FINANCIAL INSTITUTIONS DEVELOPMENT AND ITS INFLUENCE ON GREEN FINANCE: DOES REASEARCH AND DEVELOPMENT MATTERS?

LEE LI YING

NG MING WEN

PHUA TANG NING

WONG XUN YI

BACHELOR OF BUSINESS ADMINISTRATION (HONS)
BANKING AND FINANCE

UNIVERSITI TUNKU ADBUL RAHMAN

FACULTY OF BUSINESS AND FINANCE

DEPARTMENT OF BANKING AND RISK MANAGEMENT

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BY

LEE LI YING

NG MING WEN

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A final year project submitted in partial fulfilment of the requirement for the degree of

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DEDICATION

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LIST OF ABBREVIATIONS

ARCH	Autoregressive Conditional Heteroskedasticity
ARDL	Autoregressive Distributed Lag
CUSUM	Cumulative Sum
CUSUMSQ	Cumulative Sum of Squares
DOLS	Dynamic Ordinary Least Square
ECO	Economic Development
ECM	Error Correction Model
ESG	Environmental, Social and Governance
FMOLS	Fully Modified Ordinary Least Square
FID	Financial Institution Development
GF	Green Finance
IND	Environmental Governance
JB	Jarque Bera
LM	Lagrange Multiplier
RAD	Research and Development
RESET	Regression Equation Specification Error Test
SDGs	Sustainable Development Goals
TEC	Energy Consumption
UECM	Unrestricted Error Correction Model

PREFACE

"Financial Institution Development and Its Influence on Green Finance: Does Research and Development Matter?" is the research topic. The aim of this study is to examine how research and development (R&D) and financial institution development contribute to the growth of green finance in China. The term "green finance" describes financial contributions intended to assist environmentally friendly and sustainable projects and efforts.

In this research, shows that how R&D and financial institution development affect green finance in China. Development of financial institutions encompasses the expansion and enhancement of banking systems, regulatory frameworks, and financial markets, all of which are essential for raising capital for environmentally friendly initiatives. Research and development (R&D) is necessary for innovation and technical progress, both of which are necessary for the creation of new environmentally friendly technology and sustainable practices.

Readers will obtain a better grasp of the ways in which research and development (R&D) and financial institutions support the growth of green finance in China through this study. In addition, the project will examine the relative significance of these variables and how they work together to affect green finance, providing information that financial institutions and policymakers can use to better promote sustainable development.

ABSTRACT

This study looks into how China's green finance is affected by the growth of financial institutions and research and development (R&D). Within the framework of China's economy, the study aims to comprehend the relationship between the independent factors, financial institution development and R&D, and the dependent variable, green financing.

The 24 observations that make up the annual data from 1998 to 2021 are used in this study. In order to investigate the long-term relationships and the significance of these factors in influencing green finance, this study uses advanced econometric techniques, such as the Unit Root Test, ARDL Cointegration Bounds Test, and robustness estimations through Fully Modified Ordinary Least Squares (FMOLS) and Dynamic Ordinary Least Squares (DOLS).

The ARDL Cointegration Bounds Test is used to find long-term equilibrium relationships between the variables after the Unit Root Test, which is used to determine whether the time series data is stationar. As supplementary estimations, FMOLS and DOLS are employed to guarantee the validity of the results. The main conclusions of the study are outlined, together with their implications for the growth of green finance in China

CHAPTER 1: INTRODUCTION

1.0 Introduction

Chapter 1 of the study serves as a foundational introduction to the research project, offering a thorough examination of the subject matter. It encompasses various sections aimed at elucidating the research background, addressing pertinent problems, and outlining research objectives and questions. Additionally, the chapter delves into the formulation of hypotheses strategies and discusses the significance of the study, shedding light on its potential benefits. Finally, it culminates with a conclusion that encapsulates the overarching themes introduced in the chapter.

1.1 Research Background

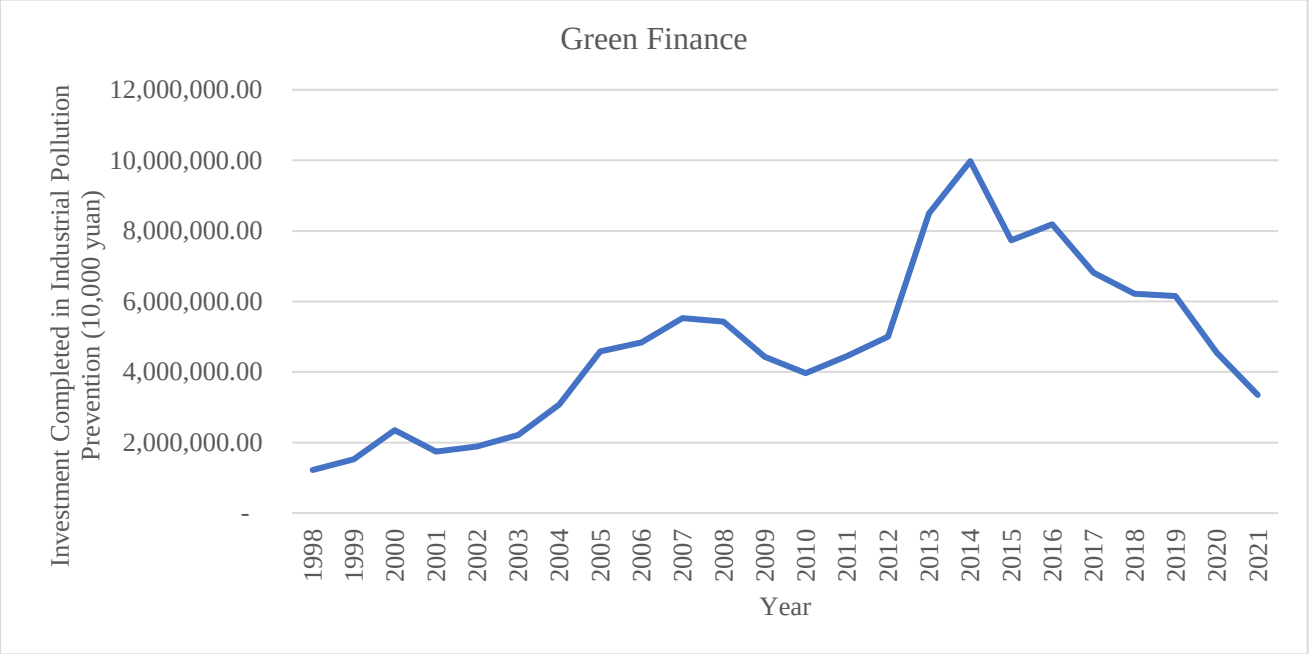
The rapid development of globalization and technological development has also accelerated economic growth (Jorgenson & Vu, 2016). While economic growth benefits people, it also brings unsustainable negative consequences, uncontrolled growth will lead to serious and far-reaching adverse effects, it is a double-edged sword (Steffen et al., 2015). Besides providing convenience and improving living standards, it also damages the environment and human health such as water pollution and damage to the earth's atmosphere (Edwards, 2021). In 1987, the World Commission on Environment and Development proposed the concept of sustainable development (Brundtland, 1987). Sustainable development means a development model in which resources can not only meet current needs but also ensure that they meet the needs of future generations (Mensah, 2019). China is also increasingly aware of the negative impact of rapid economic and social development will have on the environment, so it has begun to pursue sustainable development goals (Li et al., 2023). Based on Kumar et al., they suggested that green finance is an important tool for supporting sustainable development. Therefore, the government in China has begun to realize the need to provide investments that are helpful to the environment through some new policies such as integrating environmental issues with financial issues, using new financial instruments including green banks, green bonds, and financial technology which we also call green finance (Sachs et al., 2019; Coquelet et al., 2016; Nassiry, 2018).

Green finance plays a significant role in realizing the sustainable development goals (SDGs). Direct and indirect relationships have existed between green finance and SDGs (Kwilinski et al., 2023). There is a direct relationship between green finance and SDG7 which is affordable and clean energy, SDG11 which is sustainable cities and communities as well as SDG13 which is climate action (Scharlemann et al., 2020). For example, green finance is highly correlated with the sustainable development goal 13 that relates to acting rapidly to counter climate change and mitigate the influence of climate change. In addition, green finance also indirectly correlates with SDG3 which is good health and well-being, SDG14 which is life below water as well as SDG15 which is life on land (Scharlemann et al., 2020). For instance, green finance correlates with goal 3 that relates to guaranteeing a healthy life and fosters the welfare for the human no matter what age (Hesary & Yoshino, 2019).

Green finance also acts as an important role in environmental, social, and governance (ESG) while ESG acts as a significant role to achieve a persistent and superior development (Qian & Yu, 2023). Green finance can enhance the performance of ESG through ease of financial restriction. The other important thing is that green finance can improve the ability to generate profit as well as enhance the financing which is associated with ESG and ultimately lead to reduction in the action of greenwashing (Zhang, 2023).

There is no common definition for green finance as the scholars are still at odds over how to define green finance. Some studies describe green finance as “funding for the investments which offer the environmental advantages such as reducing the environmental pollution”. There is also a definition of green finance as funding for the investments that offer the environmental advantages under the framework of ecologically sustainable development (Khan et al., 2022). Green finance can be divided into 3 key areas which are green investments, green credit and financing of green assets (Muganyi et al., 2021). According to Frimpong et al. (2021), green finance also involves green insurance, climate finance and others. There are various types of green finance instruments which include green bonds, green loans and others (Hossain, 2018).

Figure 1.1: Green Finance of China from year 1998 to year 2021

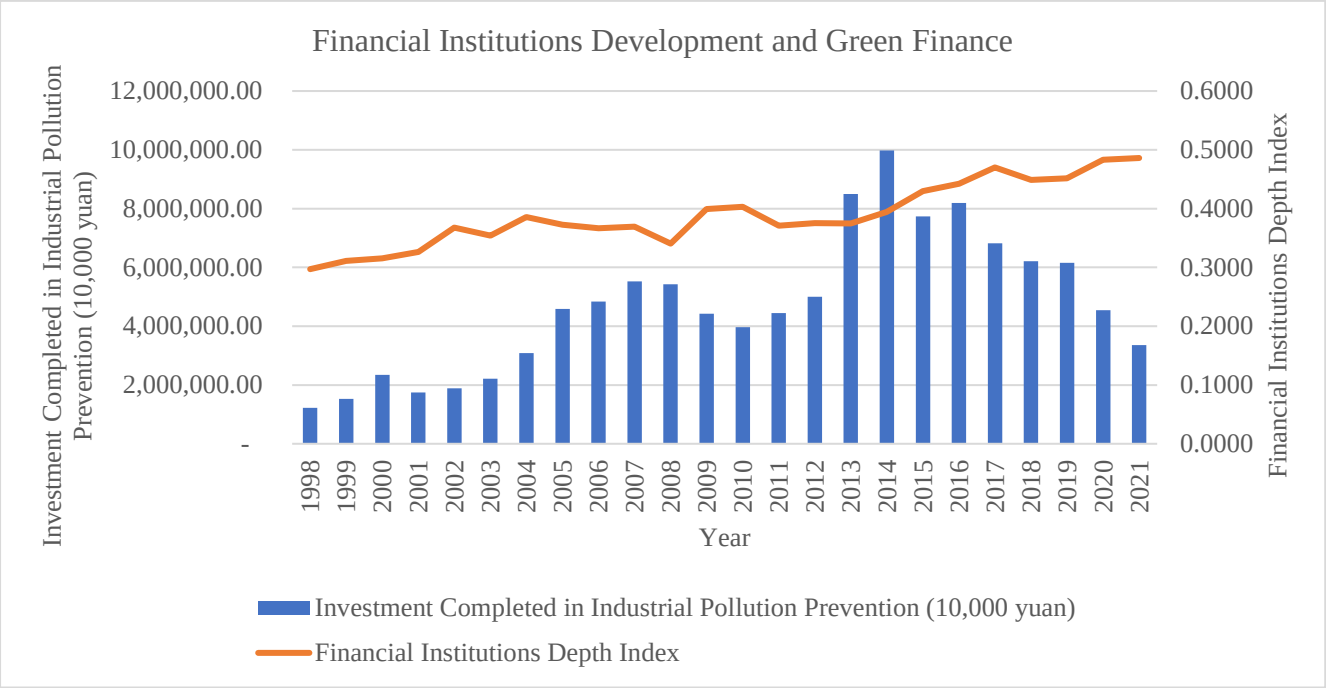


Source: Economy Prediction System (2024)[1]

Figure 1.1 shows green finance in China during 1998 until 2021. According to Li et al. (2021), the measurement of green finance in China can be derived from the total amount invested in the sector of precaution of the contamination from industries which under the green finance's key area of green investment and it is accessible in the Chinese Economy Prediction System. From figure 1.1, it is clear to see that green finance in China presents fluctuation trends over 1998 to 2021.

