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Does Green Finance Expand China's Green Development Space? Evidence from the Ecological Environment Improvement Perspective

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Abstract: It is important to explore the intrinsic mechanism of green finance's role in widening the green development space for China, in order to optimize the structure of green financial development and accelerate the construction of a modernized economic system. Taking ecological environment improvement as a new research perspective, this paper presents the impacts and mechanisms of green finance on the green development space of the economy and society through the fixed-effect model and moderating-effect model, based on panel data from 30 provinces and municipalities in China from 2011 to 2020. The findings show that green finance development in China significantly expands the green development space of the economy and society, and this conclusion did not change after robustness tests such as replacing the main variables, adjusting the study interval, and considering endogeneity. In terms of its mechanism of action, ecological environment improvement plays an important mediating and regulating role in the process of green finance, essentially magnifying the green development space of the economy and society. In terms of a heterogeneity analysis, the effect of green finance on the expansion of the green development space is the largest in the eastern region, followed by the northeastern region, and the smallest in the central and western regions. In addition, the positive effect of green finance is relatively larger in regions with a higher urbanization level, government fiscal expenditure level, foreign investment level, and advanced industrial structure. The main contribution of this paper is to the field of green development, revealing the important role of the ecological benefits of green finance, which can help to achieve high-quality sustainable development in the economy and society.

Keywords: green finance; green development space; ecological environment; comprehensive index system; heterogeneity study

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1. Introduction

Following the implemnation of its reform and opening-up policy, China's economic development has maintained high growth rates for a long time, creating a "growth miracle" throughout the history of global economic development [1]. At the same time, the collateral products of the extensive economic development model of high input and high output have also brought about serious obstacles to the sustainable and healthy advancement of China's economy, especially with excessive investments in highly polluting industries. Such particular investments have led to a waste of resources and environmental pollution that can form overcapacity and ecological damage. In this context, the Chinese government has begun to pay attention to environmental issues and target the dual goal of balancing ecological environmental protection and sustainable economic development by transforming the mode of economic growth, in order to promote a high-quality economy and society [2]. In

2017, China's economy left the stage of high-speed growth and entered the stage of high-quality development, placing even higher requirements upon its economic expansion [3]. Therefore, how to steadily and rapidly improve the quality of this economic development and promote its green transformation have become topics of continuous concern for many scholars.

Financial development is a key factor in improving the efficiency of economic and social resource allocation and is also a major driver of economic growth. With the change in its economic development mode, China's financial development also ushers in other new changes. For example, the "greening" of this financial development has become a major trend, and green finance, as an environmental economic policy, has become a new engine for promoting the green development of its economy and society [4]. Green finance refers to economic activities that support environmental improvement, climate change, and the efficient use of resources. Providing financial services to energy conservation and environmental protection, clean energy, green buildings, and other fields helps to promote ecological environmental protection and restoration, guide the green transformation of high-pollution and high-energy-consumption industries, and achieve the development goals of a high-quality adjustment of the economic structure and harmonious co-existence between human beings and nature [5]. The green development concept of green finance coincides with the ecological civilization concept of high-quality economic development, and so vigorously promoting green financial development has important roles in widening the green development space of the economy and society and enhancing the level of high-quality economic development.

Green finance as the core driving force for promoting the optimization and adjustment of economic and social development is now the consensus in academic circles; however, the current research on the topic tends to focus on the economic benefits it generates [6]. Some scholars have also explored the importance of developing green finance from the perspective of energy efficiency and energy consumption [7–9], but have not given the same degree of attention and focus to the ecological benefits of green finance [10,11]. Given that there are few studies on the impact of green finance on the green development space, this paper aims to fill this gap in the literature. Accordingly, it takes ecological environment improvement as a new research perspective to explore the impact of green finance on the green development space of economy and society through its own ecological benefits.

China is a typical representation of a developing country. Exploring the influence of green finance in China on its economic and social green transformation development and green development space will thus assist other developing countries in learning from its experiences and avoiding the repeated development route of pollution first and then treatment. This study is of great significance for better realizing the green sustainable development of China and other similar countries.

The research process ran as follows. First, we measured the green development space, green financial development level, and ecological environment of 30 provinces and municipalities in China from 2011 to 2020 (Tibet, Hong Kong, Macao, and Taiwan are not included, due to serious data deficiencies). Second, the study used the fixed-effect model, intermediary-effect model, and moderating-effect model to explore the effect and mechanism of green finance on the green development space. Third, we analyzed the effects of green finance on the green development space based on the differential models and conducted a heterogeneity analysis to explore such effects. Finally, the study applied various robustness tests, such as replacing the variables, adjusting the research interval, and using instrumental variables to ensure the reliability of its findings.

The main contributions of this paper are in three aspects. First, unlike studies that have only explored the ecological benefits or economic benefits of green finance alone, this paper presents the ecological benefits of green finance, takes the improvement of ecological environment as a channel for green finance to influence the green development space of economy and society, and argues for the transformation of the ecological benefits of green finance as drivers of quality economic development. Second, this study integrates

green finance, the ecological environment, and the green development space into the same framework. Third, it incorporates green finance, the ecological environment, and the green development space into the same framework for analysis, and unlike the two-on-two relationship test that is customary in the literature, this paper not only explores the influence of green finance on the green development space through improving the ecological environment with the mediating effect model, but also examines the strengthening effect of ecological environment improvement on green finance's impact with the moderating effect model. The research process is more in line with objective reality. Fourth, after a series of heterogeneity analyses and robustness tests, the findings herein better explain the reasons for the differences in the effects of green finance development on the green development space in different regions of China and fundamentally prove the importance of the eco-efficiency of green finance for achieving the high-quality development of the economy and society.

The rest of this paper is organized as follows. Section 2 is a literature review that compares the research history and latest research results of scholars. Section 3 presents the data and model section, introduces the variables of this paper, and constructs the empirical model for subsequent use. Section 4 is a presentation and analysis of the model regression results that deeply explores the effects and mechanisms of green finance on the green development space. Section 5 offers a conclusion and recommendations.

2. Literature Review

The related literature on green finance by domestic and foreign scholars is relatively abundant and mainly divided into two parts. The first relates to the ecological benefits of green finance. The other strand concerns the economic benefits of green finance.

