the impact of green finance and digital platforms on China's economic growth over the period 2013–2023, utilizing a panel dataset covering 30 provinces. The research is grounded in endogenous growth theory, innovation diffusion theory, and system dynamics theory, which together provide a theoretical foundation for understanding the contributions of green finance, digital platforms, and technological innovation to sustainable economic growth. Green finance (measured by green bonds and green credit) and digital platforms (measured by electronic payment and e-commerce) serve as the independent variables, with economic growth (measured by GDP) as the dependent variable. Technological innovation (measured by R&D investment) is included as an interaction variable. Using a fixed effects model with robust standard errors, the findings reveal that both green finance and digital platforms exert a statistically significant positive effect on economic growth. Additionally, the interaction between green finance and technological innovation produces a positive impact on economic growth. Theoretically, the findings extend the theoretical application of financial and innovation frameworks in the context of sustainable economic development. Practically, the results provide policy-relevant insights into harnessing digital transformation and research and development to enhance the impact of green finance on economic growth. Policymakers are encouraged to develop interactive policy strategies that integrate green finance, digital platforms, and technological innovation to promote sustainable economic growth in China.

CHAPTER 1

INTRODUCTION

1.1 Introduction

Amid global efforts to promote economic growth, China's green finance and digital platforms have emerged as pivotal strategies. This chapter introduces the background of the study and outlines the problem statement. It then clearly defines the research objectives and questions, which are strategically derived from the identified problem. Furthermore, the chapter highlights the theoretical and practical contributions of the study. Finally, key terms essential to the investigation are explained. This chapter lays the groundwork for a critical examination of green finance and digital platforms as drivers of China's economic growth from 2013 to 2023, addressing the research gap by bridging theoretical insights with empirical analysis.

1.2 Background of the Study

Economic growth refers to the increase in the production of goods and services over time, typically measured by changes in GDP. On September 6, 2023, Beijing hosted the "Forum on Sustainable Development and Digital Technology Application Demonstrations." During this forum, the "Initiative on Digital Technology for Achieving the Sustainable Development Goals" was launched. This initiative underscored the critical importance of advancing innovation in digital technology to accelerate progress towards global sustainable development objectives. It was recommended that China expand its green digital finance market and promote green foreign direct investment (FDI) as strategies to address economic uncertainties and support the OECD's national development strategy (Han & Gao, 2024).

Global efforts to foster sustainable development have propelled green finance and digital platforms to the centre of contemporary economic policymaking and scholarly research. In the wake of climate change, geopolitical instability, and economic shocks such as the COVID-19 pandemic, governments and institutions are increasingly relying on these instruments to stimulate inclusive, resilient, and low-carbon growth. According to the World Bank (2023), the global green bond market has surpassed USD 2.5 trillion in cumulative issuance, indicating growing investor demand for environmentally sustainable financial instruments. Similarly, digital platforms now contribute over 15% of global GDP, with advanced economies, such as the European Union and the United States, adopting strategies to expand e-commerce, fintech, and digital infrastructure as part of post-COVID-19 pandemic recovery plans (OECD, 2022).

Green finance facilitates the reallocation of capital toward low-carbon and climate-resilient projects, aligning financial systems with the sustainable development goals (SDGs). Meanwhile, digital platforms, through innovations such as electronic payment systems, e-commerce, and platform-based fintech, transform business models, lower transaction costs, and enhance financial inclusion, particularly in emerging economies. Research indicates that in Chinese prefecture-level cities, a bidirectional relationship exists between digital finance, green innovation, and environmental performance (Sun & He, 2023). Digital finance, together with green innovation, significantly enhances environmental performance, with the degree of digitalization in digital finance playing a crucial role (Y. Hao et al., 2023). However, China's digital economy and green finance are currently in the early stages of coordinated development, characterized by stable growth but significant regional disparities (J. Guo et al., 2022). Further research is needed to promote the coordinated development

of the digital economy and green finance, with the goal of achieving high-quality, sustainable economic growth (Z. Liu et al., 2023).

1.2.1 Economic Growth in China

Economic growth in China has been characterized by rapid industrialization and technological advancement over the past several decades. This growth resulted from reforms that opened China to global trade and investment, along with domestic efforts to modernize infrastructure and industries (Q. Wang & Zhang, 2021). However, in recent years, China's economic growth has shown signs of structural slowdown, transitioning from high-speed growth driven by exports and investments to more moderate growth focused on consumption, services, and technological innovation (Ali et al., 2024). This shift is partly due to external factors such as the COVID-19 pandemic, which led to a temporary economic contraction globally but also highlighted China's resilience and rapid growth (Zuo et al., 2024). In the long term, China's growth strategy is increasingly reliant on technological innovation, sustainable development, digital finance and green finance initiatives, reflecting global trends toward a more balanced and sustainable growth model.

China, positioned as the world's second-largest economy, has witnessed unparalleled economic expansion over recent decades (Hauke-Lopes et al., 2022). Yet, this brisk advancement has been accompanied with significant challenges, notably environmental degradation and an escalating carbon footprint (Y. Wang & Zheng, 2019). Concurrently, the digital revolution has profoundly altered the economic landscape, impacting consumer behaviour, business models, and the provision of financial services (K. Zhong, 2022). The advent of the COVID-19 pandemic has further complicated the economic scenario, necessitating innovative strategies for sustainable growth (Hámori, 2021). For China, the path to economic growth extends

beyond regaining pre-recession levels; it involves aligning growth with broader objectives, including achieving developmental goals and adhering to principles of sustainable development, as indicated in current policy trends and economic analyses (H. Wu et al., 2024).