[1] Authors own calculations for Figure 1.1

Figure 1.2: Financial Institutions Development and Green Finance from year 1998 to year 2021

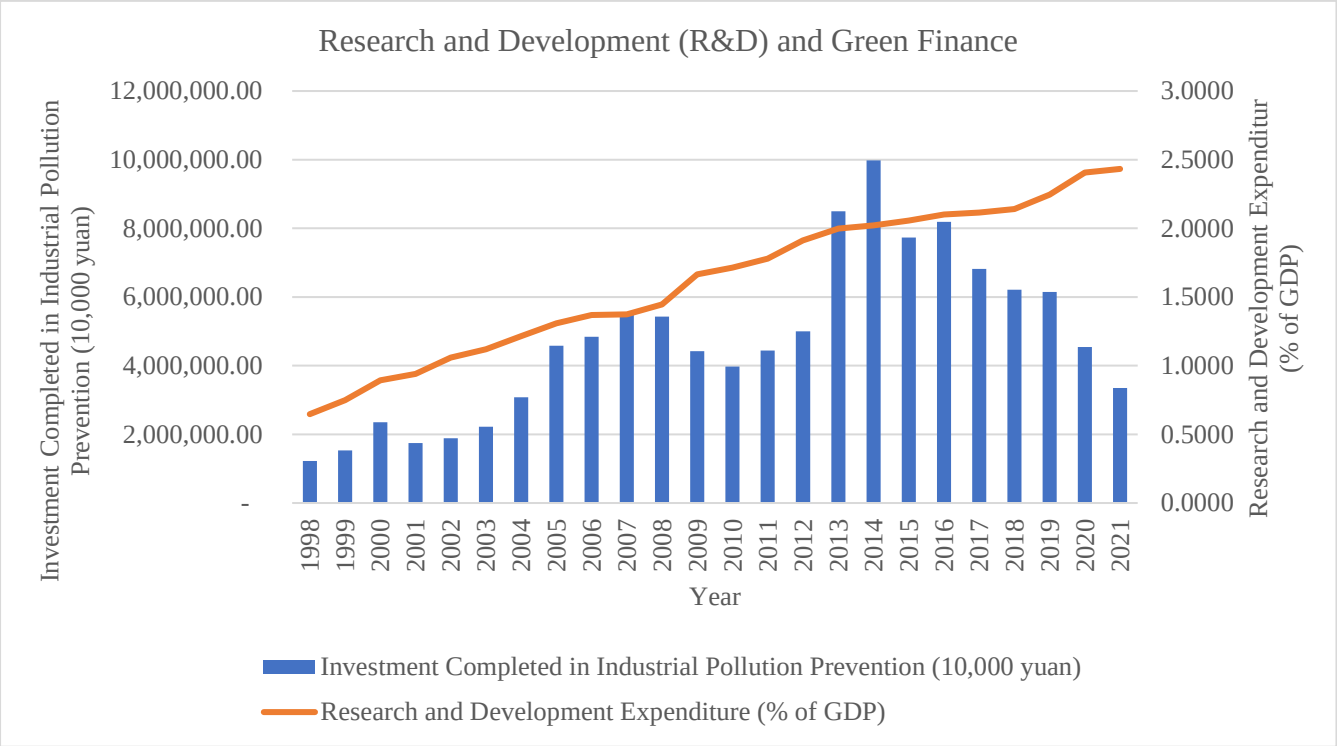


Source: Economy Prediction System and International Monetary Fund (2024)[2]

Figure 1.2 shows the relationship between financial institution development and green finance in China during 1998 to 2021 where the measurement of green finance in China is the total amount invested in the sector of precaution of the contamination from industries. Financial institutions refer to the institutions which handle the funds matters such as banks. Financial institutions development can be simply explained as the development related to financial institutions. It is clear that the financial institutions development slightly increased from 1998 to 2021. Although there is an upward trend in financial institutions development, green finance is fluctuating. For instance, financial institution development hit a peak with 0.4861 in 2021 while green finance is low as 3352364.34 in 2021. One of the reasons why green finance showed a fluctuation trend is the rising worldwide energy costs (Li et al., 2021). Since green finance showed a fluctuation trend instead of increasing with the upward trend of finance institutions development or decreasing, this study is conducted in order to explore the influence of financial institutions development on green finance.

[2] Authors own calculations for Figure 1.2

Figure 1.3: Research and Development (R&D) and Green Finance from year 1998 to year 2021



Source: Economy Prediction System and World Bank (2024)[3]

Figure 1.3 shows the relationship between research and development and green finance in China over 1998 to 2021 where the total amount invested in the sector of precaution of the contamination from industries is the measurement of green finance in China. Research and development can simply be called as R&D represents the corporation's endeavor to improve their knowledge pool to bring forth new ideas and fuse the new ideas with the goods and services as well as the procedures. R&D involves the participation and effort of professionals from different fields (Gutterman, 2023). From figure 1.3, it clearly showed that the R&D in China showed an upward trend from 1998 to 2021. This indicated that China put effort into the R&D aspect. In 2020, China has set up more than 800 R&D centers. The R&D degree of China is over the average R&D degree of Europe (Han et al., 2023). Although R&D and China showed an upward trend, there is a fluctuation trend in green finance in China. For example, R&D peaked in 2021 but green finance was quite low in the same year. The oil crisis is one of

[3] Authors own calculations for Figure 1.3

the reasons why the green finance in China reported a fluctuation trend (Li et al., 2021). However, green finance in China is still considered as high. The proof is that the sum of green bonds issued by China is more than other countries such as France, Japan and Malaysia in 2018 (Wang et al., 2020). Due to the indistinct relationship shown in the figure 1.3, this study is conducted which aims to examine the influence of R&D on green finance.

In a nutshell, this study is conducted to examine the influence of financial institutions development and R&D on green finance since green finance in China showed a fluctuation trend instead of following the upward trend of financial institutions development and R&D or opposite with them. This study is conducted to provide a clear direction to the policy makers in order to better promote green finance in China.

1.2 Problem Statement

As mentioned earlier in this chapter, the Chinese government has been actively promoting the development of green finance in the past few decades as a response to environmental issues caused by economic growth. However, developing green finance is not an easy task. There are still significant problems and challenges (Lee, 2020). While it is growing rapidly, it also faces obstacles. For instance, the term "green" is abstract and broad, and its definition varies among individuals. Without accurate and unified standards, efficient development of green finance becomes difficult (Zhou, 2022).

Green finance is a new financial model that integrates environmental issues with finance (Salazar, 1998). In addition to research in the field of green finance, it is crucial to raise awareness of its importance among market participants like individual investors and companies. Without a thorough understanding, people may not prioritize it (Zhou, 2022). In China, some individuals and companies lack professional knowledge and understanding of green finance, leading them to be skeptical about green projects. Concerns about risks and low returns on investment in new technologies make assessing the uncertainty of green credit challenging, and therefore they are hesitant to adopt them (Halle, 2015). Another issue is that banks and financial institutions are limited by the Basel Treaty when it comes to allocating loans to riskier projects. For loans with high-risk exposure, banks require higher capital, stricter interest rates, and stress

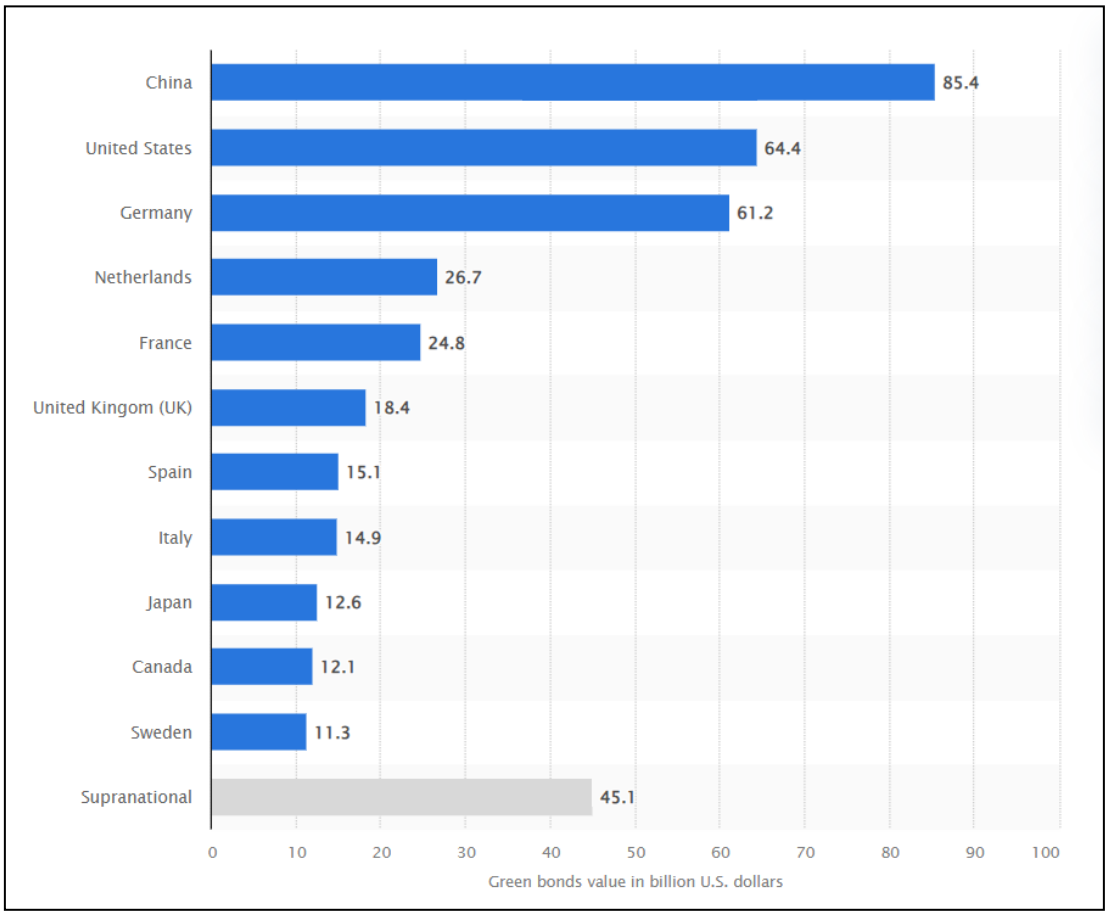
tests (KPMG, 2014). Moreover, banks primarily rely on customer deposits as their main source of funds, which are typically short- to medium-term deposits (Halle, 2015). However, green projects require long-term investment, making it difficult for banks to provide financing for such projects (Sachs et al., 2019).

Furthermore, China's traditional finance is already widespread, presenting obstacles to investing in and innovating green finance, which currently makes up a smaller proportion of the overall financial assets (Du et al., 2023). Despite this, China has significant potential to promote the growth of green finance and mitigate the negative impact of economic growth on the environment (Ahmed et al., 2020). China has started demonstrating its commitment to green finance through practical actions, such as issuing green bonds and implementing relevant regulatory laws to promote green finance (Li et al., 2023).

However, according to An et al., China's green financial products lack innovation. Since entering the green bond market in 2015, green credit has consistently dominated, accounting for over 90% of green financing (An et al., 2017). Conversely, other green products like green insurance, green stocks, and tools like green funds are not fully utilized, have limited availability, and do not provide strong support for the green industry. Additionally, green finance has limited support for industries such as construction and transportation, which have a significant environmental impact and require more green support to transition to a low-carbon model (An et al., 2017). China needs to diversify its green financial products to promote and develop a robust green financial system (Han and Du, 2021).

On the basis of these problems, this study also additionally analyzes China’s potential in green finance, further explaining the reasons why this study uses China as the research object.

Figure 1.4: Leading countries in terms of green bonds issued in 2022

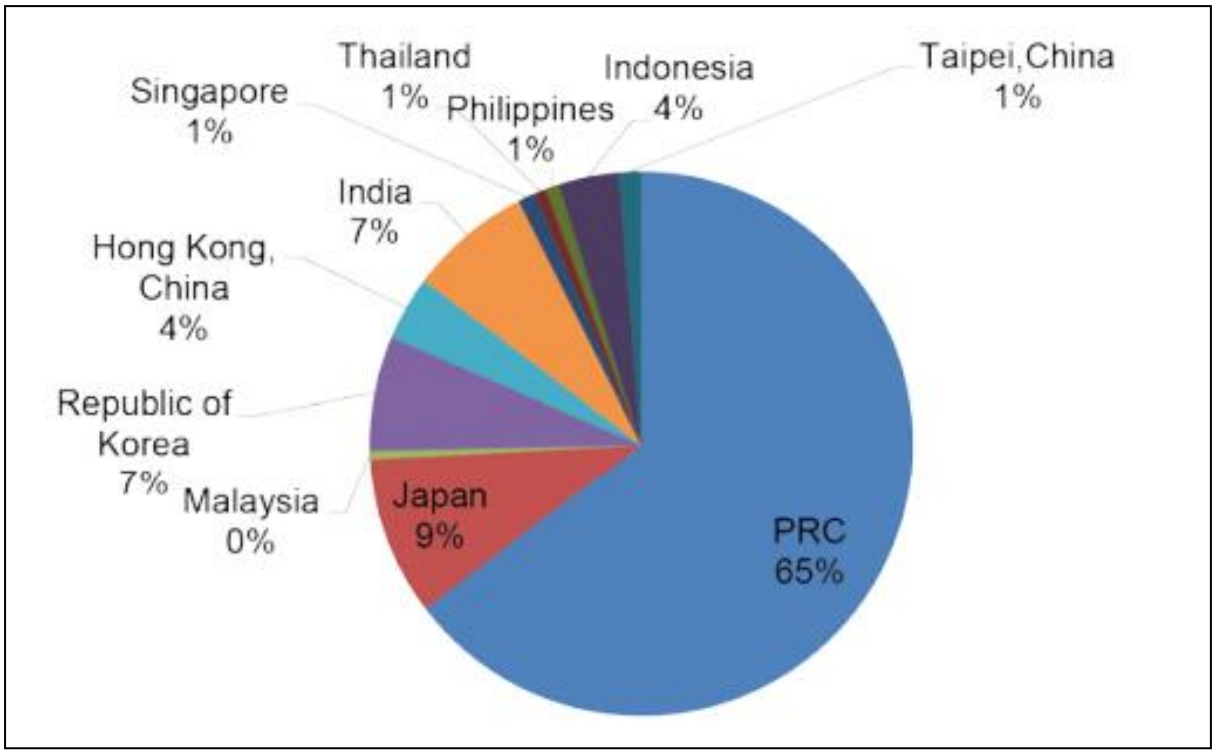


Source: Statista Research Department (2023)

Figure 1.4 shows that in 2022, more than US$85 billion worth of green bonds were issued by China, reaching the top level of green bond issuance in the world. The United States ranked second, issuing $64.4 billion in green bonds. Furthermore, Germany issued green bonds worth US$612 in 2022, ranking third in the world (Statista Research Department, 2023). China has established some financial institutions and government agencies in cities, providing a platform for the development of green finance and promoting the development of green finance. Hence, it is important to study the development and research and development of green finance by Chinese financial institutions because China has made great achievements in this area, including developing rules for green banks and creating a green bond market, among other initiatives (Feng et al., 2023).