The concept of green finance was first formally put forward by White (1996), and it was then discussed by other scholars [12]. Li et al. (2020) analyzed the practical attempts at developing green finance in China, Japan, the United Kingdom, and the European Union [13]. In terms of the ecological benefits of green finance, Wang et al. (2019) believed that green finance development can reallocate financial resources, restrain investment in energy-intensive industries, and promote investment in technology-intensive industries [14]. Dong et al. (2019) brought financial factors into the theoretical framework of sustainable development and demonstrated the credit discrimination and ecological environment pollution nexus [15]. Dziwok and Jger (2021) distinguished the green financial forms of neoliberalism, reformism, and progressivism [16]. Some scholars have noted that green finance is a financial model for solving environmental problems, and the development of green finance promotes the sustainability of the ecological environment (Ozili, 2021; Cai and Guo, 2021) [17,18].

Huang et al. (2021) found through empirical research that the establishment of a green financial reform pilot zone reduces environmental pollution [19]. Tma et al. (2021) came to a similar conclusion that China's green financial policy significantly reduces industrial gas emissions [20]. However, Zhou and Xu (2022) found a U-shaped relationship between green finance and ecological environment through empirical research [21]. In addition, Wang et al. (2021) combed 815 global papers on green finance and energy policy in the Web of Science database and put forward that reducing carbon dioxide emissions should be the focus of future research [22]. This conclusion was verified by scholars and the research proved the correlation between green finance and carbon emissions (Sun and Cheng, 2021) [23], demonstrating the carbon emission reduction effect of green finance (Zhang et al., 2021; Che et al., 2021; Chen and Chen, 2021; Wang et al., 2021) [24–27]. Alharbi et al. (2023) evaluated the promotion of green finance for renewable energy based on 44 countries around the world [28]. Lorente et al. (2023) took the conflict between Russia and Ukraine as a geopolitical risk and discussed the correlation index between green finance and renewable energy [29].

In terms of the economic benefits of green finance, early discussions on the economic benefits of green finance mainly focused on the influence of financial institutions

on sustainable economic development (Jeucken and Bouma, 1999) [30]. Subsequently, Markandya et al. (2015) discussed the dual benefits of the Green Climate Fund for economic growth and low-carbon goals in developing and developed countries [31]. Ruiz et al. (2016) analyzed the financing support of green finance for Colombia's water infrastructure [32]. Zhang et al. (2021) demonstrated the economic benefits of green finance development in the Belt and Road Initiative countries such as Israel, Kuwait, Egypt, Oman, Qatar, and Iran [33]. Kong et al. (2021) and Arif et al. (2022) pointed out that green finance, as a combination of "finance" and the "environment", had an important positive impact on economic improvement and urban green development after the COVID-19 epidemic [34,35]. Wang et al. (2021) found that the establishment of a green development and innovation pilot zone can promote regional green development through industrial structure upgrading and technological innovation [36]. Jiang et al. (2020) showed that green finance promotes the sustainable development of an economy and also reduces poverty [37].

Tu et al. (2021) stated that the implementation of green financial instruments can offset the adverse impact of the COVID-19 epidemic on renewable energy [38]. Liu et al. (2021) also found that green finance significantly promotes high-quality economic development and that environmental regulation has a non-linear regulatory role in this [39]. Yin and Xu (2022) presented a significant synergy between green finance and economic growth [40]. Ccl and Cclb (2022) pointed out that green finance development significantly improves the level of green productivity [41]. Hunjra et al. (2023) found that green finance promotes the sustainable development of developing countries [42]. Xu et al. (2023) took 29 countries with green financing markets as research objects and discussed the positive role of green finance in the green economy [43]. Other scholars have also discussed the optimization of industrial structures by green finance (Wang and Wang, 2021; Gu et al., 2021; Gao et al., 2022) [44–46].

The comprehensive literature shows how scholars have richly explored the ecological benefits and economic effects of green finance through various methods, but there are still the following shortcomings. First, few scholars have included the improvement effect of green finance on the ecological environment and the greening development efficacy of the economy and society into the same framework for research and analysis. Second, scholars' research methods and ideas are relatively single and mainly performed with a model to verify the ecological and economic benefits of green finance, while ignoring the interactions between green finance and the ecological environment. Based on this, this paper expands the analysis of the existing research in order to fill the above research gaps.

3. Data and Models

3.1. Data and Variable Selection

This paper focuses on the role of green financial development in the green development space of economy and society through the perspective of ecological environment improvement. Thus, the green development space is the explanatory variable herein, and the levels of green financial development and ecological environment are the core explanatory variables.

Considering the scientificity and availability of the relevant data in the process of selecting the proxy indicators, the green development space of the economy and society is measured by green total factor productivity (GTFP). The green financial development level (GF) and ecological environment (ST) are comprehensive indicators, which are calculated by constructing an index system and using an entropy weighting method.

There are many factors that can influence the economy and society to achieve green development during the process of economic and social development. In addition to green finance and the ecological environment, this study selects control variables from the following four aspects: population size (PS), expressed as the year-end resident population in each province and urban area; R&D expenditure (RF), which is the expenditure on research and experimental development; fixed asset investment (FA), which is used to

explore the impact of capital factor accumulation on economic development; and the degree of openness to the outside world (OD), or the ratio of total import and export trade to GDP.

The research objects of this paper are 30 provinces and cities in China (excluding Tibet, Hong Kong, Macao, and Taiwan). According to the data availability, the research interval is set as 2011–2020. The relevant data of the variables in this paper come from the China Statistical Yearbook, China Industrial Statistical Yearbook, China Energy Statistical Yearbook, China Environmental Statistical Yearbook, and EPS data platform.

3.1.1. Measurement of Green Total Factor Productivity (GTFP)

Chung et al. (1997) [47] first introduced the concept of bad output in the process of measuring total factor productivity using a data envelopment analysis (DEA) and calculated this total factor productivity under environmental constraints based on the Malmquist-Luenberger (ML) index; i.e., the green total factor productivity (GTFP) in our study is based on the Malmquist-Luenberger (ML) index [48]. However, this measurement method has certain shortcomings. First, when using a DEA to measure productivity, the existence of radial and angular problems will probably lead to estimation bias. Second, the ML index does not satisfy the factors of additivity and transferability, and it is impossible to calculate a feasible solution during the process of solving linear programming problems. To overcome these problems, Tone (2001; 2003) proposed the SBM model based on the DEA model [49,50], while Oh (2010) improved the ML index and gave the global Malmquist-Luenberger (GML) index [51]. Therefore, drawing on the conventional practice of scholars (Zhang and Wu, 2021; Yang et al., 2022) [52,53], we construct the GML index to estimate the GTFP through the SBM approach and evaluate the production efficiency under environmental constraints in 30 provinces and municipalities in China from 2011 to 2020. It is noted that the basic assumption of constant payoffs to scale is introduced in the measurement of the GTFP.