China's strategy for economic growth has been outlined through an integration of short-term stabilization measures and long-term structural reforms (Zuo et al., 2024). The government has enacted fiscal policies, monetary easing, and infrastructure investments as catalysts for growth; this shift accentuates green finance and digital transformation as pivotal components of the revised approach (S. Zhong et al., 2023). Economic growth, which comprehensively indicates the health and trajectory of China's economy, is measured through indicators such as the GDP, GDP growth rate (Boubakri et al., 2023; Doruk, 2023). These metrics collectively delineate the dynamism and overall economic vitality of the region, providing a holistic view of its economic condition. GDP stands as a pivotal indicator of economic expansion. The adverse effects of the COVID-19 pandemic on China's GDP growth surpassed the severity experienced during the global financial crisis, underscoring the profound economic repercussions of the COVID-19 pandemic (Gunay et al., 2021).

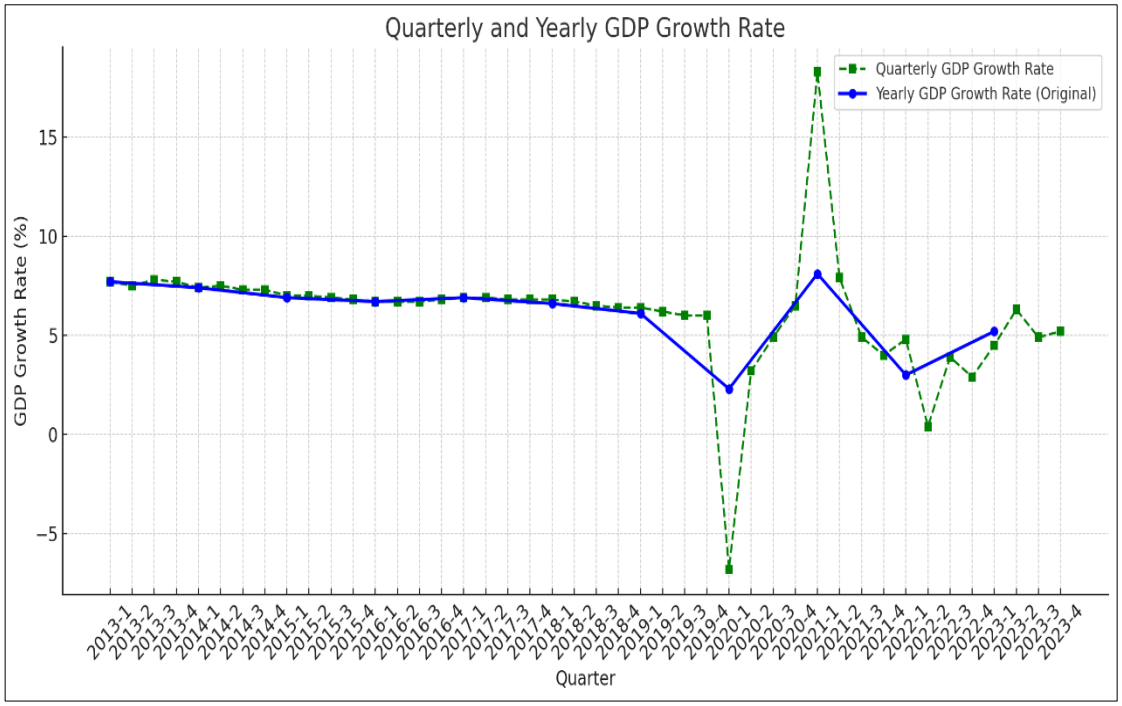

Figure 1.1 Quarterly GDP Growth Rate

Source: China National Bureau of Statistics (NBS)

Figure 1.1, provides a snapshot of the fluctuations in China's economic performance over recent quarters, with the GDP growth rate serving as a critical indicator of economic performance. Which experienced a sharp decline into negative territory in the first quarter of 2020. Nonetheless, positive growth was observed in the second quarter of 2020, highlighting the key trends in the country's economic and growth. The figure highlights China's economic resilience, demonstrating a sharp GDP contraction in Q1 2020 as a result of the COVID-19 pandemic, followed with a rapid rebound in Q2 2020. Despite the disruption, the annual GDP growth trend reflects the economy's overall upward trajectory. Overall, although the COVID-19 pandemic has had a short-lived impact on China's economy, in the long run, China's economy has been on a growth trend.

1.2.2 Green Finance in China

In alignment with environmental imperatives and the objectives of the global sustainable development goals (SDGs), green finance has emerged as a pivotal mechanism for steering investments towards sustainable development endeavours (Martin, 2023). The concept of green finance has attracted considerable attention in recent decades, particularly in the wake of a worldwide mobilization for sustainable development and efforts to mitigate climate change (Duchêne, 2020). Within China, green finance has been methodically incorporated into the national development agenda, facilitating the alignment of financial flows with investments that are both low-carbon and climate-resilient (W. Yang et al., 2021). The People's Bank of China (PBOC), alongside other regulatory bodies, has enacted policies to foster the growth of green credit, green bonds, and other sustainable financial instruments, underscoring China's dedication to transitioning towards a green economy. Given this context, it becomes both pertinent and timely to examine the influence of green finance on economic growth.

The Chinese government has implemented substantial measures to integrate environmental considerations into national economic policies. Initiatives such as "the Belt and Road Guidelines for Green Development", "the Green Credit Guidelines", "the Green Finance Evaluation Programme for Banking Financial Institutions", and "the Bank of China's Green Finance Talent Project Programme" demonstrate a strong and sustained commitment to advancing green finance. Figure 1.2 illustrates a post-2020 rebound in green bond issuance, while Figure 1.3 depicts a pronounced upward trend in green credit balances in the subsequent period. As of 2023, outstanding green credit amounted to RMB 30.08 trillion, representing approximately 12.7% of total credit, providing evidence that policy initiatives have successfully translated into

large-scale implementation. These initiatives aim to incentivize financial institutions to integrate environmental considerations into their strategic and operational decision-making processes. This study also seeks to examine the relationship between natural resource volatility, global economic growth, and government governance during the period 2013–2023 (Hsu et al., 2023).

