ISSN 2616-5783 Vol.7, Issue 8: 97-103, DOI: 10.25236/AJHSS.2024.070816

A Heterogeneous Study on the Impact of Green Finance on Economic Growth: An Empirical Analysis Based on Provincial Panel Data

Yang Xiaojin[1,a,*], Xue Ziyi[1,b]

[1]*Guangzhou City University of Technology, Guangzhou, China*
[a]*yangxj@gcu.edu.cn,* [b]*1939563529@qq.com*
[*]*Corresponding author*

Abstract: *Under the background of the new development concept and the "dual carbon" goals, China has also put forward new requirements for economic growth. Green finance is committed to optimizing the ecological environment and actively supporting the vigorous development of green industries. Its impact on economic growth has become an important topic in the study of China's economic development. This study uses provincial panel data and fixed-effect models to explore the relationship between green finance and economic growth. It also explores whether the impact of green finance on economic growth will produce differences in different regions. Through data analysis and model construction, this study finds that there is a positive correlation between green finance and economic growth, and the impact of green finance on economic growth varies by region. Among them, the impact on the eastern region is significantly positive, while the impact on the central and western regions is weaker than that of the eastern region. Finally, based on theoretical analysis and empirical regression results, this study puts forward policy suggestions for promoting economic growth through green finance.*

Keywords: *Green finance; Economic growth; Regional heterogeneity*

1. Introduction

In recent years, China has achieved significant and sustained economic growth. However, this growth has been accompanied by increasingly serious environmental pressures. The excessive exploitation of coal resources has not only exacerbated environmental problems such as air pollution and water pollution but also highlighted the limitations of the previous extensive economic development model. Clearly, this development model can no longer meet China's current and future economic development needs. In the report of the 19th National Congress of the Communist Party of China, the Party Central Committee clearly proposed to build a green circular development system that meets the development requirements of the new era, so as to achieve sustainable economic growth. Green finance can integrate the concept of green development into economic development, taking into account China's environmental protection and promoting economic growth at the same time. So, it has become an indispensable part of promoting high-quality economic development.

Scholars have carried out multi-dimensional analysis and research on the impact of green finance on economic growth, and it is generally believed that green finance can significantly promote economic growth. For example, Chai Jingxia (2018) analyzed the impact of green finance on macroeconomic growth from the perspectives of consumption and investment, proving that green finance promotes economic growth by influencing investment and consumption [1]. Wen Shuyang et al. (2022) constructed a model with green innovation as an intermediary variable, and proved through empirical testing that green finance promotes the economy through green innovation [2]. Sun Miaolin et al. (2019) analyzed the impact of green finance on economic growth by constructing a provincial data vector autoregressive model and concluded that green finance has a significant positive effect on economic growth [3]. Wei Hua et al. (2023) used China's provincial panel data from 2004 to 2015 to construct a dynamic panel simultaneous equation model and analyzed that green finance has a significant pulling effect on economic growth [4]. Sreenu Nenavath et al. (2023) conducted an empirical regression analysis based on data from various regions of India and confirmed that green finance and financial technology have an impact on India's economy and can contribute to high-quality economic growth [5]. However, since green finance is the product of green economy, low-carbon economy, and financial

ISSN 2616-5783 Vol.7, Issue 8: 97-103, DOI: 10.25236/AJHSS.2024.070816

industry development, it is still a relatively new field, and there is not much research by scholars. Moreover, the focus of scholars' research is on the relationship between green finance and economic growth or economic development. As for the research on whether green finance has different impacts on economic growth in different regions, most scholars only touch on it briefly and do not systematically analyze it. Due to the different development strategies and processes in various regions of China, the economic growth in different areas has led to distinct ecological consequences, and regional economic development presents typical unbalanced characteristics. As an indispensable part of promoting economic growth, green finance has important research significance to study whether green finance has heterogeneous effects on economic growth in different regions and the reasons for this.

Therefore, this article aims to explore the relationship between green finance and economic growth, and focuses on analyzing the heterogeneity of this impact in different regions. On this basis, it further explores the deep-seated reasons for the heterogeneity, providing useful references for formulating green finance policies in different regions, and helping them effectively promote economic growth through green finance means, thereby narrowing the gap in regional economic development.