This research assumes that the production process has a total of three inputs: labor, capital, and energy; thus, two types of outputs are obtained: desired output and non-desired output. The labor factor is the total number of employed people at the end of the year. The capital factor is the total investment in fixed assets, where the total investment in the fixed assets of each province and urban area takes the constant prices in 2010 as the base period. The energy factor is the total energy consumption, which is calculated by converting various types of energy into a million tons of standard coal. The desired output is the constant GDP level of each province and urban area based on 2010. The non-desired output includes industrial wastewater, industrial sulfur dioxide, and industrial dust emissions. The above data are obtained from the National Bureau of Statistics of China.

3.1.2. Construction of the Indicator System for Core Explanatory Variables

Since green financial development and ecological environment are comprehensive variables, they cannot be measured by a single indicator and need to be examined considering multiple dimensions. Therefore, this study constructs a comprehensive index system of green financial development level and the ecological environment and then measures them. Table 1 presents the constructed comprehensive index system.

Table 1. Comprehensive index system of green financial development level and ecological environment.

Comprehensive Index	Dimensional Indicator	Proxy Indicator	Indicator Meaning
Green Finance Development	Green credit	Environmental protection loan amounts	Annual loan amounts to energy-saving and environmental protection enterprises
		Percentage of interest/ interest expenses in six non-polluting industries	Six non-polluting industries' interest/interest expenses for industrial enterprises above the scale
	Green securities	Market capitalization of energy-saving and environmental protection companies	Market capitalization of energy-saving and environmental protection companies on the A-share stock exchange
		Market capitalization of energy-saving and environmental protection enterprises as a percentage	Total market capitalization of A-share energy-saving and environmental protection enterprises/Total market capitalization of all A-shares
	Green investment	Environmental pollution control investment ratio	Investment in environmental pollution control/GDP
		Energy saving and environmental protection fiscal expenditure ratio	Financial expenditure on energy conservation and environmental protection/total local financial expenditures
	Green insurance	Share of agricultural insurance scale	Agricultural insurance expenditures/total insurance expenditures
		Agricultural insurance payout ratio	Agricultural insurance expenditure/income from agricultural insurance
	Carbon finance	Loan intensity of carbon emissions	Domestic and foreign currency loan balances/carbon emissions
Ecology	Resource consumption	Water consumption per capita	Total annual water consumption/year-end resident population
		Electricity consumption per capita	Total annual electricity consumption/year-end resident population
	Pollution emissions	Chemical oxygen demand emissions	Total chemical oxygen demand discharge in industrial wastewater
		Sulfur dioxide emissions	Total sulfur dioxide emissions from industrial waste gases
		Solid waste generation	Total industrial solid waste generation
	Environmental status	Urban green space area	Urban green space area in 10,000 hectares
		Urban park green space	Urban park green space in 10,000 hectares
		Green coverage of built-up areas	Green coverage area/built-up area
	Environmental governance	Daily sewage treatment capacity	Urban wastewater treatment in million cubic meters per day
		Household waste harmless treatment capacity	Daily tonnage of harmless domestic waste disposal
		Fixed asset investment completion	Completed amount of forestry system's fixed asset investment

Similar to Ferrer et al. (2021), Li et al. (2022), and Wang et al. (2021) [53–55], green finance development in China includes five parts: green credit, green securities, green investment, green insurance, and carbon finance. Therefore, this study comprehensively measures the development level of green finance in China considering these five aspects. Among them, green credit is mainly examined in terms of the loan amount of energy-saving and environmental protection enterprises and the interest share of six non-polluting industries [1]. Green investment is considered in terms of the scale and share of the market values of these energy-saving and environmental protection enterprises. Green insurance is based on agricultural insurance and measured by the ratio of the scale of agricultural insurance to the payout. Carbon finance is expressed by the loan intensity of carbon emissions. The level of green finance development thus contains five dimensions and nine proxies.

In the calculation of the ecological environment, Cheng et al. (2021) measured the ecological environment of China considering the two aspects of environmental pollution and environmental governance [56]. Xie et al. (2021) considered China's ecological environment considering three aspects: environmental pollution, the present situation, and treatment [57]. Based on scholarly research, this paper maintains that an investigation of the ecological environment should not only focus on the present situation, degree of pollution, and treatment level of the ecological environment, but also include the resource consumption in the comprehensive index system to measure the quality of the ecological environment more in-depth. Therefore, the comprehensive index of the ecological environment in this paper is investigated through four dimensions: resource consumption, pollution discharge, environmental status, and environmental governance. The current state of the ecological environment is examined in terms of urban green areas, park green areas, and the green coverage of built-up areas. Ecological environment management is measured in terms of sewage treatment capacity, domestic waste harmless treatment capacity, and forestry fixed asset investment. Such management is measured in three aspects: sewage treatment capacity, domestic waste treatment capacity, and forestry fixed assets investment. Therefore, the comprehensive index of the ecological environment has 4 dimensions and 11 proxies.

3.1.3. Determining the Weights of the Composite Indicators

There are two main methods for measuring the composite indices: subjective assignment and objective assignment. The subjective assignment method refers to experts and scholars who set artificial weights for the proxies in the composite index system according to the actual development process of the composite indices and then measure the value of these composite indices. The objective weighting method refers to calculating the weights of the proxies in the comprehensive index system through relevant statistical methods and then measuring the value of the comprehensive index. This generally includes a principal component analysis and the entropy weighting method.

Since the objective information contained in the proxy indicators is the key to reflecting the true value of the composite indicators, this study adopts the objective weighting method to measure these composite indicators. The principal component analysis method may aggravate the correlation of the indicators and lead to the problem of disorder. Thus, we adopt the entropy weighting method to measure the comprehensive indicators of the green financial development level and ecological environment. The specific process runs as follows.