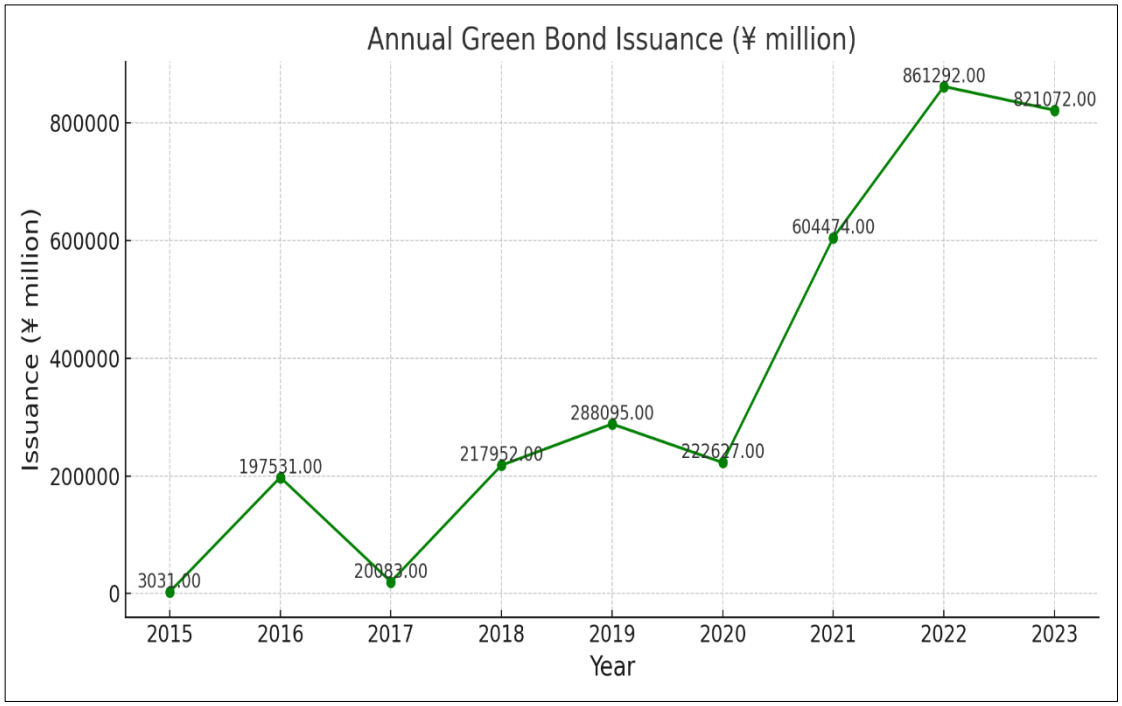

Figure 1.2 Annual Green Bonds Issuance

Source: China Bureau of Statistics

As shown in Figure 1.2, despite a slight decline in the volume of China's green bond issuances during the peak of the COVID-19 pandemic in 2020, issuance volumes increased significantly thereafter, underscoring China's commitment to sustainable development as an integral component of its economic strategy. The time series exhibits an overall upward trajectory, accompanied by short-term fluctuations. Issuance volumes declined during the COVID-19 pandemic period, accelerated after 2020, and moderated in 2023 from their recent peak. Green bonds can therefore be characterised as following an upward long-term trend with cyclical fluctuations. They

constitute a crucial financial instrument within the broader framework of green finance. This trend indicates that China is actively promoting the development of its green bond market.