China is chosen in this study for several reasons. Firstly, China has achieved rapid development in green finance and is also a leader in green financial products and services such as green bonds. Since more than 25% of global carbon emissions come from China, the Chinese government uses green finance to solve this problem to ensure sustainable development and promote the economy. China's successful development of green finance is a good example. China issued its first green bond in 2015 and became the largest green bond market in the world (Feng et al., 2023).

Figure 1.5: Issuance of Green Bonds in Asia (2015–2020)



Source: (Azhgaliyeva & Kapsalyamova, 2021)

Secondly, Figure 1.5 shows the distribution of green bond issuance around the world. In the figure, this study observed that China is the leader in green bond issuance. China has made rapid progress in green finance and has gained a lot of experience and lessons. Therefore, these can very well help other countries, especially developing countries, provide information and provide useful decision-making reference for the development of global green finance. (Li et al., 2022).

Figure 1.6: Country of origin of the author on green finance

Source: (Feng et al., 2023)

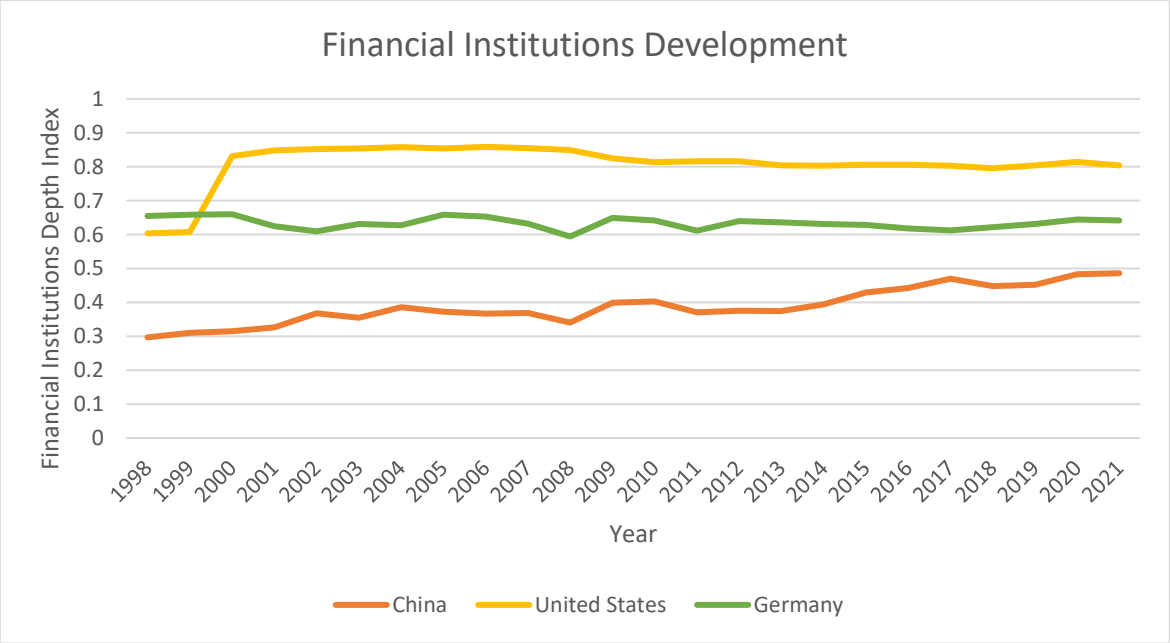
Lastly, most of the authors of green finance research are from China. For example, Jun Ma and Guojun An are the authors who have a certain influence in the field of green finance. They began to publish the first article on green finance in 2016. Subsequently, many high-quality publications were produced. This has enabled China's research on green finance to make initial progress (Li et al., 2022). Chinese researchers attach great importance to sustainable development issues such as reduce carbon emissions, climate risks and more. Therefore, researching and analyzing green finance in China can bring valuable insights to other countries (Li et al., 2022).

Furthermore, green finance is also affected by various factors such as financial institutions and research and development. Financial institutions play a key role in finance, especially banks. When banks develop through the introduction of financial technologies such as mobile payments, robots, and other technologies (Ding et al., 2022). Banks can promote their financial products and services to the public through diversified channels to meet the changing needs of customers (Karim & Meo, 2022). For example, The China Banking Association, in cooperation with other relevant financial organizations, has taken a series of measures such as formulating

green banking guidelines, assessing environmental risks, etc to promote the development of green finance (Feng et al., 2023).

Next, in terms of Research and development usually refers to the process by which an enterprise creates, innovates new products, or introduces new technologies through efforts and knowledge. Research and development are essential drivers of innovation and progress, helping to advance technology, improve quality of life, and spur economic development (Gutterman, 2023).

Figure 1.7: Compare the financial institutions development between China, US, and Germany



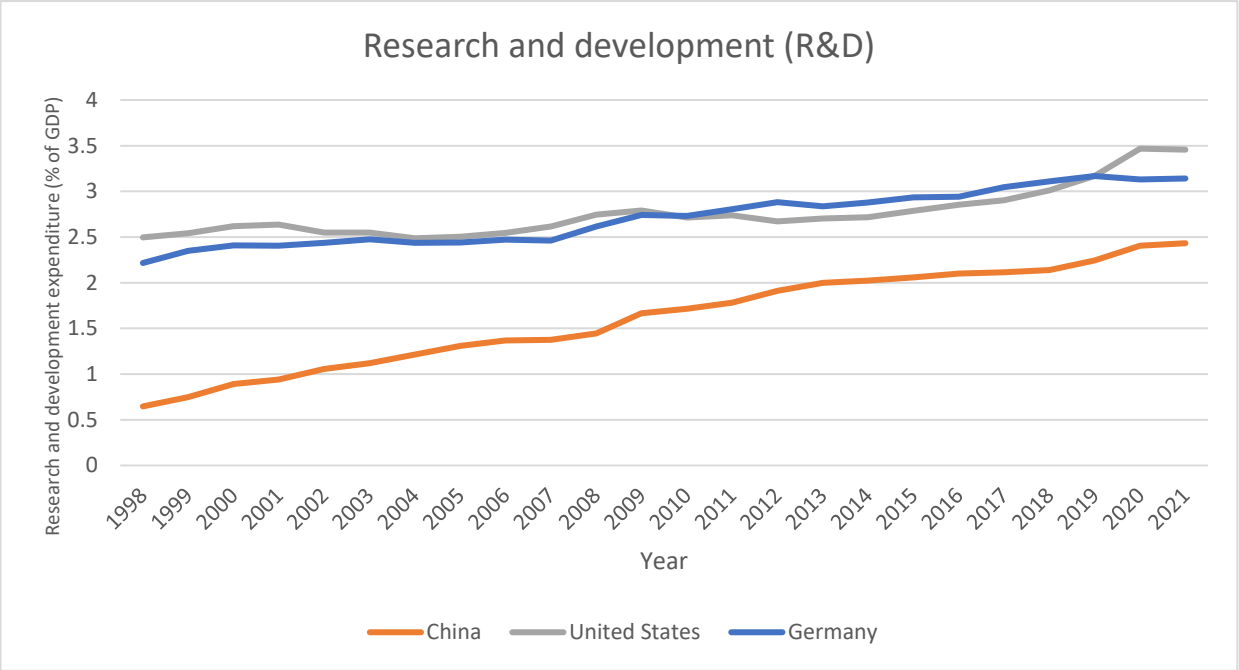
Source: International Monetary Fund (2024)[4]

Figure 1.7 shows the financial institutions development in the three countries from the year 1998 to the year 2021. This research observes that the development of China's financial institutions is the lowest among the three countries. Although it has continued to rise from 0.2970 in 1998 to 0.4860 in 2021, compared with the United States and Germany, China's index of investment in financial institutions development is still the lowest. This is due to the strict

[4] Authors own calculations for Figure 1.7

regulatory agencies in China, for example, China does not encourage people to speculate, and foreign brokers are not allowed to operate in China (Petry, 2020). Therefore, China's capital market is subject to strict controls on the financial system, making it difficult for financial institutions to develop well (Shi, 2023).

Figure 1.8: Compare the research and development between China, US, and Germany



Source: World Bank (2024)[5]

Figure 1.8 compares the three countries' expenditure on R&D from the year 1998 to the year 2021. China's expenditure on R&D accounted for only 0.6469% of GDP in 1998. Besides, in 2021, the expenditure invested in R&D of China reached 2.4326% of GDP. Although there has been continuous growth in these years, China still is the country that invests the least in R&D among the three countries.

From Figures 1.7 and 1.8, this research can find that China's investment in the financial institutions development and research and development is less than the United States and Germany, but it occupies a leading position in green finance. Financial institution development

[5] Authors own calculations for Figure 1.8

and research and development are both variables that will affect green finance. China has been able to invest relatively few resources in these two areas but has achieved outstanding development in green finance. For example, at the end of 2021, China will have a total of 15.9 trillion yuan in green loans. These loan funds are mainly to achieve the goal of carbon neutrality. Moreover, China has created many attractive green investments and promoted the development of green industries such as sustainable energy (Xu et al., 2023). Therefore, this research can conduct in-depth research and analysis on China.

All in all, this study analyzes the challenges that China faces in the field of green finance. However, it is important to note that China also possesses great potential and has made significant progress in establishing green finance. China's large population, robust infrastructure, and strong manufacturing capabilities serve as a solid foundation for the development and innovation of green finance. With these abundant resources at its disposal, China can invest in the development of green financial projects.

Furthermore, China recognizes the importance of sustainable development and actively promotes the growth of green finance. Through collaboration with other countries and companies, China can acquire knowledge and technology in the field of green finance. This approach not only facilitates technological innovation but also reduces the need for internal research and development, thereby enabling China to make rapid progress in green finance. Moreover, China seeks to understand and learn from the research and technology of other countries in the realm of green finance. By studying and imitating the existing knowledge and experience of others, China can develop strategies that best suit its own needs, thereby minimizing its expenditure on the development and research of financial institutions.

1.3 Research Objectives

1.3.1 General Objectives

The general objective of this study is to deepen understanding of green finance while exploring the potential impact of financial institution development and research and development activities on its evolution.

1.3.2 Specific Objectives

The following specific objectives are established to realize the general objectives.

1. To examine the impact of financial institution development on green finance in China.
2. To examine the impact of research and development on green finance in China.

1.4 Research Questions

The subsequent research questions have been formulated to enhance the discourse on the subject matter.

1. Is there a significant relationship between financial institution development and green finance in China?
2. Is there a significant relationship between research and development and green finance in China?

1.5 Hypothesis of the Study

H1: There is a significant relationship between financial institution development and green Finance in China.

H2: There is a significant relationship between research and development and green finance in China.

1.6 Significance of the Study

First of all, this study needs a theoretical basis to improve green finance. Some of the common theory models also be used in this study. The acceptance of the key independent variables which are financial institutions development and, research and development; and some controllable variables which are environmental governance, economic development, and energy consumption will be talked about in the theory frames. The theoretical frameworks may accurately describe green finance. Thus, scholars may find it simpler to carry out future studies by being more imaginative in their choice of theoretical framework.

Secondly, this study makes a substantial contribution to our knowledge of the reasons driving green finance by identifying elements that may influence it. For example, the study investigates at how financial institutions have evolved, how they affect green finance, and what function research and development plays through secondary data analysis. According to Wang & Zhi (2016), green finance, which emphasises the terms "green" and "finance," is a revolutionary financial model that blends sustainability with financial rewards. Gaining a deeper comprehension of the driving forces behind green finance enables us to offer guidance on pertinent policy formulation and facilitate the assimilation of green finance development with financial sustainability.

Additionally, society can utilize the research results to create comprehensive strategies and initiatives aimed at promoting the development of green finance. This includes implementing supportive policies, fostering collaboration between key stakeholders, educating the public and businesses, investing in sustainable technologies, and developing transparent reporting and impact assessment frameworks. These efforts collectively contribute to a robust and sustainable green finance ecosystem. For instance, governments should create incentives to entice financial firms to increase their investments in sustainable development initiatives, such as tax cuts, subsidies, and advantageous regulatory frameworks. Financial institutions can use these incentives to increase the amount of money allocated to environmentally friendly investments and enhance their risk management plans by adding sustainability standards. In order to satisfy investors' increasing needs for sustainable and socially conscious investments, financial institutions can also employ study findings to create more creative green financial products and services, such as green bonds, sustainability-linked loans, and green investment funds. They can locate new markets and modify their products to better meet environmental, social, and governance standards by combining research findings with secondary data analytics. Not only that, but educational institutions may also play a critical role in empowering financial professionals with the information and skills needed to spearhead green finance projects by designing and implementing training programs based on study findings.