The raw data are first pre-processed using polarization to normalize them and eliminate the magnitude and magnitude differences by:

$$y_j(it) = \frac{x_j(it) - \min_{1\le i\le n}\min_{1\le t\le T}(x_j(it))}{\max_{1\le i\le n}\max_{1\le t\le T}(x_j(it)) - \min_{1\le i\le n}\min_{1\le t\le T}(x_j(it))} \quad (1)$$

Here, $y_j(it)$ denotes the standardized value of indicator j in region i in period t, and $x_j(it)$ denotes the original value of indicator j in region i in period t.

The weights of each value in each proxy are next calculated.

$$p_j(it) = \frac{x_j(it)}{\sum_{i=1}^{n}\sum_{t=1}^{m} x_j(it)} \quad (2)$$

Here, $p_j(it)$ indicates the proportion of the data of the jth indicator for the ith region in year t to the sum of the values of this indicator.

In turn, the entropy value of each proxy is calculated.

$$e_j = -\frac{\sum_{i=1}^{n}\sum_{t=1}^{m} p_j(it) * \ln p_j(it)}{\ln(nm)} \quad (3)$$

Here, e_j denotes the entropy value of the jth indicator, n denotes the number of provincial and urban areas, and m denotes the number of years.

We further determine the weights of each proxy w_j by:

$$W_j = \frac{1 - e_j}{\sum_{j=1}^{T} 1 - e_j} \tag{4}$$

The specific values of the composite indicators are finally measured.

$$Z_{it} = \sum_{j=1}^{T} W_j * x_j(it) \tag{5}$$

Table 2 shows the indicator weights of each proxy indicator in the comprehensive index system of the green financial development level and ecological environment.

Table 2. Weighting of the three levels of indicators.

Tertiary Indicator	Weight	Tertiary Indicator	Weight	Tertiary Indicator	Weight	Tertiary Indicator	Weight
X_{a1}	0.1421	X_{a6}	0.0663	X_{b2}	0.0210	X_{b7}	0.1506
X_{a2}	0.1433	X_{a7}	0.1662	X_{b3}	0.0338	X_{b8}	0.0246
X_{a3}	0.0821	X_{a8}	0.0671	X_{b4}	0.0228	X_{b9}	0.1607
X_{a4}	0.1544	X_{a9}	0.0891	X_{b5}	0.0181	X_{b10}	0.1668
X_{a5}	0.0894	X_{b1}	0.0132	X_{b6}	0.1731	X_{b11}	0.2151

Notes: X_a indicates proxies for green finance in the same order as Table 1. X_b indicates proxies for ecological environment in the same order as Table 1.

In Table 2, the weights of the proxies in the ecological environment are calculated using the entropy assignment method, while the weights of the proxies in the level of green financial development are comprehensive weights, which are obtained by multiplying the weights calculated using the entropy assignment method with the weights assigned by the expert assignment method. Green finance development has attracted widespread attention in Chinese academic circles. After years of research and exploration, experts and scholars in China have a deeper understanding of the actual situation of the country's green finance development. Therefore, when calculating the development level of green finance, this study not only considers the amount of information contained in the various proxy indicators, but also takes into account the actual situation of China's green finance development.

The development index system of green finance constructed by various scholars is not completely the same, which leads to some differences in the measurement of the development level of green finance. To ensure the validity of the calculation results as best as possible, this paper sets the expert weights of green credit, green securities, green investment, green insurance, and carbon finance as 45%, 25%, 10%, 10%, and 10%, respectively, as shown in Figure 1.

3.1.4. Descriptive Statistics of Variables

There are many factors that influence the economy and society to achieve green development during economic and social development. In addition to green finance and the ecological environment, this paper selects control variables from the following four aspects: population size (PS), expressed as the year-end resident population in each province and urban area; R&D expenditure (RF), which is the expenditure on research and experimental development; fixed asset investment (FA), which helps to explore the impact of capital factor accumulation on economic development; and the degree of openness to the outside world (OD), which is measured as the ratio of total import and export trade to GDP. In summary, the research process herein contains seven important variables, of which GTFP is the explained variable for measuring the green development space of the economy and society, while green financial development and the ecological environment

are the main explanatory variables. In addition, four representative control variables are also included. The results of the descriptive statistics of each variable appear in Table 3.

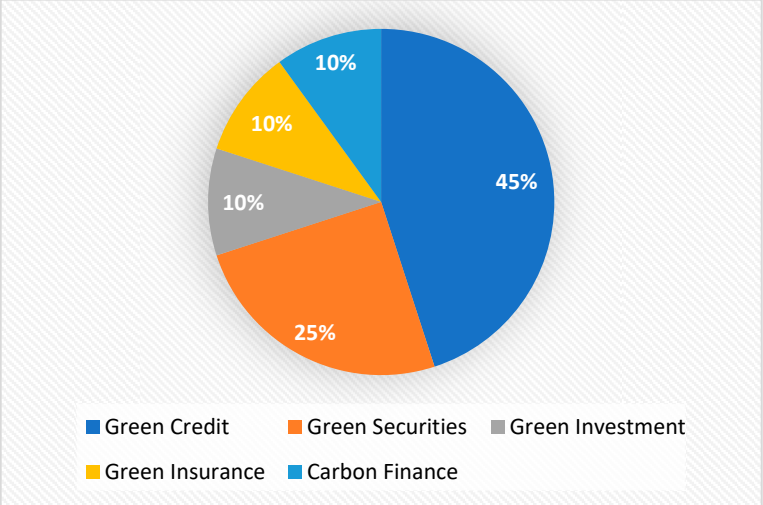

Figure 1. Green financial development.

Table 3. Descriptive statistics of the variables.

Variable	Symbol	Observations	Average Value	Standard Deviation	Minimum Value	Maximum Value
Green total factor productivity	GTFP	300	1.2671	0.3714	0.7714	3.9849
Green finance	GF	300	0.3476	0.0768	0.1320	0.5466
Ecology	EQ	300	0.2336	0.1067	0.0939	0.7595
Population size	PS	300	8.2068	0.7452	6.3424	9.4434
R&D funding	RF	300	5.5021	1.3856	1.5872	8.1548
Fixed asset investment	FA	300	9.5445	0.7972	7.2685	10.9590
Degree of openness to the outside world	OD	300	8.0667	1.5808	3.1355	11.2001

Note: The control variables in the above table are the basic statistics after taking logarithms.