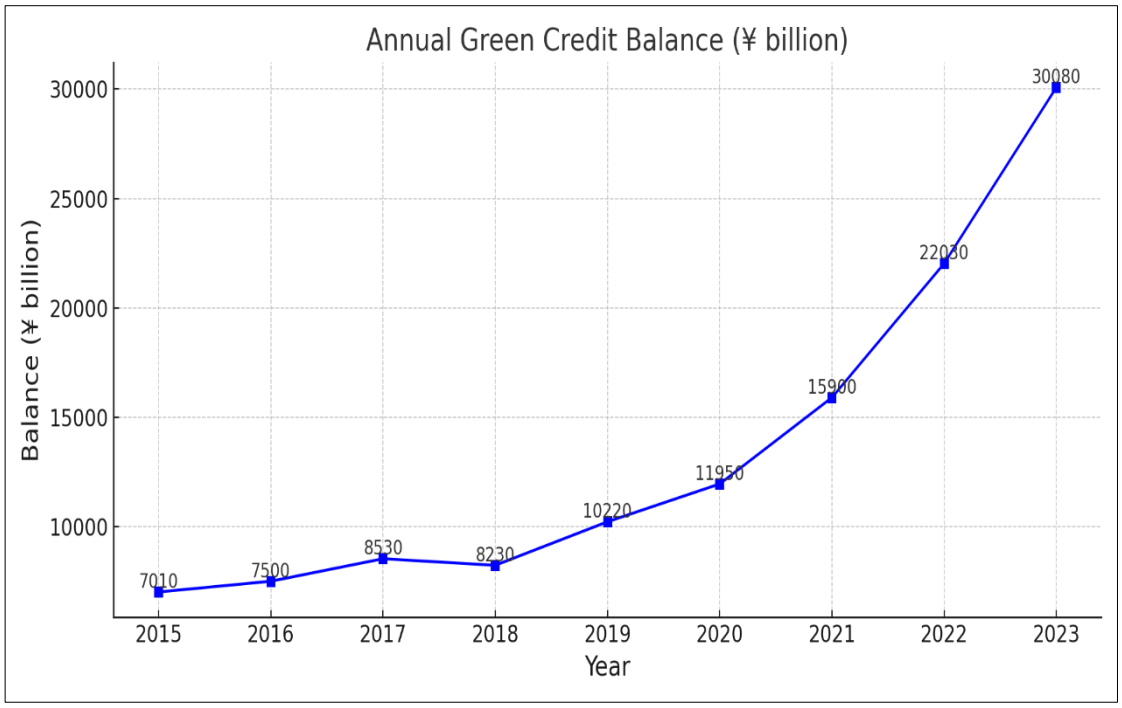

Figure 1.3 Annual Green Credit Balance

Source: China Bureau of Statistics

From Figure 1.3, despite the adverse conditions during the peak year of the COVID-19 pandemic in 2020, the volume of China's green credit remained relatively stable. Green bonds, which form a critical component of green finance, also experienced significant growth. The figure demonstrates a substantial upward trajectory in green credit issuance, particularly accelerating after 2020. This rapid growth underscores the increasing role of green finance in supporting projects that align with China's environmental goals.

Over the past few decades, China has transitioned from a period of high-speed, investment-led expansion to a growth model that increasingly relies on consumption, services, and innovation. Although short-term shocks in 2020 did not disrupt the long-

term growth trajectory, they revealed the limitations of demand-side management in sustaining economic output. Green finance, particularly through instruments such as green bonds and green credit, has expanded in both depth and breadth, directing capital toward low-carbon projects and industrial upgrading. Issuance and credit volumes rebounded rapidly after 2020, reflecting strong policy commitment to aligning capital flows with environmental objectives.

The advent of green finance has emerged as a critical mechanism in channelling investments toward the fulfilment of SDGs, with a particular emphasis on climate change mitigation and environmental conservation. Green finance has significantly contributed to enhancing the sustainability indices of listed Chinese manufacturing companies (J. Wu, 2024). Green finance has established a fundamental catalyst for sustainable economic growth, notably within developing economies (Ngo et al., 2022). The strategic utilization of green finance mechanisms to foster incentives for both economically disadvantaged groups and investors is instrumental in promoting equitable benefit-sharing and sustainable economic growth (Han & Gao, 2024). Moreover, green finance has demonstrated its efficacy in mitigating energy poverty and facilitating a green economic growth in China in the aftermath of the COVID-19 pandemic (J. Zhao et al., 2023).

Although prior research has explored the connection between green credit and economic growth, there remains a lack of comprehensive empirical validation regarding the influence of green credit policies on sustainable economic development. Additionally, earlier studies have not sufficiently analysed the economic effects arising from various contributing factors (Li et al., 2022). Evidence indicates that the issuance of green credit positively influences China's economic growth, and that green credit

policies hold the potential to simultaneously advance environmental quality and economic development (C. Chen et al., 2021).

1.2.3 Digital Platforms in China

Digital platforms have become an integral part of economic activity. The emergence of digital platforms has fundamentally transformed traditional methods of conducting business and executing financial transactions (Hauke-Lopes et al., 2022). Serving as an integral component and a pivotal driving force of the digital economy, digital platforms offer new pathways for economic growth (Nerbel & Kreutzer, 2023). Digital platforms act as catalysts in the evolution of the digital economy, fostering innovation, enhancing productivity, expanding markets, altering market dynamics, and presenting solutions to societal challenges (Ablyazov & Rapgof, 2019). The digital economy has exhibited remarkable resilience and adaptability, especially amid economic turmoil, underscoring its pivotal role in promoting economic growth.

Digital platforms are online systems designed to facilitate the exchange of goods, services, information, or value among various stakeholders, including consumers and businesses (Keizer et al., 2023). Through the use of advanced technologies such as cloud computing, big data analytics, and artificial intelligence, digital platforms establish interconnected ecosystems that facilitate seamless interactions and transactions, removing traditional obstacles related to geography, financial constraints, or logistics (Ens et al., 2023).

Digital platforms generally function as intermediaries, allowing users to interact and transact in ways that were once restricted due to geographical, financial, or logistical limitations (Reza-Gharehbagh et al., 2022). They encompass a broad range of applications, including: electronic commerce (e-commerce): platforms like Alibaba, Amazon, and JD.com that facilitate buying and selling of goods and services

online; electronic payments: systems such as Alipay, PayPal, and WeChat Pay that allow secure, fast, and convenient financial transactions; social media and networking: platforms like Facebook, WeChat, and LinkedIn that enable communication, content sharing, and professional networking; digital finance: fintech platforms offering services like peer-to-peer lending, crowdfunding, and digital asset management; gig economy platforms: platforms such as Uber, Didi, and Meituan that connect workers with customers for on-demand services (Drewel et al., 2021; Galkina et al., 2023; Jones et al., 2023; Ong & Toh, 2023; Tse et al., 2023; Wen, 2023; Zielonka et al., 2022).

Digital platforms enhance market efficiency, lower transaction costs, and promote innovation (Pundziene et al., 2023). They are integral to the growth of the digital economy and are recognized as critical drivers of economic growth and sustainability in a globalized, technology-driven world. Through enabling connectivity, resource allocation, and innovation, digital platforms transform traditional business models and make significant contributions to sustainable development and economic modernization (Benitez et al., 2023; Herold et al., 2023; Nerbel & Kreutzer, 2023; Petrik et al., 2024; Sarwar et al., 2024).