By means of these activities, the community can not only facilitate the advancement of green finance but also cultivate sustainable economic and social progress, thereby establishing a firm

groundwork for subsequent expansion. As a result, by developing a more robust and sustainable financial system that fosters long-term prosperity, society may profit from the research findings.

1.7 Conclusion

The primary goal of chapter 1 is to enrich understanding of the multifaceted aspects influencing green finance. This study endeavours to assess the impacts of key independent variables and controllable variables on the green finance.

CHAPTER 2: LITERATURE REVIEW

2.0 Introduction

In Chapter 2, the structure unfolds seamlessly. Firstly, it embarks on a comprehensive review of the literature concerning the dependent variable, green finance. Subsequently, it delves into the intricate relationships between this dependent variable and two independent variables: financial institution development and research and development. Building upon this foundation, the chapter proceeds to discuss relevant theoretical frameworks, furnishing the research with a solid theoretical grounding. The subsequent section is devoted to constructing the conceptual framework, providing a visual representation of the dynamic interplay between the independent and dependent variables. Lastly, hypotheses central to the study are formulated, encapsulating the anticipated relationships under investigation.

2.1 Review of Literature

2.1.1 Financial Institutions Development

Financial institutions play a key role in finance and serve as support for the development of financial technology. According to Zhou et al. (2022), research found that when financial institutions, especially banks, develop financial technology innovation, it has a positive effect on the development of green finance. In addition, Le et al. (2021) believe that banks' fintech development can play a positive role in promoting green projects. Goodell et al. (2022) also believe that banks' development of artificial intelligence, machine learning, and other financial technologies will have a positive relationship with green finance and can better allocate funds to green projects.

The development of banking financial technology has helped banks greatly reduce costs and increase profitability using automation and simplified step processes (Wan et al., 2023). This development will allow banks to promote the development of green finance more actively. For example, when banks introduce the development of financial technology, they can reduce risks such as bank information asymmetry and improve the quality of green financial projects such as green credit. (Wang et al., 2021b; Lee et al., 2021; Demir et al., 2020).

Mo et al. (2022) conducted research on countries with serious pollution including China, Russia, India, and Japan. According to the research results, expanding the development of financial institutions will have a significant positive impact on promoting green growth and helping countries reduce pollution. When financial institutions such as the banking industry begin to use advanced machinery for development, it can stimulate the growth of green finance and thereby achieve the goals of environmental protection and sustainable development (Mo et al., 2022).

However, Cao et al. (2022) indicated that there is a negative relationship between financial institution development and green growth. The majority financial institutions in China are the banks and the big government-owned companies are preferred by the state-owned banks. There will be greater and greater resources of finance assimilated into the finance industry and result in developing in financial institutions over time. This has led to the financial resources being unable to be distributed effectively to companies excluding big government-owned companies that focus on the advancement in the technology field. Thus, it will negatively impact green growth that is driven by advancement in the technology field. As green finance plays an important component in green growth, it can indicate that financial institutions development indirectly and negatively influences green finance (Soundarrajan & Vivek, 2016).

2.1.2 Research and Development

The general definition of research and development (R&D) refers to the innovative processes that aim to improve the knowledge base and utilize the knowledge base to design and launch new products (Doloreux et al., 2015). R&D can be measured by the R&D spending (Mo et al., 2022). According to Dutordoir et al. (2023), R&D also can be defined as the proportion of R&D spending divided by the revenue which proves that R&D can be represented by R&D investment since there is the same calculation for the R&D investment's indicator (Xin et al., 2019). According to Mo et al. (2022), R&D significantly and positively affects green growth in certain countries which are Russia, China and Japan and this can prove that R&D indirectly affects green finance. This is because green finance serves as a key component of green growth (Soundarrajan & Vivek, 2016).

According to Hu et al. (2023), there is a significant relationship between green finance instruments, which is green insurance and green innovation. In addition, there is also research indicating that green innovation performance is related to green innovation (Chen, 2007). Xu et al. (2020) had conducted research with a purpose of examining how R&D investment and performance of ESG influence the green innovation performance. This research used the data that comes from 223 listing corporations in China over the period of 2015 to 2018 and the method utilized in this research is multiple regression analysis. A positive relationship between R&D investment and green innovation performance is found in this research and this has proved that there is an indirect positive relationship between R&D and green finance.

Moreover, Zhang and Jin (2021) also identified a significant and positive relationship existing between R&D expenditure and green innovation in their research and this proved that R&D indirectly influences green finance. The data used in their research comes from China's listing corporations over the period of 2007 to 2019 and regression analysis and robustness analysis are utilized.

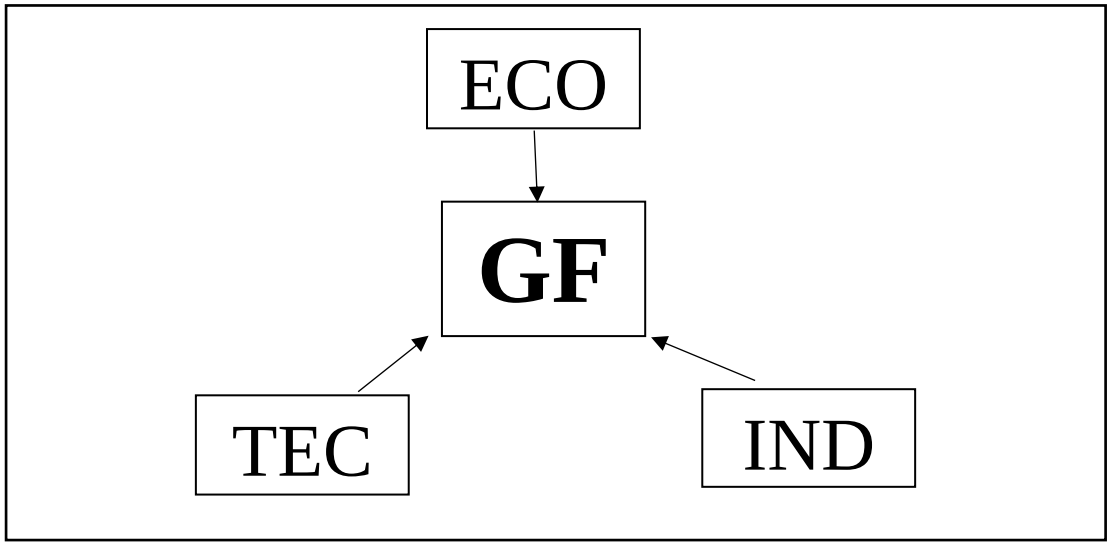
However, according to Fan and Teo (2022), there is a negative relationship between R&D investment and green innovation performance. R&D investment will negatively influence green innovation performance if the degree of innovation in technology is lower than 0.1082. This has proved that there is an indirect negative relationship between R&D and green finance. Besides that, according to Shi and Yang (2022), there will be a shift from the negative relationship between R&D and green innovation to positive as a result of the exaltation in the standard of the judicial system. This has shown that R&D indirectly and negatively affects green finance if the judicial system's standard is low.

2.2 Theoretical Framework

Previous research has formulated many ideas to elucidate the correlation between green finance and its controllable variables, including environmental governance, economic development and energy consumption.

2.2.1 Proposed Theoretical Framework

Figure 2.1: Researcher's Model



Adapted from: Zhou et al. (2022).

As seen in Figure 2.1, the suggested theoretical framework expands on previous models to investigate the factors that influence green finance (GF) in China. Within this approach, environmental governance (IND), economic development (ECO), and energy consumption (TEC), are the main independent variables that impact the dependent variable which is green finance (GF).

One of the key factors influencing green finance is described as environmental governance (IND) is an additional crucial independent variable. Stable policy environments that support long-term investments in environmentally friendly initiatives are produced by effective environmental governance. Strong governance frameworks are crucial for reducing risks and uncertainties and promoting sustainable financial flows, according to Zhou et al. (2022). Therefore, it is expected that environmental governance and green finance will have a favorable relationship.

In this concept, green finance is thought to be significantly predicted by economic development (ECO), which is commonly gauged by the GDP growth rate. Growth in the economy raises the need for green investments and synchronizes goals with sustainability in the environment.

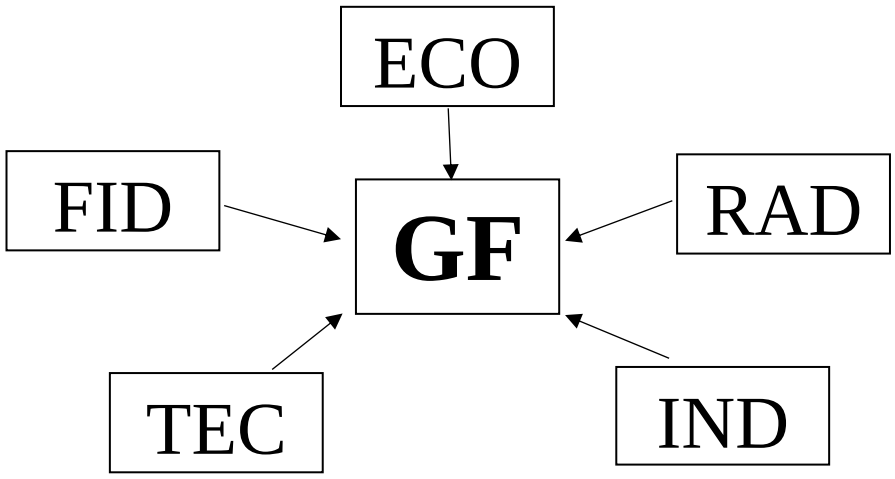
According to Zhou et al. (2022), as developing economies often give priority to sustainable development, economic development is predicted to have a beneficial impact on green financing.

Important considerations in green finance are the energy consumption's source and intensity (TEC). Overconsumption of energy, especially from non-renewable sources, could hinder the expansion of green finance. However, switching to renewable energy sources can mitigate these issues and promote ecologically responsible financial practices. Zhou et al. (2022) have demonstrated that a significant factor in the intricate relationship between energy use and green finance is the mode of energy consumption.

To sum up, this theoretical framework offers an organised method for comprehending how China's environmental governance, economic growth, energy consumption, and green financing interact. It is anticipated that these factors will provide significant insights into the mechanisms behind sustainable finance and provide guidance for improving the efficacy of green financial practices.

2.3 Conceptual Framework

Figure 2.2: Conceptual Framework



Building upon the theoretical models outlined earlier, Figure 2.2 presents a conceptual framework aimed at scrutinizing green finance. This framework integrates two key independent variables: financial institution development and research and development and four controllable variables: environmental governance, economic development, and energy consumption. Past studies indicate that these variables play pivotal roles in significantly influencing green finance outcomes. Thus, this framework stands poised to serve as a fundamental tool for validating this conjecture. Moving forward, the ensuing section will see the formulation of hypotheses derived directly from this framework, contributing further to a comprehensive analysis of green finance dynamics.

2.4 Conclusion

This chapter provides a comprehensive review of the literature surrounding the independent variables of financial institutions development and research and development, along with the dependent variable of green finance. In addition to thoroughly exploring these variables, it delves into the theoretical frameworks employed in prior research. Furthermore, this chapter lays the groundwork for the study by establishing the conceptual framework and hypotheses. These preliminary steps serve as a solid foundation for the subsequent chapter, which will delve into the methodology employed in this research endeavor.

CHAPTER 3: METHODOLOGY

3.0 Introduction

The methodology section, included in Chapter 3, offers a thorough description of the study procedure. It covers the design, sampling strategies, operational definitions of important terms, measurement scales, and data analysis procedures. By describing the processes taken in preparation before entering the analysis phase, this chapter lays the groundwork for the upcoming chapter on data analysis.

3.1 Research Design

The general structure created to answer a particular research issue is known as research design. It describes the methodical strategy and steps taken to look into the current issue. According to Myers et al. (2010), research designs can be broadly divided into two categories: qualitative research and quantitative research.

The decision has been made to use quantitative research for this research. The objective of quantitative research is to acquire numerical data to address a specific research question (Myers et al., 2010). This study aims to examine the impact of two main independent variables, namely financial institution development and research and development, and three controllable variables, namely environmental governance, economic development, and energy consumption, on the dependent variable, green finance (Mo et al., 2022; Zhou et al., 2022).

3.2 Data Collection Methods

Data was collected before the start of the study. The information collected can be categorized into two types: primary and secondary (Daas & Arends-Tóth, 2012). To achieve the research goals, secondary data was chosen for the study. Secondary data offer a plethora of material pertinent to the breadth and focus of this research, gathered from sources such as databases, reports, and earlier studies (Daas & Arends-Tóth, 2012).

3.2.1 Secondary Data

Given the nature of the data, a quantitative research methodology was utilized for this study. All of the data contained quantitative or numerical information. Quantitative research is a type of social science research that uses empirical techniques and statistically based methodologies to gather, analyze, and interpret numerical data to explain phenomena (Watson, 2015). Data obtained from the IMF and World Bank is considered quantitative because of its numerical format. This aligns with the objectives of quantitative research, enabling the application of statistical analysis techniques to derive meaningful insights and draw conclusions based on empirical evidence (Watson, 2015; Martin & Bridgdmon, 2012; Sukamolson, 2007).