The basic statistical results in Table 3 show that the maximum value of the GTFP is 3.9849, the minimum value is 0.7714, and its mean value is 1.2671, which imply that the green development space of each provincial and urban area in China was generally in a state of continuous expansion during the study interval of 2011–2020. The difference between the greatest values of green financial development is smaller than that of the ecological environment, while the standard deviation of the ecological environment is larger than that of green finance, meaning the difference in the ecological environment among provincial and urban areas is larger versus the level of green financial development. For the control variables, the standard deviation of each control variable is larger, meaning that population size, expenditure on scientific research, the level of investment in fixed assets, and the degree of openness to the outside world all differ greatly among provinces and urban areas.

3.2. Research Process and Model Construction

Based on the previous theoretical analysis and variable setting, this paper divides the research process of green finance affecting the green development space of economic society into three parts: (1) examining the effect of green finance on the green development space; (2) exploring the mechanism of green finance affecting the green development space—that is, determining the role played by ecological environment improvement in the process of

green finance affecting the green development space; and (3) conducting a heterogeneity analysis of the effect of green finance on the green development space of the economy and society.

First, when studying the effect of green finance on the green development space, we set up the following model.

$$GTFP_{it} = \alpha_0 + \alpha_1 GF_{it} + \alpha_2 PS_{it} + \alpha_3 RF_{it} + \alpha_4 FA_{it} + \alpha_5 OD_{it} + \mu_{it} \quad (6)$$

Here, subscript i denotes the provincial and urban areas, t denotes the year, and μ denotes the random disturbance term.

Second, the mediating effect model and the moderating effect model are used to explore the role played by ecological environment improvement in the process of green finance influencing the green development space of economy and society. The constructed models are:

$$EQ_{it} = \beta_0 + \beta_1 GF_{it} + \beta_2 PS_{it} + \beta_3 RF_{it} + \beta_4 FA_{it} + \beta_5 OD_{it} + \varepsilon_{it} \quad (7)$$

$$GTFP_{it} = \phi_0 + \phi_1 GF_{it} + \phi_2 EQ_{it} + \phi_3 PS_{it} + \phi_4 RF_{it} + \phi_5 FA_{it} + \phi_6 OD_{it} + \eta_{it} \quad (8)$$

$$GTFP_{it} = \varphi_0 + \varphi_1 GF_{it} \times EQ_{it} + \varphi_2 PS_{it} + \varphi_3 RF_{it} + \varphi_4 FA_{it} + \varphi_5 OD_{it} + \lambda_{it} \quad (9)$$

Equations (7) and (8) are the mediating effect models constructed on the basis of Equation (6) and are mainly used to determine whether green finance can expand the green development space of the economy and society by improving the ecological environment through the stepwise test method. If the coefficients of *GF* in Equations (6) and (7) are both significantly positive, then green finance has a positive influence on both the green development space and ecological environment of the economy and society. If the coefficient of *EQ* in Equation (8) is also significantly positive, then there is a mediating effect of the ecological environment in the process of green finance that expands the green development space of the economy and society.

Equation (9) is a moderation effect model constructed on the basis of Equation (6), and the cross-product term of *GF* and *EQ* is the key variable in the model. If the influence coefficient of the cross-product term of *GF* and *EQ* is significantly positive, then the ecological environment has a positive regulating effect, and any improvement in the ecological environment can strengthen the positive effect of green finance on the green development space. Conversely, if its influence coefficient is significantly negative, then the ecological environment has a negative regulating effect. If its influence coefficient is not significant, then, in the process of green finance expanding the green development space of the economy and society, there is no moderating effect of the ecological environment.

Third and finally, this study tests the effect of heterogeneity on the role of green finance affecting the green development space of the economy and society based on the idea of differencing. The model is set up as:

$$GTFP_{it} = \theta_0 + \theta_1 DV_{it} \times GF_{it} + \theta_2 PS_{it} + \theta_3 RF_{it} + \theta_4 FA_{it} + \theta_5 OD_{it} + \rho_{it} \quad (10)$$

Here, *DV* denotes the dummy variable used to group the provincial and urban areas. This paper takes the mean value of the total sample as the grouping criterion, and when the mean value of urbanization water within the provincial and urban areas is greater than the mean value of the urbanization level in the whole sample, the corresponding *DV* takes the value of 1 and otherwise 0. This allows us to explore whether there is a difference in the effect of green finance on the green development space under different urbanization levels.

We see that the cross-product of *GF* and *EQ* is the object of attention in Equation (10). When its coefficient is significantly positive, the effect of green finance on the green development space is stronger in areas with a higher urbanization level than those with a

lower urbanization level. If its coefficient is significantly negative, then the effect of green finance is stronger in areas with a lower urbanization level. If its impact coefficient is not significant, then there is no heterogeneous effect of the urbanization level on the impact of green finance on the green development space.

4. Analysis of Regression Results

4.1. Analysis of Baseline Regression Results

According to the research strategy of this paper, the impact of green finance on the green development space of the economy and society is first explored at the full sample level through a benchmark regression model. The regression results appear in Table 4 in the form of a fixed effects model. It can be observed during the process of adding the control variables one by one that the impact coefficients of green finance are all significantly positive at the 1% level, despite the different magnitudes of the impact coefficients of green finance. Taking column (5) with the inclusion of the control variables, each 1% increase in the level of green finance development leads to a subsequent expansion of the green development space of the economy and society by 2.14%. Although the magnitude of the impact of green finance may vary depending on the statistical methods, this result validates the positive effect of China's green financial development on its economic and social green development space, indicating that green financial development does promote the country's economic and social development so as to achieve high-quality development faster and meet the basic requirements of its current economic development stage.

Table 4. Baseline regression results of green finance impact on green development space.