Over the past two decades, China's digital platforms ecosystem has undergone exponential growth, transforming into a global hub of innovation and digital entrepreneurship. This transformation has set the stage for the emergence of electronic commerce giants and electronic payment solutions (Pop & Gîfu, 2020). Leading platforms such as Alibaba, JD.com, and Tencent have revolutionized retail and financial services, establishing extensive networks that connect consumers, businesses, and financial institutions (Danilin, 2020). Electronic commerce has surpassed traditional retail channels in China, becoming a fundamental component of the nation's

economic structure (C. M. Wang et al., 2012). Furthermore, electronic payment systems have emerged as the cornerstone of China's digital economy, reducing transaction costs and barriers to entry for online enterprises, thereby fostering a conducive environment for the development of electronic commerce (Tang et al., 2021).

Digital platforms, leveraging the combined strengths of electronic commerce and electronic payments, have assumed a pivotal role in China's economic growth strategy, particularly in the aftermath of disruptions such as the COVID-19 pandemic (Y. Yang et al., 2023). Moreover, the inherent flexibility and capacity for innovation within digital platforms enable them to swiftly adjust to shifts in consumer behaviour and market demands, thereby playing an instrumental role in the facilitation of economic growth (J. Y. Lee et al., 2023).

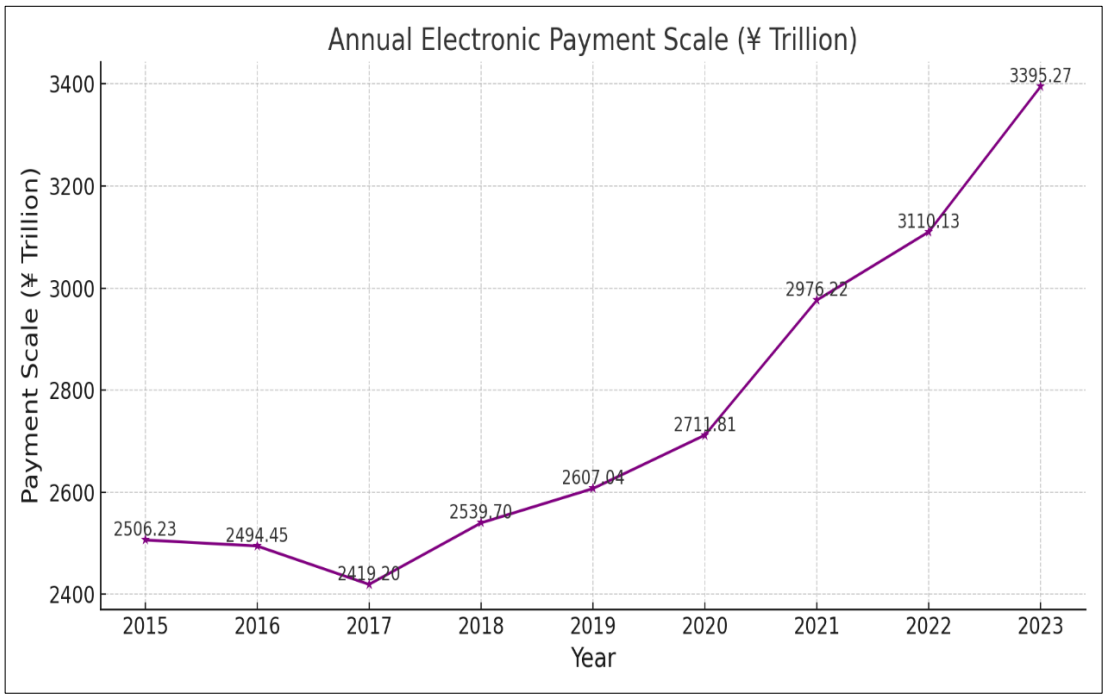

Figure 1.4 Annual Electronic Payment Scale

Source: People's Bank of China

From Figure 1.4, contrary to expectations of a decline, the volume of China's electronic payment transactions saw a significant increase during the COVID-19 pandemic in 2020. Electronic payments, as a component of digital platforms, play a crucial role in modernizing China's financial infrastructure and improving economic efficiency. The rapid growth of electronic payments reflects the increasing digitization of the Chinese economy, which has important implications for economic growth.