Time series data consists of variable values recorded over consecutive time intervals, ranging from daily to yearly periods (Gujarati & Porter, 2009). In this study, time series data was utilized due to its consistent collection at regular intervals. All the data used in the study are classified as secondary, having been previously collected by others for different research purposes. Secondary data was chosen for its cost-effectiveness, eliminating the need for time-consuming data collection efforts. This approach streamlines the research process and allows for greater focus on data analysis. Additionally, sourcing secondary data from online repositories such as the IMF and World Bank, whether through paid or free access, further contributes to cost savings and accessibility, enhancing the efficiency and focus of the research endeavor.

3.3 Data Processing

Data processing plays a crucial role in transforming raw data into valuable insights. It involves several important procedures, such as editing, verifying, and eliminating unnecessary information, to prepare the data for analysis. According to Rossmann & Van Beek (1999), researchers carefully review and update the data to ensure its accuracy and reliability. They start by referencing past studies to validate the selected indicators, making sure they align with established research findings. During data collection, researchers pay close attention to maintain consistency with indicators used in previous research projects. They meticulously adjust the data to address any discrepancies, especially when dealing with omitted observations from sources like the World Bank and IMF. Furthermore, when inputting the data into

analytical tools like EViews, researchers conduct multiple checks to identify and correct any potential errors (Rossmann & Van Beek, 1999). This rigorous verification process establishes a strong foundation for subsequent research activities, enhancing the accuracy and reliability of the analysis.

3.4 Data Analysis

Data analysis involves a systematic process of refining, converting, and manipulating raw data to extract meaningful insights essential for informed decision-making. In the context of this research, Electronic Views (EViews) serve as the platform for conducting and testing regression analysis.

3.4.1 Method of estimation – ARDL cointegration bounds test

The study examines the impact of financial institution development, research and development, environmental governance, economic development, and energy consumption on green finance in China.

The equation for the approach is stated as follows:

$$LGF_t = \theta_0 + \theta_1 LFID_t + \theta_2 LRAD_t + \theta_3 LIND_t + \theta_4 LECO_t + \theta_5 LTEC_t + e_t \quad (1)$$

Where t=1, …, T, L is natural logarithm, GF is the green finance, FID is the financial institutions development, RAD is the research and development, IND is the environmental governance, ECO is the economic development, TEC is the energy consumption and e is the error term. While the parameter estimates for energy consumption (θ_5) is predicted to be negative, the estimated coefficients for θ_1, θ_2, θ_3 and θ_4 are anticipated to be positive.

In this study, the ARDL method is adopted to assess the magnitude of green finance.

Here is the reason why ARDL is unique:

i. The variables in Equation (1) do not need to be integrated in the same order for the ARDL method to be effective; this differs from other approaches. Pre-testing for unit roots is not

necessary, as the flexibility of ARDL allows for the combination of I(0) and I(1) variables within a single model (Tan et al., 2016; Baharumshah et al., 2009; Chang et al., 2021).

ii. One advantage of the ARDL approach over other cointegration strategies is that it shows resilience even with reduced sample sizes (Tan et al., 2016; Baharumshah et al., 2009; Chang et al., 2021).

iii. Serially uncorrelated regression residuals may be successfully addressed by ARDL (Tan et al., 2016; Baharumshah et al., 2009; Chang et al., 2021).

The initial phase of bounds testing involves the creation of an unrestricted error correction model (UECM), which is outlined as follows:

$$\begin{aligned}\Delta LGF_t = {} & \beta_0 + \beta_1 LGF_{t-1} + \beta_2 LFID_{t-1} + \beta_3 LRAD_{t-1} + \beta_4 LIND_{t-1} + \beta_5 LECO_{t-1} \\ & + \beta_6 LTEC_{t-1} + \sum_{p=1}^{n1} \theta_1 \Delta LGF_{t-p} + \sum_{p=0}^{n2} \theta_2 \Delta LFID_{t-p} \\ & + \sum_{p=0}^{n3} \theta_3 \Delta LRAD_{t-p} + \sum_{p=0}^{n4} \theta_4 \Delta LIND_{t-p} + \\ & + \sum_{p=0}^{n5} \theta_5 \Delta LECO_{t-p} + \sum_{p=0}^{n6} \theta_6 \Delta LTEC_{t-p} + \mu_t\end{aligned} \tag{2}$$

where the long-run parameter θ_0 is given by $\theta_0 = 1/\beta_1$and the long-run parameters

$\theta_1 = -\sum_1^q \alpha_{2i} \ /\beta_1$, $\theta_2 = -\sum_1^r \alpha_{3i} \ /\beta_1$, $\theta_3 = -\sum_1^s \alpha_{4i} \ /\beta_1$, $\theta_4 = -\sum_1^t \alpha_{5i} \ /\beta_1$, $\theta_5 = -\sum_1^u \alpha_{6i} \ /\beta_1$.

The assessment of Equation (1) as the long-run model hinges on the application of the bounds test for cointegration. Through this method, the presence of a long-run cointegrating relationship among variables is scrutinized using F-statistics (Tan et al., 2016; Baharumshah et al., 2009; Chang et al., 2021). This entails a comprehensive examination through a joint test where the null hypothesis posits that all coefficients of the lagged level variables in Equation (2) are jointly equal to zero.

$$H_0: \beta_1 = \beta_2 = \beta_3 = \beta_4 = \beta_5 = \beta_6 = 0$$

$$H_0: \beta_1 \neq \beta_2 \neq \beta_3 \neq \beta_4 \neq \beta_5 \neq \beta_6 \neq 0$$

Identification of the long-run cointegrating relationship involves comparing the computed F-statistic with the critical value bound, typically tabulated for small sample sizes. When the computed F-statistic surpasses the upper bound critical value, the null hypothesis of no cointegration is rejected, indicating that the variables are indeed cointegrated. Conversely, if the estimated F-statistic falls below the lower bound critical value and the null hypothesis of no cointegration remains unchallenged, it suggests that the variables are not cointegrated. In cases where the calculated F-statistic lies between the upper and lower bound critical values, the decision regarding cointegration is inconclusive. To determine the optimal lag lengths for the ARDL specification, criteria such as AIC or SBC are employed, along with diagnostic checks for residuals (Tan et al., 2016; Chang et al., 2021).

3.4.2 Estimating long-run and short-run models

Once cointegration is confirmed, the ARDL model approach is utilized to estimate the long-run model specified by Equation (1). Assuming an ARDL (1,1,1) model, the following results are obtained:

$$LGF_t = Y_0 + Y_1 LGF_{t-1} + Y_2 LFID_t + Y_3 LFID_{t-1} + Y_4 LRAD_t + Y_5 LRAD_{t-1} + Y_6 LIND_t + Y_7 LIND_{t-1} + Y_8 LECO_t + Y_9 LECO_{t-1} + Y_{10} LTEC_t + Y_{11} LTEC_{t-1} + e_t \quad (3)$$

The coefficients derived from Equation (3) to represent long-term effects are computed as follows$\theta_0 = \frac{Y_0}{1-Y_1}, \theta_1 = \frac{Y_2+Y_3}{1-Y_1}, \theta_2 = \frac{Y_4+Y_5}{1-Y_1}, \theta_3 = \frac{Y_6+Y_7}{1-Y_1}, \theta_4 = \frac{Y_8+Y_9}{1-Y_1}, \theta_5 = \frac{Y_{10}+Y_{11}}{1-Y_1}$.

Conversely, the estimation of the short-term error correction model (ECM) proceeds as follows:

$$\Delta LGF_t = \alpha_0 - \varphi ECT_{t-1} + Y_2 \Delta LFID_t + Y_4 \Delta LRAD_t + Y_6 \Delta LIND_t + Y_8 \Delta LECO_t + Y_{10} \Delta LTEC_t + e_t \quad (4)$$

where

$ECT_{t-1} = [LGF_{t-1} - \theta_0 - \theta_1 LFID_{t-1} - \theta_2 LRAD_{t-1} - \theta_3 LIND_{t-1} - \theta_4 LECO_{t-1} - \theta_5 LTEC_{t-1}], \varphi = 1 - Y_1$, is the coefficient that represents the rate of change.

Finally, the estimated long-run Equation (1) is utilized to gauge the scope and impact of green finance, considering parameters such as financial institution development, research and development, environmental governance, economic development and energy consumption. Equation (1) is re-estimated with these parameters adjusted, while other variables remain constant. The difference between the original and adjusted estimations provides insights into how financial institution development, research and development, environmental governance, economic development and energy consumption affect the distribution of green finance.

3.4.3 Diagnostic making

In order to investigate the impact of financial institution development, research and development, environmental governance, economic development, and energy consumption on green finance in China for the period from 1998 to 2021, this study employed the Fully Modified Ordinary Least Square (FMOLS) testing approach and Dynamic Ordinary Least Square (DOLS) methodologies as robustness estimations to ensure that the results of ARDL were correct (Khan et al., 2019; Abumunshar et al., 2020).

Phillips and Hansen (1990) devised the Fully Modified Least Square (FMOLS) method to provide an optimum estimate of co-integrating regression. The FMOLS regression technique is a residual-based test that was initially devised by Pedroni (2001). This technique produces efficient results for cointegrated variables. Additionally, FMOLS is regarded as a dependable estimate when the sample size is small and the issues of endogeneity and serial correlation among the variables are resolved (Pedroni, 2001; Khan et al., 2019; Hamit-Haggar,2012).

The FMOLS estimator referred to by Merlin and Chen (2021) is shown below:

$$LGF_t = \beta_0 + \beta_1 LFID_t + \beta_2 LRAD_t + \beta_3 LIND_t + \beta_4 LECO_t + \beta_5 LTEC_t + \varepsilon_t \quad (5)$$

where,

β is the coefficient value. *t* is a time series, which covers 24 years, t=1998… 2021. ε_t is the stochastic error term.

Both the DOLS and FMOLS calculations were conducted to verify the coherence of the result (Khan et al., 2019). DOLS estimate method was introduced by Stock and Watson (1993) in 1993. However, according to Kao and Chiang (2001), the use of Dynamic Ordinary Least Squares (DOLS) yields superior outcomes compared to Fully Modified Ordinary Least Squares (FMOLS). It also eliminates any correlation among the regressors (Kao & Chiang, 2001; Merlin & Chen, 2021).

3.5 Conclusion

Throughout this chapter, a range of research methodologies were employed, including research design, data collection methods, data processing, and data analysis, to ensure the reliability of the results. Having identified the selected data and methodologies, the subsequent analysis will be conducted in Chapter 4.

CHAPTER 4: DATA ANALYSIS

4.0 Introduction

In this chapter, various analysis methods and tools, such as the ARDL bound test and diagnostic checking, are employed to thoroughly investigate the data. Data analysis plays a crucial role in the research by providing a deeper understanding of the relationship between green finance and other independent variables.

4.1 Unit Root Tests

Researchers evaluated the selected variables' stationarity and order of integration using the Phillips-Perron (PP) and Augmented Dickey-Fuller (ADF) unit root tests. These tests are crucial to ascertain whether the variables require differencing to achieve stationarity or are stationary at level. The table 4.1 shows the outcomes of various exams.

Table 4.1 Unit Root Test Result

	ADF		PP	
	Level			
Variable(s)	Constant Without Trend	Constant With Trend	Constant Without Trend	Constant With Trend
LGF	8.835432	0.67721	8.576559	0.821706
	(1.0000)	(0.9992)	(1.0000)	(0.9995)
LFID	-0.945768*	-2.784511**	-0.619629*	-2.784511**
	(0.7545)	(0.2161)	(0.8477)	(0.2161)
LRAD	-0.217106	-1.926146	-0.099660	-1.926146
	(0.9231)	(0.6086)	(0.9384)	(0.6086)
LIND	0.891341	-1.548130	0.891341	-1.398097
	(0.9934)	(0.7803)	(0.9934)	(0.8340)
LECO	4.593894	-1.142906	5.119862	-1.717230
	(1.0000)	(0.8987)	(1.0000)	(0.7105)
LTEC	-0.350488	-1.047115	-0.363167	-1.530694
	(0.9024)	(0.9166)	(0.9002)	(0.7885)

	First Difference			
LGF	-0.797667	-5.559043***	-1.268756	-5.486256***
	(0.7991)	(0.0010)	(0.6249)	(0.0011)
LFID	-5.905055***	-4.001857**	-6.220327***	-6.068205***
	(0.0001)	(0.0274)	(0.0000)	(0.0003)
LRAD	-4.517795***	-4.426402***	-4.522905***	-4.423500***
	(0.0019)	(0.0103)	(0.0019)	(0.0104)
LIND	-3.225217**	-3.639351**	-3.225217**	-3.639867**
	(0.0320)	(0.0494)	(0.0320)	(0.0493)
LECO	-1.808173	-4.210505**	-1.339017	-4.328915**
	(0.3669)	(0.0168)	(0.5925)	(0.0126)
LTEC	-2.256910	-2.254246	-2.256910	-2.324250
	(0.1936)	(0.4393)	(0.1936)	(0.4050)

*Notes: *, **, *** denotes significant at 10%, 5%, and 1% significance level, respectively. Both the ADF and PP tests are based on the null hypothesis of a unit root.*

Since the null hypothesis of a unit root cannot be rejected for any of the variables at the 1%, 5%, or 10% significance levels, the test statistics for both the ADF and PP tests at the level indicate that none of the variables are stationary. The p-values, above the critical values at every level, clearly show this (Dickey & Fuller, 1979; Phillips & Perron, 1988).