2. Impact Path Analysis

1) Green finance promotes economic growth by driving optimization of the industrial structure

Green finance is an important part of the development of the modern financial industry. Its core lies in using financial instruments and innovative services to guide enterprises to invest funds in low-carbon and environmentally friendly industries and projects, thereby promoting the optimization of the industrial structure. Green finance offers preferential financing conditions to provide diverse financing channels for enterprises interested in developing green industries, thereby channeling funds towards environmental protection and sustainability sectors, and fostering the growth of emerging industries such as clean energy and green agriculture. Not only can this optimize the industrial structure to better align with the intrinsic requirements of sustainable development, but it also injects new vitality into economic growth, thereby driving rapid economic expansion.

2) Green finance drives economic growth by enhancing technological innovation

Green finance can provide enterprises with financial support and stimulate their R&D investment efforts. By offering financial support for the research and innovation of environmental protection technology, green finance plays a key role in accelerating technological progress and enhancing production efficiency. This mechanism not only contributes to current economic growth but also lays a solid technical foundation for future sustainable development, and provides strong support for the long-term development of the economy and society.

3) Green finance drives economic growth through green investment and green consumption

On one hand, green finance can encourage enterprises to increase their investment in environmental protection projects and guide more capital into the green industry by offering low-interest green loans, tax incentives, and other means. On the other hand, as consumers become increasingly concerned about environmental issues, green finance promotes the formation and development of the green consumption market by directing funds towards eco-friendly products and services. These actions not only help to drive economic growth but also make positive contributions to environmental protection, achieving a win-win situation for both economic and environmental benefits.

3. Variable Selection and Model Construction

3.1. Variable Selection

1) Dependent Variable

This paper takes 2012 as the base year and calculates the real GDP using the nominal GDP* (last year's GDP index / 100), and uses it as the explanatory variable in this paper.

2) Explanatory Variable

The green finance development index is the explanatory variable of the study model. At present, many scholars have measured green finance through the construction of the green finance index. This article refers to the construction of the green finance index in "The Measurement of the Level of

ISSN 2616-5783 Vol.7, Issue 8: 97-103, DOI: 10.25236/AJHSS.2024.070816

Economic System Construction of Green Circular Low-carbon Economy in China" for analysis [6], and selects 7 related indicators as secondary indicators and their corresponding tertiary indicators, as shown in Table 1, and uses the entropy method to calculate the green finance development index.

Table 1: Green Finance Development Level Indicator System.

First-level indicator	Secondary indicator	Measurement method
Green credit	Proportion of environmental protection project credit	Total environmental protection project credit in the province / total credit in the province
Green investment	Proportion of environmental pollution control investment in GDP	Environmental pollution control investment / GDP
Green insurance	Promotion degree of environmental pollution liability insurance	Environmental pollution liability insurance income / total premium income
Green bond	Development degree of green bond	Total green bond issuance / total bond issuance
Green support	Proportion of fiscal environmental protection expenditure	Fiscal environmental protection expenditure / general budget expenditure
Green fund	Proportion of green fund	Total market value of green fund / total market value of all funds
Green equity	Depth of green equity development	Carbon trading, energy rights trading, emission trading / equity market trading total

3) Control Variables

In order to more accurately assess the impact of green finance on economic growth and reduce omitted variable bias, this article selects the following variables as control variables, as shown in Table 2:

Table 2: Control Variables.

Variable name	Variable symbol	Variable meaning
Government fiscal expenditure scale	gov	Proportion of provincial general budget expenditure to GDP * 100
Urbanization level	urban	Proportion of urban population to permanent population at the end of the year * 100
Employment level	une	Provincial registered urban unemployment rate * 100

The data of the variables selected in this article come from multiple authoritative institutions and official statistical materials, including the official websites of the National Bureau of Statistics of China, the Ministry of Science and Technology of China, the People's Bank of China, etc., as well as professional yearbooks such as the "China Science and Technology Statistical Yearbook" and the "China Financial Yearbook".