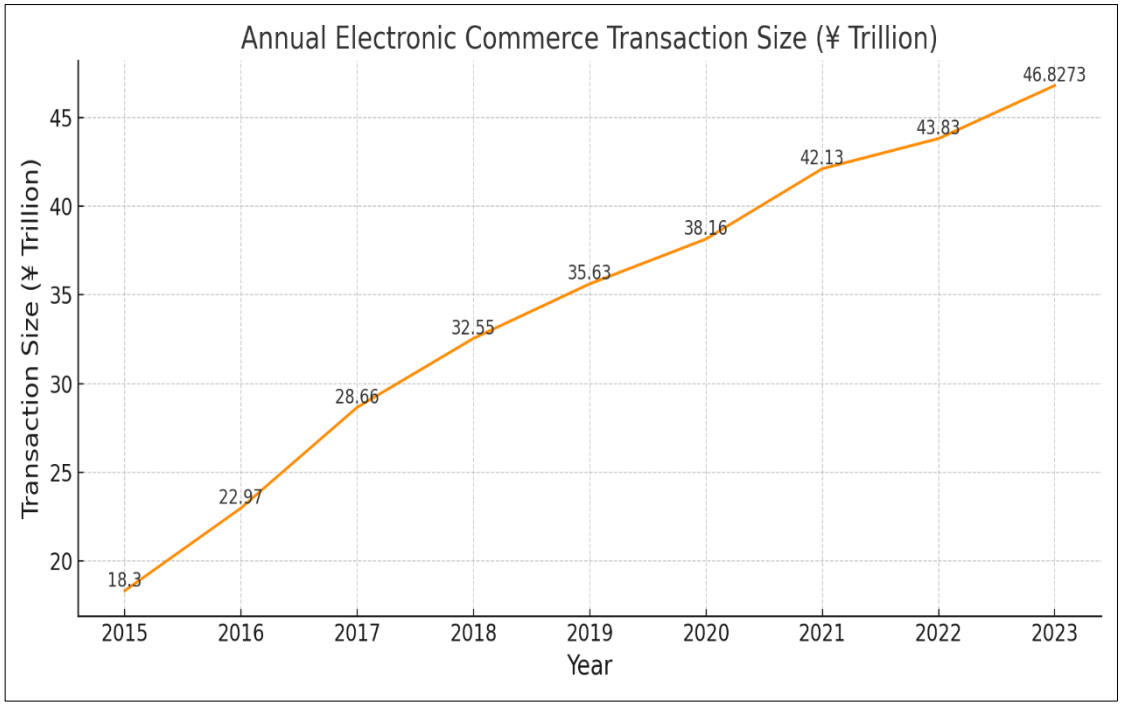

Figure 1.5 Annual Electronic Commerce Transaction Size

Source: China Bureau of Statistics

From Figure 1.5, the volume of electronic commerce transactions in China did not decline during the COVID-19 pandemic; instead, it showed steady growth. This growth in electronic commerce underscores the increasing influence of digital platforms in driving China's economic growth.

Research indicates that digital platforms, depending on their business models, prioritize distinct factors in facilitating socio-economic advancement (Telnov et al., 2023). Consumer-to-consumer (C2C) platforms emphasize the enhancement of social

connectedness and trust, whereas business-to-consumer (B2C) platforms focus on rule-making and transactional ease (Drewel et al., 2021). The adoption of flexible business model integration, along with technological innovation, is deemed an effective strategy for optimizing social and economic advantages (Cui et al., 2021).

Furthermore, findings suggest that China's platform economy exerts both facilitative and inhibitory effects on the high-quality development of its economy (G. Yang et al., 2022). However, progressive digital platform models that amalgamate the resources of economic activities within the digital economy can efficaciously consolidate the resources of autonomous control systems, thereby enhancing the productivity and efficiency of economic endeavours (Zatsarinnyy & Shabanov, 2019). Consequently, the integration of digital platforms into the financial ecosystem has emerged as a cornerstone in cultivating a more inclusive and dynamic economic environment.

1.2.4 Green Finance and Technological Innovation on the Economic Growth

Green finance and technological Innovation represent pivotal components in fostering high-quality economic growth, particularly within the context of China's ongoing structural transformation. Green finance, through targeted funding for environmentally sustainable projects, alleviates financial constraints for green innovations, thus promoting technological advancements aimed at reducing carbon emissions and improving energy efficiency. Similarly, technological innovation enhances the operational efficiency of green finance, driving demand for green products and creating opportunities for investment in green technologies (Y. Li & Zhou, 2024).

Studies suggest that the coupling and coordination between green finance and technological innovation lead to a positive, synergistic impact on economic growth.

This interaction enables the successful implementation of low-carbon technologies and supports long-term sustainable development. Empirical evidence shows that regions with higher coupling degrees of green finance and technological innovation exhibit greater economic resilience and faster recovery from environmental and economic shocks (R. Wang & Tan, 2021).

Furthermore, green finance provides the necessary capital for the research and development (R&D) of new technologies, which in turn accelerates the transition to a green economy(C. Liu & Xia, 2018).

While green finance focuses on reducing financial risks associated with environmental issues, technological innovation serves as the catalyst for turning these financial investments into tangible economic benefits. For example, investments in renewable energy, energy-efficient technologies, and pollution control systems lead to both environmental improvements and economic returns (C. Yang et al., 2024). Together, create a self-reinforcing cycle of sustainable growth, which is crucial for China's goal of achieving carbon neutrality and long-term economic growth.

In conclusion, the interaction between green finance and technological innovation serves as a key driver of China's economic growth. This synergy is essential for fostering a sustainable and resilient economy capable of addressing the challenges posed by climate change and resource constraints.

1.3 Problem Statement

At a pivotal stage of global economic transformation, countries face the urgent challenge of transitioning from conventional economic models, characterized by a heavy reliance on carbon-intensive industries and non-sustainable financial mechanisms, toward more sustainable growth paradigms. In China, this shift is

particularly pressing. The traditional model, while effective in accelerating GDP growth, industrialization, and poverty reduction over the past three decades, has also led to severe environmental degradation, widening income inequality, and excessive financial leveraging. Globally, the continued dominance of non-green finance which defined by fossil fuel lending and environmentally harmful industrial subsidies that poses systemic risks to both economic and ecological stability (OECD, 2023).

In contrast, green finance emerges as a transformative alternative. It reallocates capital flows toward environmentally sustainable sectors, with the objective of balancing economic advancement and ecological preservation. In China, green bonds and green credit are increasingly prioritized by regulatory bodies such as the People's Bank of China (PBOC) and the China Development Bank. These efforts align with national and international commitments, including the Paris Agreement, the 2060 carbon neutrality target, and the United Nations Sustainable Development Goals (SDGs), particularly SDG 8 (decent work and economic growth), SDG 9 (industry, innovation and infrastructure), and SDG 13 (climate action).