However, the ADF and PP test statistics indicate that all variables become stable after taking the initial differences since the unit root null hypothesis is rejected at the 1%, 5%, and 10% significance levels. Following differencing, the p-values are much lower, indicating stationarity across all variables (Dickey & Fuller, 1979; Phillips & Perron, 1988).

After the initial difference, the variables are assumed to become stationary, leading us to conclude that they are integrated of order one, or I(1). In order to ensure the validity of subsequent econometric analyses, such as the ARDL limits test for cointegration, which requires that variables are either I(0) or I(1), it is imperative that none of the variables be integrated of order two, or I(2) (Pesaran & Shin, 1999).

4.2 ARDL Cointegration Bounds Test

The ARDL method is used to determine if there is a long-run relationship between variables in a time series analysis. Once the ARDL bounds test has been performed, additional estimation of long-term relationships and cointegration testing is carried out.

Table 4.2 Bounds test for cointegration results

Model	Calculated F-statistic	
LGF = f (LFID, LRAD, LIND, LECO, LTEC)	25.009***	
	k=5, n=24	
Critical value for bounds test	I(0)	I(1)
1%	3.06	4.15
5%	2.39	3.38
10%	2.08	3

*Notes: *, **, *** denotes significant at 10%, 5%, and 1% significance level, respectively. k denotes the number of regressors.*

Table 4.2 displays the bounds test results for cointegration. According to MacKinnon (2010), the asymptotic critical value is employed to reject the null hypothesis of no cointegration at a 5% significant level. The computed F-statistic of 25.009 exceeds the upper bound critical value of 4.15. From this, it can be inferred that a long-run relationship exists between LGF, LFID, LRAD, LIND, LECO, and LTEC.

Table 4.3 Long run coefficients results

Table 4.2 The long-run results

Dependent variables: LGF (Green Finance)

Variables	Coefficients	Std. Error	t-Statistic	Prob.
LFID	12.008029	2.149559	5.586275***	0.0025
LRAD	0.002623	0.000250	10.481410***	0.0001
LIND	0.540418	0.146102	3.698902*	0.0140
LECO	0.000243	0.000013	18.523354***	0.0000
LTEC	-0.000019	0.000002	-12.445582***	0.0001
C	0.477702	1.259432	0.379299	0.7200

*Notes: *, **, *** denotes significant at 10%, 5%, and 1% significance level, respectively. LFID is financial institutions development, LRAD is research and development, LIND is environmental governance, LECO is economic development, LTEC is energy consumption, C is constant.*

Table 4.3 indicates the results of ARDL long run coefficients. Green finance is used as dependent variable while financial institutions development, research and development, environmental governance, economic development, and energy consumption are used independent variables in this study. The long-run estimated coefficients in Table 4.4 all have the expected sign, aligning with theoretical considerations, and the parameters are statistically significant (Tan et al., 2016). Financial institution development is considered a critical factor, where more developed financial institutions increase the opportunities for facilitating green finance. Consequently, businesses and individuals looking to invest in sustainable projects are more likely to engage with these institutions (Wang et al., 2022).

Table 4.4 Interpretation of the long-run elasticities:

Coefficient	Interpretation
$\beta_0 = 0.477702$	The value of 0.477702 is the intercept of the line, indicating that the average of Green Finance is 47.77% when the level of financial institution development (FID), research and development (R&D), environmental governance (IND), economic development (ECO), and energy consumption (TEC) are zero.
$\beta_1 = 12.008029$	When the financial institution development increases by 1%, on average, green finance will increase by 12.01%. This demonstrates high elasticity, suggesting that increasing access to financial institutions development can significantly promote green finance activities.
$\beta_2 = 0.002623$	When the Research and Development (R&D) increases by 1 %, on average, green finance will increase by 0.0026%. This suggests that increasing the number of researchers and investment in R&D will have a beneficial impact on green finance.

$\beta_3 = 0.540418$	When the environmental governance increases by 1%, on average, green finance will increase by 0.54%. This result shows that environmental governance positive to the dependent variable.
$\beta_4 = 0.000243$	When economic development increases by 1%, on average, green finance will increase by 0.0002%. This demonstrates that there is a positive but weak relationship between economic development and green finance.
$\beta_5 = -0.000019$	When the energy increases by 1%, on average, green finance will decrease by 0.000019%. Over-reliance on energy has led to uncontrolled energy consumption, which has seriously worsened environmental problems.

Table 4.5 Robustness Checks

Diagnostic Test	√/×
JB	√
LM	√
ARCH	√
RESET	√

Notes: √ denotes significant and × denotes insignificant at 10%. JB is Jarque Bera normality test, LM is the Breusch-Godfrey serial correlation LM test, ARCH is the ARCH test for heteroscedasticity and RESET is the Ramsey RESET misspecification test.

The results of different diagnostic tests have been demonstrated in Table 4.5. The results in Table 4.5 show that the residuals are not serially correlated and are free from the problem of heteroscedasticity. Also, the result of the Ramsey RESET test shows that the estimated model is properly quantified. However, the null hypothesis of normality residuals can be rejected at the 5% level.

The model's diagnostic tests offer a thorough understanding of its statistical characteristics and dependability. First of all, the p-value is much higher than the traditional significance criterion of 0.10, indicating that the Jarque-Bera normality test indicates that the error terms are regularly distributed. The robustness of the model's estimations is supported by this normal distribution of error terms, which is essential for the validity of many inferential statistics.

Furthermore, the Breusch-Godfrey LM test indicates that the model appears to be autocorrelation-free. The p-value indicates that the error terms are not serially associated, as it surpasses the significance level of 0.05. For the regression coefficients to be impartial and effective, there must be no autocorrelation.

The ARCH test, which demonstrates that there is no heteroscedasticity problem, further supports the model's dependability. The variance of the error terms does not change over time, as indicated by the p-value, which is significantly higher than the significance level of 0.05. The validity of hypothesis tests and the consistency and efficiency of the estimators depend on this homoscedasticity.

Furthermore, the p-value, which is higher than the significance level of 0.05, indicates that Ramsey's RESET test validates that the model is accurately described. This finding implies that the model is not significantly impacted by any misspecification or missing variables. Precise specification is essential for precise forecasts and significant analyses of the regression coefficients.

All in all, the diagnostic tests show that the model's error components are normally distributed, that the model is correctly described, and that there are no problems with heteroscedasticity or autocorrelation. These findings confirm the model's overall robustness and reliability, guaranteeing the validity of the conclusions and inferences made from it.

Figure 4.1 CUSUM

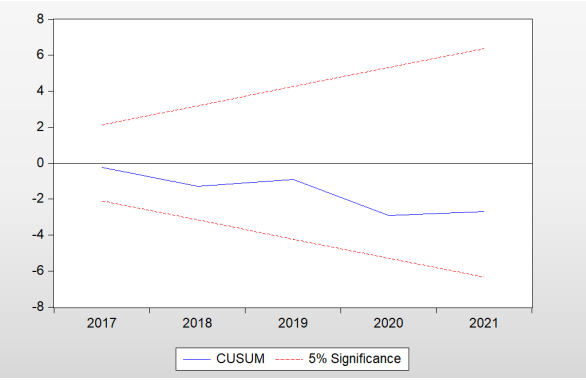
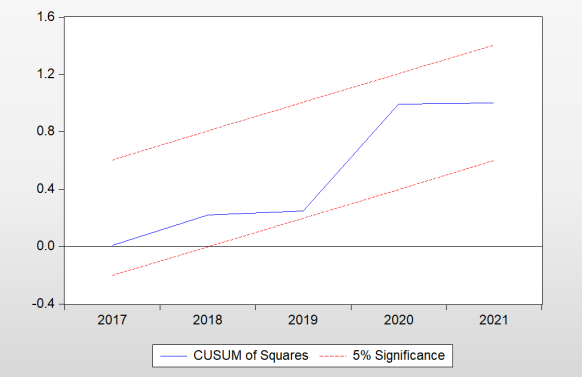


Figure 4.2 CUSUM of Squares



The cumulative sum of recursive residual (CUSUM) and cumulative sum of squares of recursive residuals (CUSUMSQ) tests are employed to evaluate the stability of parameter estimates for ARDL

models. Figure 4.1 and Figure 4.2 illustrate the outcomes of CUSUM and CUSUMSQ. The blue line in both figures is contained within the red lines, which indicates that the coefficients are stable at the 5% level of significance.

4.3 Using Fully Modified Ordinary Least Square and Dynamic Ordinary Least Square as robustness estimations

Table 4.6 Long run coefficients, FMOLS, and DOLS models

Variable	FMOLS	DOLS
LFID	9.398300**	12.04151***
LRAD	0.002115***	0.002584***
LIND	0.108305***	0.320434***
LECO	0.000200**	0.000223**
LTEC	-1.65E-05***	-1.77E-05***
R^2	0.997332	0.999900

*Notes: *, **, *** denotes significant at 10%, 5%, and 1% significance level, respectively. LFID is financial institutions development, LRAD is research and development, LIND is environmental governance, LECO is economic development, LTEC is energy consumption.*

The relationship between dependent and independent variables was investigated in this study using the FMOLS (fully modified ordinary least square) model and the DOLS (dynamic ordinary least square) model. In Table 4.6, the regression results are shown.

Additionally, the coefficients that were estimated can be employed as long-term elasticities. It is evident that the coefficients calculated from the two models, the FMOLS and DOLS models, are highly similar and exhibit identical indications. In fact, the regression coefficients are statistically significant at the 1% significance level, with the exception of economic development, as evidenced by the results in Table 4.6.

Additionally, empirical research indicates that green finance is positively impacted by economic development. The positive correlation between economic development and green finance can be attributed to the fact that the demand for sustainable investments increases as economies expand, resulting in the development of more sophisticated green finance systems. Consequently, the expansion

of green finance is facilitated by economic growth. These results are in agreement with Wang et al. (2023), Zhang and Zhao (2024), and Geng et al. (2023).

Besides that, the R^2 values are exceptionally high (0.997332 for FMOLS and 0.999900 for DOLS), suggesting that these models account for almost the entire variation in the dependent variable. The results from FMOLS and DOLS provide additional support for the robustness of the long-run relationships identified.

4.4 Conclusion

In summary, there is a positive relationship between financial institution development, research and development, environmental governance, and economic development with green finance. However, energy consumption has a negative relationship with green finance. It is important to note that this model does not include any econometric problems such as autocorrelation, multicollinearity, or heteroscedasticity. In the next chapter, we will further discuss the limitations and recommendations of this study.

CHAPTER 5: DISCUSSION, CONCLUSION AND IMPLICATIONS

5.0 Introduction

China seeks to strike a balance between environmental preservation and economic growth; thus, it is vital to comprehend the variables that affect green financing in that nation. In the last chapter, researcher examined the data to investigate these associations using techniques like the Ramsey RESET Test, diagnostic checking, and the ARDL bound test. This chapter acknowledges study limitations, makes recommendations for future research areas, and compares the findings with previous research. It also examines implications for policymakers and practitioners.

5.1 Summary of Statistical Analysis

In Chapter 4, researcher started by using the ARDL bound test to see if the dependent variable, green finance; and the independent variables, which are research and development (R&D) and financial institution development (FID), had a significant long-term association. Since there was a substantial correlation seen in the data, we decided to do additional diagnostic testing to make sure the model was robust.

In order to validate the underlying assumptions of the regression model, then ran a number of diagnostic tests. In order to determine if the model's error terms are normally distributed, the Jarque-Bera normality test was first run. The error terms' normalcy was validated by the findings. After that, used Ramsey's RESET test to make sure the model specification was accurate and to look for any mistakes. Researcher so conducted a multicollinearity test to address any potential multicollinearity and discovered no notable multicollinearity problems among the variables. Second, ARCH test revealed that there is heteroscedasticity in the data collected moreover, the preliminary analysis of the results raised concerns over heteroscedasticity which corrected by employing heteroscedasticity-consistent variance and standard errors estimated by White's Heteroscedasticity-consistent Variances and Standard Errors.

To find autocorrelation in the regression model, also used the Breusch-Godfrey Serial Correlation LM Test. The model's reliability was confirmed by the test results, which revealed no discernible autocorrelation issues. These statistical tests demonstrated the robustness, accurate specification, and lack of significant econometric problems such autocorrelation, multicollinearity, and heteroscedasticity in the model. Therefore, went ahead and interpreted the model's output.

Research and development (R&D) and financial institution development (FID) were found to be significant predictors of green finance in China. Additionally, controllable variables such as environmental governance and economic development also demonstrated a significant positive impact on green finance. Furthermore, another controllable variable which is energy consumption demonstrated a significant negative impact on green finance.

In conclusion, the analysis concludes that there is a significant positive relationship between green finance in China, R&D and FID. Green finance is also positively impacted by economic development and environmental governance; on the other hand, energy consumption, while significant, have a negative impact on green finance. The specific results and implications of these findings are elaborated in the following sections.