Variable	(1) GTFP	(2) GTFP	(3) GTFP	(4) GTFP	(5) GTFP
GF	3.9962 ***	3.8063 ***	2.3081 ***	2.1828 ***	2.1395 ***
	(0.4939)	(0.5023)	(0.5155)	(0.5599)	(0.5603)
PS		0.6468 *	0.2909	0.2698	0.2813
		(0.3496)	(0.3280)	(0.3305)	(0.3302)
RF			0.2991 ***	0.2840 ***	0.2849 ***
			(0.0443)	(0.0516)	(0.0515)
FA				0.0461	0.0168
				(0.0799)	(0.0831)
OD					0.0924
					(0.0726)
Con_	−0.1218	−5.3641 *	−3.5680	−3.7082	−4.2579
	(0.1727)	(2.8388)	(2.6423)	(2.6567)	(2.6885)
R-squared	0.1957	0.2059	0.3215	0.3224	0.3265
Observations	300	300	300	300	300

Note: The symbols ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

4.2. Mechanism Testing of Ecological Environment

Conventional financial industry development mainly promotes the rapid progress of the economy and society by expanding the scale of financial development, improving the efficiency of financial development, and enhancing the structure of this financial development. The main concern is the economic benefits brought about by financial development. Green finance is a new type of financial development model that evolved from the conventional financial development model. It not only supports economic benefits for the economy and society, but also pays more attention to their development quality, mainly through green credit, green securities, green investment, and other channels. Its general aim is to promote the green transformation of all types of enterprises in the economy and society, adjust the industrial development structure, and optimize the economic development model, in order to promote green development. Based on this, green finance development means increasing the efforts of pollution prevention and control, environmental protection, and the degree of resource conservation and intensive use, so as to promote the harmonious

co-existence between humans and nature and enhance the green development space of the economy and society. In short, throughout the process of green finance expanding the green development space of those two areas, improvement in the ecological environment is one important way for green finance to exert its influence.

Table 5 shows the regression results with the ecological environment as the mediating variable to test whether green finance expands the space for the green development of the economy and society by improving the ecological environment. Columns (1) and (2) in Table 5 show that green finance development in China has a significant improvement effect on its ecological environment. In the regression results with the control variables taken into account, for every unit increase in the level of green finance development, the corresponding ecological environment improves by about 1/4 units. This demonstrates the ecological benefits of green finance development.

Table 5. Regression results of mediating effects of ecological environment.

Variable	(1) EQ	(2) EQ	(3) GTFP	(4) GTFP
GF	0.5370 ***	0.2510 ***	1.5580 ***	1.2049 **
	(0.0489)	(0.0521)	(0.5319)	(0.5492)
EQ			4.5400 ***	3.7228 ***
			(0.5509)	(0.6209)
PS		0.0810 ***		−0.0203
		(0.0307)		(0.3144)
RF		0.0170 ***		0.2214 ***
		(0.0048)		(0.0496)
FA		0.0360 ***		−0.1171
		(0.0077)		(0.0812)
OD		0.0027		0.0823
		(0.0068)		(0.0683)
Con_	0.0470 ***	−0.9775 ***	−0.3350 **	−0.6190
	(0.0171)	(0.2500)	(0.1567)	(2.5989)
R-squared	0.3094	0.4901	0.3583	0.4072
Observations	300	300	300	300

Note: The symbols ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

Columns (3) and (4) in Table 5 show that, similar to green finance, the ecological environment also has a significantly positive impact on the green development space of the economy and society, and the intensity of this effect is higher than that of green finance. The regression results in Tables 4 and 5 denote that the direct effect of green finance on the green development space accounts for 56% (1.2049/2.1395), and the indirect effect of improving the ecological environment to expand the green development space of the economy and society accounts for 44% (0.251). At 44% ($0.251 \times 3.7228/2.1395$), ecological environment improvement plays an important intermediary role in the process of green finance expanding the green development space of the economy and society.

There are obvious differences in the ecological environment in different regions, and so green finance exerts its ecological benefits in different ways, as follows. In areas with a poor ecological environment, green finance funds are more inclined to repair the environment by pollution control. In areas with a good ecological environment, green finance development can use more funds for ecological environment protection (Wang et al. 2023 [58]). Therefore, the ecological environment will affect the ecological benefits of green finance by changing the allocation of funds for green finance.

This study also measures the green development space of the economy and society by green total factor productivity. Hence, the influence of the ecological environment factors is considered in the explained variables—that is, the ecological environment has an obvious influence on the green development space of economy and society. Because the ecological environment impacts both green finance and the economic and social green development

space, the ecological environment may play an important regulatory role in the process of green finance affecting the economic and social green development space.

Table 6 shows the regression results with the ecological environment as the regulating variable. From the regression results in Table 6, we see in the process of adding the control variables one by one that the cross-product term between the ecological environment and green finance is always significantly positive at the 1% level. This indicates that the ecological environment has an important positive regulatory effect on the process of green finance expanding the green development space of the economy and society. According to the results in Table 5, with the increasing coupling between green finance and the ecological environment (Zhu, 2020; Shi, 2022) [59,60], on the one hand, green finance development continuously promotes improvement in the ecological environment, and on the other hand, an improvement in the ecological environment level can also enhance the allocation of funds in the process of green finance development, as well as the efficiency of this green finance development, thus forming a positive feedback mechanism for improvements in the green finance development level and the ecological environment, finally jointly promoting the expansion of the green development space in the economy and society.

Table 6. Regression results of the moderating effect of ecological environment.

Variable	(1) GTFP	(2) GTFP	(3) GTFP	(4) GTFP	(5) GTFP
GF × EQ	0.8613 ***	0.8467 ***	0.6419 ***	0.7164 ***	0.7092 ***
	(0.0709)	(0.0734)	(0.0874)	(0.1007)	(0.1009)
PS		0.2478	0.1174	0.1552	0.1658
		(0.3189)	(0.3117)	(0.3121)	(0.3120)
RF			0.1882 ***	0.2163 ***	0.2175 ***
			(0.0464)	(0.0500)	(0.0500)
FA				−0.1185	−0.1431 *
				(0.0802)	(0.0829)
OD					0.0800
					(0.0685)
Con_	3.5256 ***	1.4540	0.9516	1.8125	1.2901
	(0.1867)	(2.6727)	(2.6016)	(2.6604)	(2.6959)
R-squared	0.3542	0.3557	0.3931	0.3981	0.4011
Observations	300	300	300	300	300

Note: The symbols ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

4.3. Heterogeneity Analysis

The vast territory of China and the obvious regional differences in its economic development levels and economic development structures lead to regional heterogeneity in the green financial development and green development space in each region as well. Accordingly, this research conducts regression analyses in different regions separately to explore the regional differences in terms of the impact of green finance on the green development space. Using geographical location as the regional division criterion, China's provincial and urban areas can be divided into eastern, central and western, and northeastern regions. The central and western regions are combined due to their similar levels of economic development.