3.2. Model Construction

This article selects the multiple regression model to analyze the impact of green finance on economic growth. However, considering that time and region will affect the construction of the model, this article chooses to construct a double fixed effect model with fixed time and individuals on the basis of the original model. The model construction is as follows:

$$rgdp_{it} = \beta_0 + \beta_1 gfid_{it} + \beta_2 gov_{it} + \beta_3 urban_{it} + \beta_4 une_{it} + \mu_{it} + year_{it} + \varepsilon_{it} \quad (1)$$

Among them, rgdp is the actual GDP of each province, gfid is the green finance development index, gov is the scale of government fiscal expenditure, urban is the level of urbanization, and une is the level of employment; β_1-β_4 are the coefficients of the green finance development index, the scale of government fiscal expenditure, the level of urbanization, and the level of employment, respectively; μ is the individual fixed effect, year is the time fixed effect, and εis the random disturbance term.

4. Correlation Analysis and Collinearity Test

If there is multicollinearity among the variables in the model, it will affect the research results.

ISSN 2616-5783 Vol.7, Issue 8: 97-103, DOI: 10.25236/AJHSS.2024.070816

Therefore, it is necessary to analyze the correlation between variables before conducting regression analysis. The output results are shown in Table 3. As can be seen from the results, the variables selected in this study have weak correlation.

Table 3: Correlation Analysis Results.

	rgdp	gfid	gov	une	urban
rgdp	1	--	--	--	--
gfid	0.1572	1	--	--	--
gov	-0.5279	0.0510	1	--	--
une	-0.1417	-0.1408	0.1328	1	--
urban	0.3569	0.2460	-0.5032	-0.0643	1

In order to avoid multicollinearity between variables, this study calculated the variance inflation factor (VIF) of each variable, as shown in Table 4. It can be found that the VIF values of the variables used in the study are all small, so the research model does not have multicollinearity, and the reliability of the regression results is strong.

Table 4: Variance Inflation Factor (VIF).

Variables	VIF	1/VIF
urban	1.51	0.66
gov	1.44	0.69
gfid	1.12	0.89
une	1.05	0.95
Mean VI	1.28	

5. Unit Root Test

To avoid spurious regression and ensure the reliability of the empirical analysis, a unit root test was conducted using the LLC method. The results (Table 5) indicate that all variables in the model are stationary and do not exhibit seasonal effects, validating the stability of the data and the reliability of subsequent regression results.

Table 5: Unit Root Test Results.

Variables	LLC test
rgdp	0.0000
gfid	0.0000
gov	0.0032
urban	0.0000
une	0.0243

6. Regression Result Analysis

Whether the study should adopt a fixed effects model or a random effects model depends on the results of the Hausman test, as shown in Table 6. From the test results, the p-value is very small, indicating that this study should choose the fixed effects model.

Table 6: Hausman Test Results.

	Coef.
Chi-square test value	20.84
P-value	0.0003

This study uses a fixed effects model that simultaneously fixes both the province and time variables to conduct regression analysis on the variables selected for the research. The fixed effects model is able to control for these two potential variables, province and time, reducing their interference with the research results and making the model outcomes more accurate and reliable.

The regression results are shown in Table 7:

Based on the empirical results obtained from the fixed effects model, at a significance level of 1%, for every one-unit increase in green finance investment, there is a corresponding increase in economic growth of 4,164.6442 billion yuan. This further confirms that green finance does indeed have a positive

ISSN 2616-5783 Vol.7, Issue 8: 97-103, DOI: 10.25236/AJHSS.2024.070816

effect on China's economic growth. In other words, as China's level of green finance continues to improve, its pulling effect on economic growth becomes stronger. This also indicates that green finance plays an active role in promoting economic growth.

Table 7: Regression Results.

Variables	rgdp
gfid	41,646.442***
	(3.80)
gov	232.995*
	(1.94)
une	-456.901**
	(-0.45)
urban	52,303.517**
	(2.56)
Observations	310
Number of id new	31
R-squared	0.571
id FE	YES
year FE	YES
F text	1.33e-06
r2_a	0.566

Note: ***, **, and * denote significance levels of 0.01, 0.05, and 0.1, respectively.