Table 5.1: Decision for the Hypothesis of the Study

	Hypothesis of the Study	Decision
I.	H_0: There is no relationship between all independent variables and green finance in China. H_1: At least one independent variable has relationship with the green finance in China	Reject H_0
II.	H_0: There is no relationship between financial institutions development (FID) and green finance in China. H_1: There is relationship between financial institutions development (FID) and green finance in China	Reject H_0

III.	H_0: There is no relationship between research and development (R&D) and green finance in China. H_1: There is relationship between research and development (R&D) and green finance in China	Reject H_0
IV.	H_0: There is no relationship between environmental governance (IND) and green finance in China. H_1: There is relationship between environmental governance (IND) and green finance in China	Reject H_0
V.	H_0: There is no relationship between economic development (ECO) and green finance in China. H_1: There is relationship between economic development (ECO) and green finance in China	Reject H_0
VI.	H_0: There is no relationship between energy consumption (TEC) and green finance in China. H_1: There is relationship between energy consumption (TEC) and green finance in China	Reject H_0

5.2 Discussion of Major Findings

5.2.1 Financial Institutions Development

The financial institutions development is essential to this research since it shows how easily accessible and effective domestic financial services are. Strong infrastructure for funding, risk management, and investment assistance is indicative of a well-developed financial system in China, which raises the feasibility and profitability of ventures. This encouraging trend suggests that green finance is flourishing and that the services and products needed to finance sustainable projects and innovations are readily available. Thus, evaluating the investment climate and growth potential in green finance requires an understanding of financial institution development.

The study's hypothesis test on financial institutions development (FID) revealed a substantial positive correlation between green finance in China and FID. This beneficial link emphasises how important strong financial institutions are to the advancement of sustainable finance projects.

A strong financial sector may improve capital allocation efficiency, effectively mobilise resources for green initiatives, and encourage the creation of innovative financial products that support sustainable development objectives. For example, a study by Zhou et al. (2020) demonstrates how the expansion of financial institutions lowers the cost of capital for green initiatives and improves access to financing, both of which support economic growth. This is especially true in China, where it has been determined that the best way to assist the country's shift to a low-carbon economy is to include green financing into the larger financial system.

Moreover, Zhou et al. (2020) provided evidence that the promotion of environmentally friendly investments has been greatly aided by China's green credit programs. By encouraging financial institutions to lend money more favourably to energy-efficient projects, these laws help to lower carbon emissions and promote sustainable growth. The adoption of such regulations demonstrates Chinese financial organisations' dedication to matching lending practices with national environmental objectives, so bolstering the favourable correlation between the development of financial institutions and green financing.

Furthermore, the results of Fu et al. (2023) who observed that green financing has a major impact on the development of low-carbon energy and sustainable economic growth, lend support to the role that financial institutions play in supporting green finance. The report highlights the critical role financial institutions play in directing capital towards environmentally friendly initiatives that both reduce global warming and advance economic sustainability.

Empirical data strongly suggests that financial institutions development and green financing in China have a good and meaningful link. Robust financial institutions are essential to the whole framework of sustainable economic development and environmental conservation, as they not only increase the availability of finance for green projects.

5.2.2 Research and Development

In this study, research and development (R&D) has been found to be a significant component that positively correlates with green finance in China. This link demonstrates how important research and development (R&D) is to the advancement of sustainable financing because it promotes innovation and advances green technologies.

The work from Zhou et al. (2020) shows how spending more on research and development can greatly improve the efficacy and efficiency of green finance programs. Financial institutions can create new financial products and services that are suited to support green initiatives by investing in research and development (R&D). This will help to facilitate the flow of money into sustainable sectors. As a result, there is a positive feedback loop created whereby green money encourages R&D even more, which produces more innovations and sustainable growth.

Furthermore, Fu et al. (2023) research confirms the importance of research and development (R&D) in the green finance sector, demonstrating that nations with greater R&D spending typically have more advanced green finance systems and better environmental results. This emphasises how crucial it is to keep funding R&D in order to preserve and improve green finance's competitiveness.

The noteworthy and affirmative correlation shown in China between Research and Development and green finance highlights the criticality of innovation and technical progress in accomplishing sustainable development. Research and development (R&D) not only propel the development of novel technologies with reduced environmental impact, but also bolsters the production of financial goods and services that ease the process of green investments. Thus, encouraging a strong R&D environment is crucial to the development and prosperity of green finance in China.

5.2.3 Environmental Governance

The findings show that environmental governance and green finance in China are significantly and favourably correlated, suggesting that strong environmental laws and regulations can effectively promote the growth of green financing.

Numerous studies lend evidence to this notion. For instance, according to Han et al. (2023) research, shows how green finance initiatives in China can foster high-quality economic development when they are coupled with strong environmental regulation. Furthermore, Muganyi et al. (2021) discovered that environmental protection activities are greatly advanced by green money, which is made possible by robust governance systems.

To sum up, the research highlights how important environmental regulation is to the development of green finance in China. The correlation between environmental governance and green finance is positive, indicating that strong environmental policies and regulations are crucial for fostering sustainable financial practices.

5.2.4 Economic Development

According to the research, China's green finance and economic development are significantly positively correlated. This suggests that investments in green financing rise in tandem with economic growth. This result is consistent with the findings of Wang et al. (2023), who noted that China's economically developed provinces had more sophisticated green finance systems. They contend that more affluent areas have the institutional frameworks and financial means to support sustainable initiatives.

Zhang and Zhao (2024) discovered that the desire for sustainable investments is fuelled by economic growth, which in turn creates a favourable climate for green finance. They emphasise how support for green initiatives is growing and environmental challenges are becoming more widely known as economies grow.

The correlation between green financing and economic development in China is positive, indicating that the shift to a more sustainable economy can be aided by economic growth. Government regulations and the growing consumer desire for ecologically friendly goods and services both assist this.

5.2.5 Energy Consumption

China's green financing and energy use are significantly correlated negatively. This implies that lower levels of green financial activities are linked to higher levels of energy consumption, especially from non-renewable sources like coal. This result is consistent with recent research that emphasises China's significant reliance on coal and other fossil fuels, which presents difficulties for the country as it attempts to shift to a low-carbon economy (Song et al., 2021).

For example, a study looking at China's energy consumption structure discovered that coal makes up a large amount of energy use and significantly increases carbon emissions. The development of green finance, which attempts to encourage investments and initiatives that are environmentally sustainable, has been hampered by the dominance of coal. Higher coal consumption locations typically have less established green financial markets because green finance places a strong emphasis on sustainable energy practices (Zhou et al., 2020).

Furthermore, a different study shows that through encouraging the use of cleaner energy sources and increasing energy efficiency, green finance can greatly improve energy consumption structures. The ingrained reliance on fossil fuels in some areas, however, presents a problem and hinders the expansion and efficacy of green finance efforts. The differences in the growth of green finance in China's various regions highlight the impact of current energy consumption patterns on the uptake of sustainable financial practices (Gu et al., 2023).

5.3 Implications of the Study

Research and development (R&D) and financial institution development were found to have strong positive correlations with green finance, suggesting that developments in these fields support sustainable financial practices. Furthermore, there is a strong positive correlation between green finance and environmental governance as well as economic development, which emphasises the significance of strong regulatory and economic frameworks in promoting sustainable financing. Conversely, energy consumption have substantial negative correlations with green finance, which suggest that some characteristics of financial growth and high energy use impede the advancement of green finance projects.

The relationship that exists between the financial institutions development and green finance is positive. This supports the view that sound financial infrastructure is critical in supporting sustainable activity. Policymakers should therefore be concerned about making financial institutions better conditioned with the necessary resources and incentives to mobilize capital for environmentally friendly activities, thereby incentivizing them toward focusing on sustainable development. This can be achieved through specialized regulations such as investment guidelines and green credits, thus speeding up the pace toward the greening of the economy (Dong et al., 2019).

Furthermore, the relationship between research and development (R&D) and green finance underpins the critical role that innovation plays in developing green technology and green financial products. Investments in R&D could bear fruit in environmentally friendly technologies that will sustain green financial systems. A strong foundation of research and development can be laid only through grants, tax incentives, and public-private linkages to provide impetus to innovation and sustainable development (Zhou et al., 2020).

Since green finance and economic development are positive relationship, an expanding economy means a growing demand for green investments. Economic growth is not allowed to occur at the expense of environmental degradation thanks to the cooperation between environmental goals and economic policies (Geng et al., 2023). It offers a chance to encourage

financial investments in eco-friendly companies and innovations, supporting environmental sustainability and economic expansion at the same time.

However, the negative correlation between green finance and energy consumption draws attention to China's problem of being overly dependent on fossil fuels. China has to accelerate the switch to renewable energy sources in order to address this problem. It will be imperative to put into effect regulations that encourage investments in clean energy and improve energy efficiency, especially in areas that rely significantly on coal and other non-renewable energy sources (Xu et al., 2023). These programs will contribute to a change in the energy consumption structure in favor of greener choices.

Last but not least, the benefits of environmental governance for green finance highlight how crucial strong environmental legislation and governance structures are to the advancement of sustainable finance. Stable policy environments, which are a prerequisite for drawing long-term investments in green projects, are produced by effective governance. The development of green finance can be greatly aided by the establishment of precise regulations for emissions, pollution management, and sustainable practices, as well as by the monitoring of compliance (Zhang et al., 2024).

These implications give a thorough framework for comprehending the dynamics of China's green finance sector as well as practical suggestions for advancing the sector's growth and efficacy.

5.4 Limitations of the Study

This study has several limitations even if it offers important insights into how different influencing elements in China interact with green finance. Initially, the analysis relies on secondary data, which could have errors or limitations arising from the data collection procedure. Potential measurement mistakes or reporting biases cannot be completely ruled out, despite efforts to assure the quality and reliability of the data, which could have an impact on the study's conclusions.

Moreover, the study's temporal scope is constrained to a particular time frame. Since the subject of green finance is dynamic, the relationships between the variables under study may change over time. Consequently, a longitudinal approach might provide a more thorough understanding of how these interactions evolve and alter over time. The study does not explore regional differences within China; instead, it focusses on the country as a whole. In different provinces or cities, there could be notable variations in the growth of green finance as well as the effects of financial institutions, R&D, and other factors. The study's incomplete exploration of these geographical differences may have limited the findings' applicability to a wider audience.

Furthermore, even though diagnostic tests were utilised in the study to guarantee the robustness of the model, there is still a chance of model misspecification. Green finance may be influenced by elements not included in the current model or by unobserved variables. Thus, it could be beneficial for future research to investigate other variables or different model parameters. Furthermore, the analysis did not take into consideration external issues like international trade dynamics, international climate legislation, or global economic situations. Future study should consider these broader contextual elements as they may have an impact on the relationship between green financing and the variables under investigation.

Lastly, the analysis does not consider how current or upcoming legislative changes would affect green finance. The associations discovered may change as laws and regulations impact green financing continue to change. Therefore, a more nuanced knowledge of how changing rules affect green financing in China could be obtained by include the consequences of policy changes in future studies.

5.5 Recommendations for Future Research

Expanding upon the knowledge acquired from this investigation, numerous directions for future study might be pursued to enhance comprehension of green finance in China and tackle the pointed constraints. It is advised that future study take a longitudinal approach to monitor how the linkages between green finance and its influencing elements change over time, given the dynamic character of this field. By shedding light on the long-term effects of financial

institutions, R&D, and other factors on green finance, these studies may be able to spot trends and changes in the industry.

Future research could benefit from including other factors that were not included in this study. A more complete understanding of the ways in which these external elements interact with China's green finance might be obtained, for example, by looking at the effects of global economic conditions, international trade dynamics, and international climate policies. Investigating additional potential green finance drivers, such as societal or technical advancements, may also yield more insights.

Future studies should concentrate on assessing the implications of recent and upcoming legislative changes on green finance, since green finance legislation and policies continue to change. It is possible to evaluate the efficacy of regulatory frameworks and offer suggestions for policy changes to improve green finance practices by examining the impact of new rules on green finance outcomes.

Furthermore, future research should look into alternative model specifications or approaches to resolve possible model misspecification. To capture unknown variables that might have an impact on green finance, this could entail experimenting with various econometric models or adding new data sources. Improved modelling techniques may strengthen the conclusions' resilience and offer more precise insights into the variables affecting green finance.

Future study in this important area can help shape policy, practice, and further academic inquiry by tackling these proposals and advancing the understanding of green financing in China.

5.6 Conclusion

This research offers important new insights into the evolution of green financing in China by analysing the elements that impact it. The beneficial effects of research and development (R&D) and financial institutions development (FID) on green finance are among the main conclusions. Green investment and the advancement of sustainable financial practices depend on innovation and a strong financial system.

On the other hand, literature shows that the extent of green finance is inversely proportional to energy utilization. Further development of green finance can be slow due to the short-term approaches to investments and continued usage of fossil resources. These problems demonstrate the existence of the need to have appropriate laws that encourage the long-term sustainability and investment in renewables. Furthermore, the advancement of green finance is significantly aided by environmental governance, as robust regulations promote sustainable financial practices. Furthermore, there is a favourable correlation between economic development and green finance, indicating that as China's economy expands, so too will the need for green investments.

The study's shortcomings include its set time range, reliance on secondary data, and absence of regional analysis. Subsequent studies ought to delve deeper into these domains, take into account extraneous elements, and assess how legislative modifications affect green finance.

In summary, this study sheds light on important variables and difficulties related to green finance in China. By addressing these observations, China's transition to a low-carbon and sustainable economy can be aided.