At a pivotal juncture, China faces the dual mandates of achieving economic growth and advancing environmental sustainability. China's path to economic growth is fraught with formidable challenges arising from severe economic disruptions, such as those induced by the COVID-19 pandemic, and the ongoing issue of environmental degradation, presenting a complex array of challenges and opportunities (Baky Haskuee & Asgary, 2023). Traditional financial models are inadequate in addressing the complex dimensions of the recent economic downturn, further compounded with environmental limitations and the pressing imperative for sustainable development (Das, 2022). Despite recognizing the potential of green finance initiatives, such as green bonds and green credit, to finance sustainable growth, their concrete influence

on economic growth remains insufficiently quantified and understood (H. Liu et al., 2023).

In the contemporary global economic context, China confronts the critical challenge of aligning its notable economic growth with the principles of environmental sustainability. The paradigm of green finance emerges as a crucial mechanism for this alignment, fostering investments in projects that not only uphold environmental sustainability but also potentially facilitate economic growth (Hou & Fang, 2023). Nevertheless, the precise contribution of green finance initiatives, specifically green bonds and green credits, to the economic revitalization of China is an area that requires further rigorous investigation (Li et al., 2022; B. Ma & Wang, 2023). The paucity of reliable empirical evidence connecting green finance with essential economic growth metrics underscores a significant gap in scholarly research and the development of efficacious economic strategies (Yin & Xu, 2022).

While the advent of green finance introduces innovative approaches to integrating investment with environmental sustainability, there is a conspicuous lack of empirical evidence in the academic literature regarding the efficacy of green bonds and green credit in simultaneously stimulating economic activity and addressing environmental challenges (C. Chen et al., 2023; Tan et al., 2022). Despite the theoretical alignment of green bonds and green credits with principles of sustainable development, their concrete impact on facilitating economic growth is not thoroughly investigated (W. Feng et al., 2023). This research gap notably restricts the examination of green finance's potential to drive economic expansion within the distinct context of China's market and regulatory frameworks, thus hindering the development of effective economic growth strategies for China.

Although green finance, through instruments such as green bonds and green credit, is increasingly recognized for its potential to promote sustainable economic growth, there is limited empirical evidence on its specific impact on China's GDP growth. The issue lies in quantifying the extent to which green finance drives economic performance and how effectively it contributes to the broader goal of sustainable development in the country.

In 2021, the China Development Bank announced ambitious plans to increase the proportion of green credit to over 5% of its credit assets in 2025 and further to 30% in 2030. These figures illustrate that while green financing is experiencing substantial growth, non-green financing continues to dominate the majority of China's total financing activities. However, with strong policy initiatives and commitments from leading financial institutions, the share of green financing is expected to grow significantly in the coming years, reflecting China's dedication to advancing environmental sustainability and aligning with global green development goals.

As of 2023, China's green credit approximately RMB 30.08 trillion, accounting for 12.7% of the nation's total credit balance, with non-green financing comprising the remaining 87.3%. While specific data on the direct contribution of non-green financing to GDP is unavailable, its substantial share highlights its critical role in economic activities. However, China's non-financial debt-to-GDP ratio, approaching 300%, underscores significant concerns regarding sustainable growth, particularly in highly leveraged non-green sectors. To address these challenges, the government is proactively advancing green finance initiatives. These efforts aim to reduce reliance on non-green financing, mitigate related risks, and promote long-term economic stability through the adoption of a more sustainable economic model.

Moreover, the significance of green finance is escalating as China seeks to reconcile its economic objectives with its commitments under the Paris Agreement (Xiaosheng, 2016). Despite the acknowledged importance, the scholarly comprehension of green finance's contribution to economic growth remains incomplete and requires empirical validation (Huang et al., 2023). This issue constitutes a pivotal concern, given that the effective implementation of green finance is crucial to ensuring that China's economic growth is not merely robust but also sustainable over the long haul, thereby making a substantive contribution to international efforts against climate change (X. Liu et al., 2023).

China's current financial policies, which heavily emphasize non-green financing while gradually integrating green finance, present significant challenges (X. Liu et al., 2023). Domestically, this reliance on carbon-intensive industries undermines environmental objectives, increases financial risks in traditional sectors, and delays the transition to a green economy. Globally, it exacerbates climate change, disrupts energy markets, and limits China's potential to lead in green innovation (M. Gao, 2023). Addressing these issues requires accelerating the adoption of green financing, strengthening environmental regulations, and fostering international cooperation. These measures are crucial for China to achieve sustainable development while contributing to global climate action and economic stability (Hsu et al., 2023).

Simultaneously, digital platforms, such as e-commerce and electronic payment systems that have revolutionized market access, productivity, and consumption patterns, particularly in response to the COVID-19 pandemic. These platforms facilitate financial inclusion, reduce transaction costs, and enhance access to services, all of which contribute to higher labour productivity, increased SME participation, and broader regional development. Globally, the digital economy now contributes over 15%

to world GDP (OECD, 2023), while in China, it has been instrumental in sustaining employment and household consumption amid economic disruptions.

The rapid expansion of digital platforms has revolutionized business and finance, introducing new channels for economic engagement (Ballerini et al., 2023). Although electronic payment systems and electronic commerce have become widespread, the literature on finance has yet to comprehensively delineate their contribution to economic resilience, especially regarding their capacity to drive robust economic growth within the distinct context of China's market (S. Ma et al., 2021).

Following the economic turmoil induced through the global crisis, digital platforms have emerged as pivotal in ensuring economic resilience, offering alternative avenues for maintaining continuity and fostering growth (Cueto et al., 2022). In China, with one of the highest rates of digital platform utilization globally, the potential of these platforms to expedite economic growth poses a crucial question (Ablyazov & Rapgof, 2019). However, empirical investigations into their impact, especially regarding how platforms such as electronic commerce and electronic payment systems influence critical economic growth metrics like GDP and consumer spending patterns, remain insufficient (Ismail & Azab, 2023; Oğuz et al., 2022).