In the analysis of control variables, there is a positive correlation between the scale of government fiscal expenditure and economic growth. From the regression results, for every one-unit increase in the scale of government expenditure, there is a corresponding increase in domestic economic growth of 23.2995 billion yuan, highlighting the government's crucial role in boosting economic growth through green finance. Therefore, the government should guide the market to focus on the development of green finance. At the same time, the government can also increase its investment in green finance to provide a solid guarantee for economic growth.

The regression results show that the coefficient for the employment level is negative and statistically significant at the 5% level, which clearly indicates that an increase in the unemployment rate has a negative impact on the quality of economic development. Employment, as the foundation of people's livelihood, is crucial for improving the people's standard of living and promoting economic development. Therefore, we should actively seek effective measures to increase the employment rate and further enhance people's standard of living by improving employment conditions, thereby laying a solid foundation for sustained and healthy economic development.

At the 5% significance level, for every one-unit increase in the urbanization rate, economic growth increases by 5,230.3517 billion yuan, indicating that the continuous improvement of the urbanization rate can promote economic growth. On one hand, as the scale of cities continues to expand, infrastructure is continuously improved, providing strong support for economic development. On the other hand, the process of urbanization brings about the concentration of the labor force, promotes the development of the labor market and industrial upgrading, leading to an increase in labor productivity. This, in turn, boosts the level of urban employment and drives the economic growth of cities.

In summary, the scale of government expenditure, employment level, and urbanization rate are all important factors affecting economic growth. In the process of economic transformation, the government needs to play a guiding role, optimize the industrial structure, and improve the employment level to achieve high-level economic growth.

7. Regression Result Analysis

There are many methods to test the robustness of a model, and this paper selects the method of regressing after excluding control variables one by one. The results are shown in Table 8. Models (1) to (3) are the regression results after excluding the control variables of urbanization rate (urban), employment level (une), and government fiscal expenditure (gov) respectively. By comparing the regression results of the three models, we can observe the impact of excluding different control variables on the regression results, and then evaluate the stability and reliability of the model.

In the regression results after excluding control variables one by one, we can observe that the

ISSN 2616-5783 Vol.7, Issue 8: 97-103, DOI: 10.25236/AJHSS.2024.070816

coefficient value of green finance (gfdi) has changed, but it remains positive, which is consistent with the previous regression results and further verifies the positive driving effect of green finance (gfdi) on economic growth. Therefore, we have sufficient reason to believe that the model has passed the robustness test, and its conclusions are highly reliable and valid.

Table 8: Regression Results after Excluding Variables.

Variables	(1)	(2)	(3)
gfid	67,455.322***	41,746.105***	41,889.643***
	(7.01)	(3.82)	(3.72)
gov	191.248*	235.418*	--
	(1.77)	(2.03)	--
une	-843.263*	--	-549.455*
	(-0.96)	--	(-0.53)
urban	--	53,295.763**	48,207.255**
	--	(2.64)	(2.31)
id year	YES	YES	YES
observations	310	310	310
F-test	4.23e-07	4.57e-07	1.23e-06
F	19.02	18.86	16.99

Note: ***, **, and * denote significance levels of 0.01, 0.05, and 0.1, respectively.

In conclusion, we can assert that the model is not only stable and reliable but also the conclusion regarding the positive impact of green finance on economic growth is robust.

8. Heterogeneity Analysis

In the process of economic growth, there are certain differences among provinces in terms of economic strength and investment in the development of green finance. Even if the same financial development policies are implemented, differences arise due to varying times and effectiveness of advancement in different regions. This means that the impact of green finance on economic growth will exhibit some heterogeneity. To explore this issue more comprehensively, this paper divides the 31 provinces into three different regions. This classification takes into account not only geographical factors but also the economic development characteristics of each region, which helps to more accurately reveal the mechanism of green finance in different areas. The specific grouping and regression analysis results are detailed in Tables 9 and 10.