Table 7 shows the basic descriptive statistical results of the green finance and green development space (green total factor productivity) in various regions. Based on the average development level, the green finance development level and green development space in the eastern region are relatively high, with averages of 0.3674 and 1.2996, respectively. The development level and space of green finance in northeast China are in the middle, at averages of 0.3608 and 1.2718, respectively. The development level and space of green finance in the central and western regions are the lowest, at averages of 0.3335 and 1.2471, respectively. According to geographical location, there is an obvious regional gap in the

development level and space of green finance in China, which is in line with the basic fact that these regional development gaps are relatively large.

Table 7. Regional differences in green finance and green development space.

Variable	Region	Observations	Average Value	Standard Deviation	Minimum Value	Maximum Value
GF	East	100	0.3674	0.0803	0.1848	0.5348
	Central and west	170	0.3335	0.0707	0.1320	0.5032
	Northeast	30	0.3608	0.0831	0.2358	0.5466
GTFP	East	100	1.2996	0.4831	0.7714	3.9849
	Central and west	170	1.2471	0.3028	0.8755	2.5049
	Northeast	30	1.2718	0.2913	0.9684	2.0904

The regression results by region appear in Table 8. After adding the control variables, we know that the development of green finance in the eastern region has the strongest positive impact on its green development space, with an impact coefficient of 5.1765, which is significant at the 1% level. The positive impact of the development of green finance in northeast China on its green development space is in the middle, with an impact coefficient of 2.1685, which is significant at the 5% level. The green finance development in the central and western regions does not have a significant impact on its green development space, and so its impact effect is the weakest. Whether the control variable is added or not, the size and significance of the influence coefficient of green finance will change to some extent, but the order of the influence intensity of green finance on the green development space in various regions does not change. This still shows that the influence effect of green finance is the largest in the eastern region, middling in the northeastern region, and the smallest in the central and western regions (there is no influence effect).

Table 8. Regional heterogeneity of the impact of green finance on green development space.

Variable	(1) GTFP	(2) GTFP	(3) GTFP	(4) GTFP	(5) GTFP	(6) GTFP
GF	6.7461 ***	5.1765 ***	2.7685 ***	−0.3487	3.9078 ***	2.1685 **
	(1.1419)	(1.6676)	(0.5122)	(0.4272)	(1.3882)	(0.9769)
PS		−0.5395		0.3409		−1.7921
		(1.4106)		(0.2198)		(1.1221)
RF		0.0452		0.5554 ***		0.7616 ***
		(0.0941)		(0.0535)		(0.2691)
FA		0.2564		−0.1090		−0.3931 ***
		(0.2947)		(0.0746)		(0.0859)
OD		0.4755		0.1519 ***		−0.0323
		(0.4181)		(0.0484)		(0.1746)
Con_	−1.1791 ***	−3.4482	0.3237 *	−4.2482 **	−0.1380	14.9481
	(0.4216)	(10.6948)	(0.1721)	(1.8145)	(0.5031)	(9.6365)
R-squared	0.2817	0.3161	0.1612	0.6403	0.2336	0.7506
Observations	100	100	170	170	30	30
Region	East	East	Central and west	Central and west	Northeast	Northeast

Note: The symbols ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

The impact of green finance on the green development space in different regions also shows an obvious regional heterogeneity, and the order of the impact intensity is consistent with the regional order of the green finance development level and green development space. This conclusion is in line with the expectation of this paper. The level of economic development in the eastern region is relatively high, while the level of economic development in the central, western, and northeastern regions is relatively low. Thus, the eastern region has a relative development advantage under a higher level of technological innovation, a larger scale of financial support, and a better external environment, making the level of

green finance development and green development space in the eastern region relatively high. Because the business structure in the northeast tends toward industrial development and its economic structure is more rigid, the driving force for developing green finance in this region is higher than that in the central and western regions, resulting in its green financial development level and green development space being slightly higher than that in the central and western regions. At different levels of development, the scale effect of green financial development on the green development space is different, which eventually leads to a higher level of green financial development, green development space, and the effect of green financial development on the green development space in the eastern region, while the northeastern region is in the middle, and the central and western regions are the lowest.

On the basis of analyzing the regional differences of green finance influencing the green development space, this study further conducts a heterogeneity analysis by using other relevant criteria that impact regional green development: the urbanization level (UR), government fiscal expenditure level (FE), foreign investment level (FI), and advanced degree of industrial structure (IU) [2]. Since there are many criteria for the heterogeneity analysis, here we draw on the idea of differencing and set up dummy variables for the heterogeneity analysis. Therefore, UR = 1 corresponds to the provinces and municipalities with a relatively high urbanization level and UR = 0 corresponds to the provinces and municipalities with a relatively low urbanization level. In turn, the cross-multiplication term (UR × GF) of the urbanization level and green finance can be obtained through multiplicative cooperation. This replaces green finance as the core explanatory variable in the baseline regression model for the regression, so as to test the difference in green finance on the green development space under different urbanization levels.

Table 9 shows the results of the heterogeneity regressions with the urbanization level, government fiscal expenditure level, foreign investment level, and advanced degree of industrial structure as the classification criteria. As shown in column (1), the coefficient of the cross-product of the urbanization level and green finance (UR × GF) is significantly positive at the 1% level, indicating a significant difference in the effect of green finance on the green development space under different urbanization levels; i.e., compared to provinces and urban areas with lower urbanization levels, the positive effect of green finance on the green development space is stronger in provinces and urban areas with relatively higher urbanization levels. Similarly, as shown in columns (2) to (4) of Table 9, the coefficients of the cross-products FE × GF, FI × GF, and IU × GF are also significantly positive at the 1% or 5% levels, respectively, indicating that the positive effects of green finance on the green development space are relatively greater in regions with higher levels of government spending, foreign investment, and advanced industrial structure.

The main reason for these findings is that most provinces and cities with a higher urbanization level, government expenditure level, foreign investment level, and advanced industrial structure are located in the eastern part of China. Compared to other regions, the eastern region has a higher economic development level, lower urban–rural development gap, and a more optimized and reasonable industrial structure. This provides a better development environment for green finance, and the corresponding green financial development level and green development space are relatively high. The end result is a positive impact of its green financial development on the green development space.