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Appendix

Appendix 1: ARDL Bound Test

ARDL Bounds Test
Date: 08/21/24 Time: 17:13
Sample: 2000 2021
Included observations: 22
Null Hypothesis: No long-run relationships exist

Test Statistic	Value	k
F-statistic	25.00878	5

Critical Value Bounds

Significance	I0 Bound	I1 Bound
10%	2.08	3
5%	2.39	3.38
2.5%	2.7	3.73
1%	3.06	4.15

Appendix 2: ARDL Cointegrating and Long Run Form

ARDL Cointegrating And Long Run Form
Dependent Variable: GF
Selected Model: ARDL(2, 2, 2, 1, 2, 2)
Date: 08/21/24 Time: 17:13
Sample: 1998 2021
Included observations: 22

Cointegrating Form

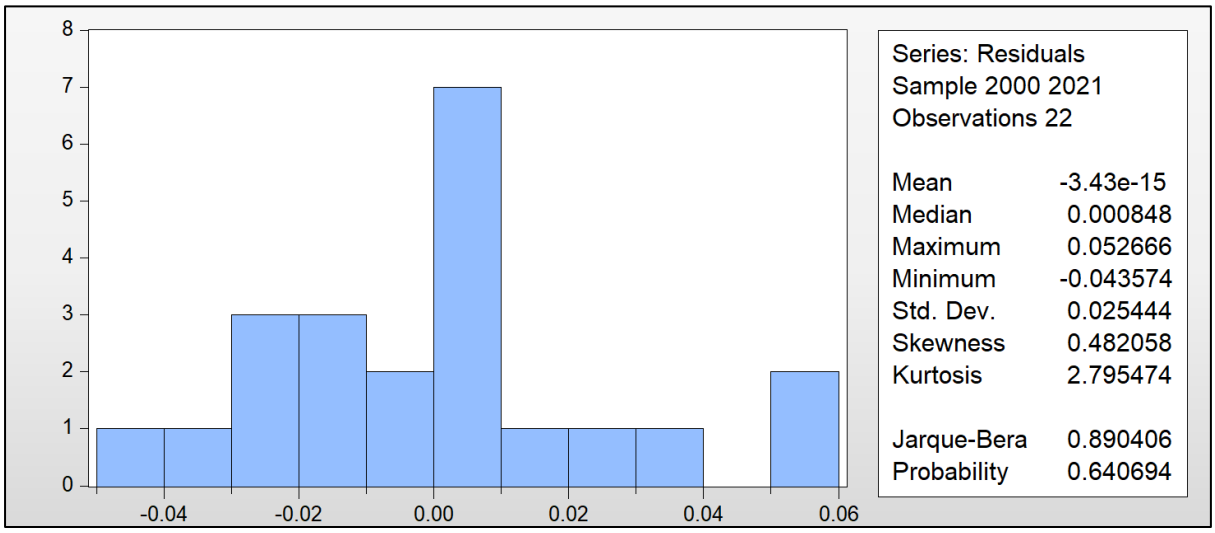
Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(GF(-1))	-0.299582	0.049969	-5.995390	0.0019
D(FID)	0.634884	0.513863	1.235512	0.2715
D(FID(-1))	-5.312551	0.637812	-8.329339	0.0004
D(R_D)	0.000547	0.000118	4.634102	0.0057
D(R_D(-1))	-0.001475	0.000127	-11.593592	0.0001
D(LOGIND)	0.242070	0.041596	5.819530	0.0021
D(ECO)	0.000028	0.000006	4.447025	0.0067
D(ECO(-1))	-0.000084	0.000014	-6.026040	0.0018
D(TEC)	-0.000011	0.000002	-6.548454	0.0012
D(TEC(-1))	0.000011	0.000002	4.986607	0.0042
CointEq(-1)	-0.744860	0.037955	-19.624864	0.0000

Cointeq = GF - (12.0080*FID + 0.0026*R_D + 0.5404*LOGIND + 0.0002 *ECO -0.0000*TEC + 0.4777)

Appendix 3: Long Run Coefficients

Long Run Coefficients				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
FID	12.008029	2.149559	5.586275	0.0025
R_D	0.002623	0.000250	10.481410	0.0001
LOGIND	0.540418	0.146102	3.698902	0.0140
ECO	0.000243	0.000013	18.523354	0.0000
TEC	-0.000019	0.000002	-12.445582	0.0001
C	0.477702	1.259432	0.379299	0.7200

Appendix 4: Histogram – Normality Test



Appendix 5: Breusch-Godfrey Serial Correlation LM Test

Breusch-Godfrey Serial Correlation LM Test:			
F-statistic	1.170517	Prob. F(1,4)	0.3402
Obs*R-squared	4.980424	Prob. Chi-Square(1)	0.0256

Appendix 6: Heteroskedasticity Test: ARCH

Heteroskedasticity Test: ARCH

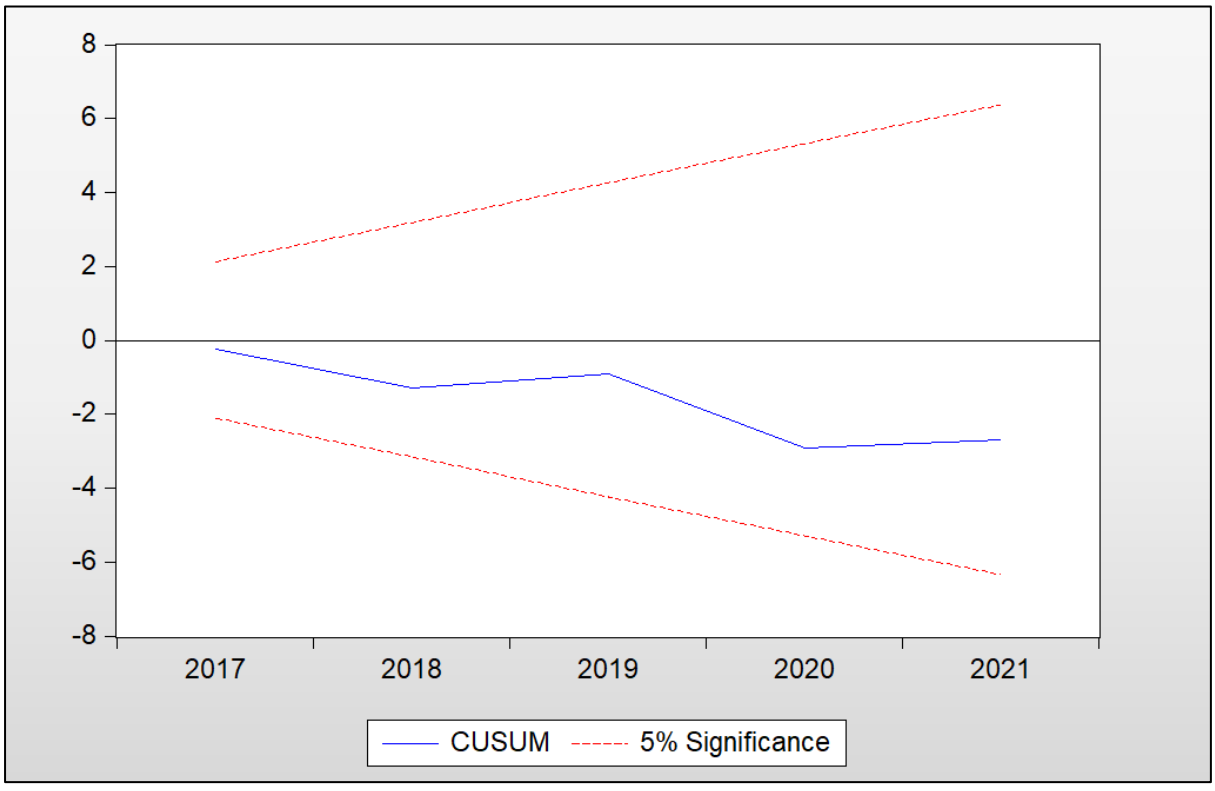
F-statistic	0.363104	Prob. F(1,19)	0.5539
Obs*R-squared	0.393799	Prob. Chi-Square(1)	0.5303

Test Equation:
Dependent Variable: RESID^2
Method: Least Squares
Date: 09/04/24 Time: 15:51
Sample (adjusted): 2001 2021
Included observations: 21 after adjustments

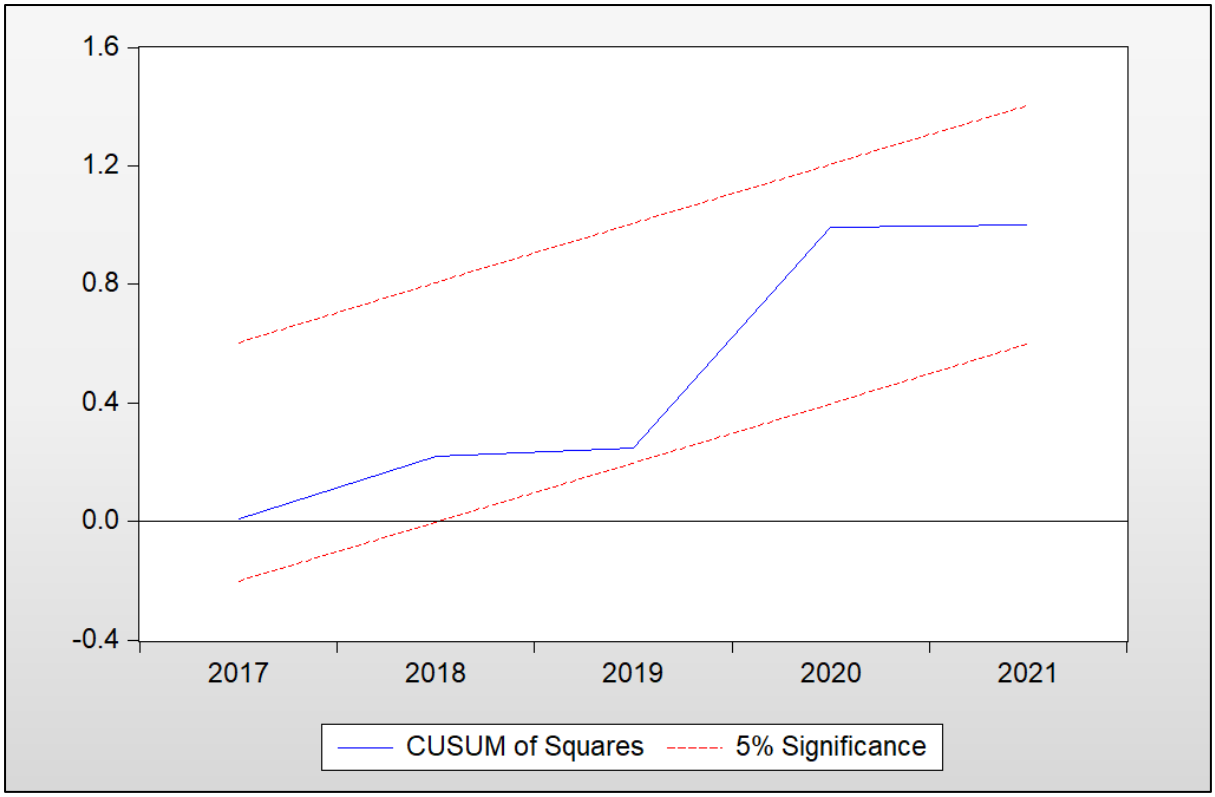
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.000548	0.000242	2.263971	0.0355
RESID^2(-1)	0.137967	0.228960	0.602581	0.5539

R-squared	0.018752	Mean dependent var	0.000637
Adjusted R-squared	-0.032892	S.D. dependent var	0.000863
S.E. of regression	0.000877	Akaike info criterion	-11.14873
Sum squared resid	1.46E-05	Schwarz criterion	-11.04925
Log likelihood	119.0617	Hannan-Quinn criter.	-11.12714
F-statistic	0.363104	Durbin-Watson stat	1.549474
Prob(F-statistic)	0.553912		

Appendix 7: CUSUM Test



Appendix 8: CUSUM of Squares Test



Appendix 9: Fully Modified Least Square (FMOLS)

Dependent Variable: GF
Method: Fully Modified Least Squares (FMOLS)
Date: 08/21/24 Time: 18:22
Sample (adjusted): 1999 2021
Included observations: 23 after adjustments
Cointegrating equation deterministics: C
Long-run covariance estimate (Bartlett kernel, Andrews bandwidth = 255.7357)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
FID	9.398300	0.202075	46.50896	0.0000
R_D	0.002115	3.89E-05	54.38323	0.0000
LOGIND	0.108305	0.018981	5.706007	0.0000
ECO	0.000200	9.77E-07	204.3884	0.0000
TEC	-1.65E-05	1.41E-07	-117.2878	0.0000
C	-1.511587	0.133424	-11.32917	0.0000

R-squared	0.997332	Mean dependent var	4.948320
Adjusted R-squared	0.996548	S.D. dependent var	3.869984
S.E. of regression	0.227380	Sum squared resid	0.878928
Long-run variance	0.000419		

Appendix 10: Dynamic Least Square (DOLS)

Dependent Variable: GF
Method: Dynamic Least Squares (DOLS)
Date: 08/21/24 Time: 18:24
Sample (adjusted): 2000 2021
Included observations: 22 after adjustments
Cointegrating equation deterministics: C
Fixed leads and lags specification (lead=0, lag=1)
Long-run variance estimate (Bartlett kernel, Newey-West fixed bandwidth = 3.0000)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
FID	12.04151	2.108808	5.710102	0.0012
R_D	0.002584	0.000232	11.14710	0.0000
LOGIND	0.320434	0.152031	2.107692	0.0796
ECO	0.000223	1.19E-05	18.70055	0.0000
TEC	-1.77E-05	1.06E-06	-16.62800	0.0000
C	-0.942711	1.556603	-0.605621	0.5670

R-squared	0.999900	Mean dependent var	5.132880
Adjusted R-squared	0.999650	S.D. dependent var	3.856062
S.E. of regression	0.072170	Sum squared resid	0.031251
Long-run variance	0.002838		