Table 9: Sample Classification

Region	Provinces
Eastern Region (11)	Guangdong, Beijing, Hebei, Shanghai, Zhejiang, Liaoning, Fujian, Tianjin, Jiangsu, Hainan
Central Region (8)	Shanxi, Jilin, Heilongjiang, Henan, Hubei, Hunan, Anhui, Jiangxi
Western Region (12)	Inner Mongolia, Guangxi, Ningxia, Xinjiang, Tibet, Chongqing, Gansu, Sichuan, Qinghai

Table 10: Regional Regression Results

Variables	Eastern Region	Central Region	Western Region
gfid	93618.91	83935.25	75474.56
gov	-2940.937	-1484.369	-335.9981
une	-7919.552	1502.21	4276.279
urban	-13373.74	-15188.37	-63899.68
id year	YES	YES	YES
Observations	110	80	120
R-squared	0.6085	0.7630	0.5448

From the table, we can clearly observe that when the 31 provinces are divided into three regions, there are differences in the impact of green finance on economic growth among the three regions, and these differences are significant.

In the eastern region, the coefficient value of the financial development index reaches as high as 93618.91, which highlights the strong driving force of green finance development on economic growth

ISSN 2616-5783 Vol.7, Issue 8: 97-103, DOI: 10.25236/AJHSS.2024.070816

in this region. The eastern region is economically developed, with a mature financial market and high efficiency in the allocation of financial resources, providing fertile ground for the development of green finance and enabling it to fully play its role in promoting economic growth.

The coefficient value of the financial development index in the central region is 83935.25, which is slightly lower than that of the eastern region but still demonstrates a positive effect. The central region is experiencing a strong economic growth momentum and is at a critical stage of catching up with the eastern region. The continuous improvement of the financial market and the gradual accumulation of financial resources have injected strong momentum into the economic growth of the central region.

The coefficient value of the financial development index in the western region is 75474.56, which is positive but lower than that of the eastern and central regions. This reflects the current situation of relatively lagging economic development and an immature financial market in the western region to some extent. However, with the continuous improvement of the financial market and the increasing attention and support from the state for the development of the western region, the potential of green finance in the western region will be gradually realized, and its role in promoting economic growth will become increasingly evident.

9. Conclusion

Based on the analysis of the impact path of green finance on economic growth, this paper constructs a fixed-effects model using data and conducts regression analysis from both a national and a regional perspective. The empirical research results show that:

(1) At the national level, green finance has a significant positive impact on economic growth. It has become one of the driving forces for promoting high-level economic growth in our country. Therefore, we should further unleash the vitality of green finance by optimizing the allocation of financial resources, innovating financial products and services, and enabling it to play a greater role in promoting economic growth.

(2) From a regional perspective, the positive impact of green finance on economic growth in the eastern and western regions is more pronounced. This indicates that the economic structure, industrial characteristics, and policy environment in the eastern and western regions are more conducive to promoting the development of green finance; while the central region has a large proportion of traditional industries, which, to some extent, restricts the development of green finance.

In response to the opportunities and challenges faced by different regions in the development of green finance, the government, when formulating green finance development strategies in the future, needs to conduct a more in-depth analysis of the actual situation in each region and mobilize local advantages to compensate for the shortcomings caused by disadvantages, in order to achieve a positive interaction between green finance and economic development. Moreover, the government can also strengthen policy coordination and cooperation to form a joint force and jointly promote the development of the green economy.

References

[1] Chai Jingxia. Analysis of the Mechanism and Path of Green Finance Impact on Macroeconomic Growth [J]. Ecological Economy, 2018, 34(09): 56-60.
[2] Wen Shuyang, Liu Hao, Wang Hui. Green Finance, Green Innovation and High-Quality Economic Development [J]. Financial Research, 2022, (08): 1-17.
[3] Sun Yelin, Chen Qingqing. Impact of Green Finance Development on Technological Progress and Economic Growth - An Empirical Study Based on PVAR Model [J]. Finance and Economics, 2019, (05): 28-33.
[4] Wei Hua, Li Yihe. Research on the Relationship between Green Finance and Environmental Quality from the Perspective of Green Finance [J]. Shandong Social Sciences, 2023, (03): 131-140.
[5] Nenavath S, Mishra S. Impact of green finance and fintech on sustainable economic growth: Empirical evidence from India [J]. Heliyon, 2023, 9(5).
[6] Zhang Youguo, Dou Ruoyu, Bai Yujie. Measurement of the Level of Economic System Construction of Green Circular Low-carbon Economy in China [J]. Quantitative Technological and Economic Research, 2020, 37 (08): 83-102.