Digital platforms integrate diverse stakeholders, streamline interactions, and harness digital technologies, underpinning the emergence of a new socio-economic development ecosystem (Zielonka et al., 2022). The study offers solutions to challenges related to labour productivity, economic expansion, and the assimilation of technology (Diaz Ruiz, 2023). Specifically, digital platforms that amalgamate autonomous control systems significantly enhance the productivity of organizational systems involved in economic activities, establishing a foundation for future

innovations in resource integration within the digital economy (Zatsarinnyy & Shabanov, 2019).

Digital platforms have transformed the financial and commercial sectors, holding promise as catalysts for economic growth. However, the gap is the precise extent of their contribution to economic growth, particularly within the distinct market environment of China, remains insufficiently validated (J. Y. Chen, 2020). The rapid expansion of electronic commerce and electronic payment systems, while notable, has not been thoroughly quantified in scholarly research concerning its effects on economic stability and growth. This gap significantly impedes China's ability to devise an informed economic growth strategy (X. Li et al., 2022; R. Zhou, 2022). Robust empirical research is urgently needed in China to explore the role of digital platforms in facilitating the nation's economic growth.

Digital platforms play a transformative role in driving GDP growth through fostering innovation, reducing transaction costs, and enhancing access to goods, services, and financial resources (Ens et al., 2023). They promote economic inclusion through integrating underserved populations and small enterprises into broader markets, thereby boosting productivity through innovation and stimulating consumer spending via secure and convenient ecosystems (Jones et al., 2023). Furthermore, digital platforms generate employment across various sectors and enhance economic resilience during disruptions, as demonstrated during the COVID-19 pandemic. Supporting the transition to a knowledge-driven economy, they contribute to the value-added component of GDP, aligning with long-term growth strategies. Empirical evidence, such as the significant contributions of e-commerce and digital payment systems in China, underscores their critical role as catalysts for sustainable and inclusive economic development. Incorporating digital platforms into economic

policies is essential for maximizing their potential in the digital era (Benitez et al., 2023).

Digital platforms, measured through electronic payment and e-commerce, transform China's economy through enhanced efficiency and accessibility in financial transactions and commercial activities. However, the study needs to evaluate whether and how these platforms contribute directly to economic growth, particularly in the context of a digital economy that is rapidly evolving. The issue here is understanding the link between the rise of digital platforms and their measurable impact on GDP growth.

Meanwhile, the interaction between green finance and technological innovation drivers remains underexplored in the context of China's economic development. Current research highlights the positive effects of green finance on promoting environmentally sustainable projects and the role of technological innovation in boosting productivity and industrial competitiveness. However, there is a critical gap in the literature regarding how the interaction effect of these two forces contribute to high-quality economic growth (Y. Li & Zhou, 2024).

Recent studies emphasize that green finance facilitates investments in clean technologies, while technological innovation improves the efficiency of resource usage and reduces carbon emissions, creating a pathway toward sustainable development. Despite these benefits, empirical research measuring the combined impact of green finance and technological innovation on long-term economic growth is scarce. The spatial interaction effects and coordination between green finance and innovation, particularly in developing regions of China, have yet to be adequately quantified, resulting in an incomplete understanding of their interaction (Hu et al., 2023).

Moreover, while technological innovation is known to foster economic growth through enhanced energy efficiency and reduced environmental degradation, the mechanisms through which green finance supports and amplifies technological innovation remain inadequately articulated. Specifically, the role of green bonds and green credit in funding innovative technological solutions is understudied, as is the extent to which these innovations contribute to GDP growth (B. Lin & Bai, 2023).

Thus, the gap is the lack of comprehensive studies examining the coordinated development of green finance and technological innovation as drivers of economic growth in China. Addressing this gap is critical for policymakers aiming to foster a more sustainable economic growth, particularly in the wake of increasing global environmental challenges and economic uncertainties (Y. Zhang et al., 2023). Therefore, this study aims to address the research gap through an empirical analysis of the interaction effects between green finance and technological innovation on China's economic growth.

Technological innovation is often seen as a key driver of economic growth, particularly when combined with green finance. This study examines how technological innovation, measured through R&D investment, influences or moderates the relationship between green finance and economic growth. There is a need to explore whether technological innovation amplifies the positive effects of green finance or if there are other dynamics at play. Therefore, this study addresses a timely and relevant research gap by conducting an empirical panel data analysis to examine the impact of green finance and digital platforms on China's economic growth during 2013–2023, with particular attention to the interaction effects of technological innovation. It aims to determine whether these instruments offer economically viable and sustainable alternatives to conventional financial models, as well as whether their

coordinated deployment can enable China to achieve the dual objectives of economic prosperity and environmental sustainability, consistent with SDG-driven national development strategies.

1.4 Research Objectives

1. To assess the impact of green finance on China's economic growth.

2. To evaluate the role of digital platforms in promoting China's economic growth.

3. To investigate the interaction effect of technological innovation on the relationship between green finance and China's economic growth

1.5 Research Questions

1. Does green finance influence China's economic growth?

2. Do digital platforms influence China's economic growth?

3. Does technological innovation interact with green finance to affect China's economic growth?

1.6 Significance of the Study

This study examines the period 2013–2023, focusing on 30 provinces in mainland China as the unit of geographical analysis. It evaluates how green finance (measured by green bonds and green credit) and digital platforms (measured by electronic payment and e-commerce) influence economic growth (measured by GDP). The interactive effect of technological innovation (measured by R&D investment), and green finance is also assessed. Control variables include money supply, fiscal expenditure, inflation rate, fixed asset investment, and industrial structure. The analysis employs a panel data fixed effects model with robust standard errors. While