Table 9. Other heterogeneous impacts of green finance on the green development space.

Variable	(1) GTFP	(2) GTFP	(3) GTFP	(4) GTFP
UR × GF	5.7814 ***			
	(1.2326)			
FE × GF		2.6892 ***		
		(0.9174)		
FI × GF			5.0706 ***	
			(0.8926)	
IU × GF				1.7476 **
				(0.8630)
PS	0.1623	0.2728	0.0420	0.3560
	(0.3280)	(0.3345)	(0.3245)	(0.3359)
RF	0.2905 ***	0.2961 ***	0.2977 ***	0.3079 ***
	(0.0506)	(0.0519)	(0.0495)	(0.0521)
FA	0.1031	0.0733	0.0619	0.0997
	(0.0769)	(0.0808)	(0.0763)	(0.0805)
OD	0.1296 *	0.1037	0.1345 *	0.1164
	(0.0717)	(0.0733)	(0.0704)	(0.0740)
Con_	−4.2146	−4.5499 *	−3.0189	−5.3969 **
	(2.6480)	(2.7174)	(2.6247)	(2.7202)
R-squared	0.3439	0.3117	0.3666	0.3002
Observations	300	300	300	300
Heterogeneous type	Urbanization level	Government financial spending	Foreign investment level	Advanced degree of industrial structure

Notes: The symbols ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively. The variables UR, FE, FI, and IU are dummy variables in the cross-product term.

4.4. Robustness Analysis

To further ensure the robustness of the regression results, this study uses different robustness methods to conduct the regression again, by specifically: (1) replacing the core explanatory variables—the objective weights obtained from the entropy value assignment method measure the comprehensive index of the green finance development level, so as to conduct the regression again; (2) replacing the explanatory variables—the mechanism test herein shows that green finance improves the ecological environment and thus expands the green development space of the economy and society, due to the high time cost required to repair and improve the ecological environment; thus, the positive effect of green finance on the green development space may have a certain time lag, and so this paper performs regression again by putting the green development space in the first period; (3) adjusting the research interval—as China's green finance is in the 2016 Guiding Opinions on Building Green Financial System, this study adjusts the research interval to 2016–2020 and regresses again; and (4) considering endogeneity—considering the possible endogeneity problem in the benchmark regression model, we adopt the conventional practice of empirical research and regress again with the lagged period of green finance as the instrumental variable of green finance.

Table 10 lists the regression results based on various robustness methods. From column (1), we see that, after replacing the measured weight of green finance with the objective weight, that its impact coefficient is still significantly positive at the 1% level. This supports the conclusion that green finance does expand the green development space of the economy and society. Column (2) shows that, after front-loading the green development space by one period, the impact coefficient of green finance is also significantly positive. This implies that the positive impact of green finance on the green development space has a certain time lag and promotes the expansion of the green development space in the future. As shown in columns (3) and (4), the direction of the impact of green finance on the green development space remains the same after adjusting the study interval or using instrumental variables. All the above regression results indicate that green finance development in China has

a significant expansion effect on its green development space. This finding has a high robustness and credibility.

Table 10. Robustness test results.

Variable	(1) GTFP	(2) F_GTFP	(3) GTFP	(4) GTFP
GF/IV_GF	2.1651 ***	2.4696 ***	2.6623 **	4.7579 **
	(0.4986)	(0.5931)	(1.3202)	(1.0246)
PS	0.1899	0.3044	0.3180	0.1251
	(0.3294)	(0.3591)	(0.4354)	(0.3383)
RF	0.2599 ***	0.3161 ***	0.2262 ***	0.2725 ***
	(0.0521)	(0.0535)	(0.0769)	(0.0529)
FA	0.0765	0.0413	0.0591	−0.0613
	(0.0780)	(0.0859)	(0.1966)	(0.0998)
OD	0.1113	0.0713	0.1915	0.0574
	(0.0719)	(0.0802)	(0.1229)	(0.0781)
Con_	−3.9598	−4.7385	−5.5816	−3.4746
	(2.6722)	(2.9166)	(3.8342)	(2.7291)
R-squared	0.3366	0.3682	0.1500	0.3521
Observations	300	270	180	270

Notes: The symbols ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

5. Conclusions and Recommendations

5.1. Main Conclusions

As China's economic development enters a new stage and high-quality economic development is the new national policy, green finance has emerged as an important engine for promoting the green development of its economy and society. This research took 30 provinces and municipalities in China as the subjects and 2011–2020 as the time interval. By measuring the levels of green financial development, the ecological environment, and the green development space of the economy and society (green total factor productivity, GTFP) and using the fixed effect model, intermediary effect model, moderating effect model, and heterogeneity effect regression model based on the idea of DID, we analyzed the green financial effects on the green development space. The results of the study were as follows.

First, at both the national and regional levels, green finance development expands the green development space. Its impact shows a distinct regional heterogeneity. The positive impact of green finance on the green development space is strongest in the eastern region, weakest in the central and western regions, and at a moderate level in the northeastern region.

Second, during the process of green finance expanding the green development space, there is an intermediary effect and regulation effect of ecological environment improvement. In other words, green finance expands the green development space of the economy and society by improving the ecological environment. At the same time, improvement in the ecological environment also strengthens the effect of green finance on green development space expansion.

Third, in addition to regional heterogeneity, there are other aspects of heterogeneity in the effect of green finance on the green development space. Specifically, the positive impact of green finance on the green development space is also relatively stronger in regions with higher levels of urbanization, government fiscal expenditure, foreign investment, and advanced industrial structure.

Fourth, after replacing the explanatory variables, adjusting the study interval, and considering the endogeneity issue and robustness tests, the effect of green finance on the green development space did not change. In fact, it still significantly promoted the green development of China's economy and society. The conclusions of this paper are reliable.

5.2. Relevant Suggestions

Based on the research contents and main conclusions of this paper, the following suggestions and strategies are put forward.

(1) Suggestions for the applicability of the research to green finance and green economic and social development. By sorting out the literature, we found that scholars were more inclined to conduct quantitative studies on green finance and the green development of economy and society, lacking relevant theoretical analyses and economic theoretical support. Follow-up research on green finance and the green development of the economy and society should effectively combine qualitative analyses and quantitative analyses, enrich the theoretical basis, set forth theoretical hypotheses, and improve the theoretical system of green finance promoting the green development of the economy and society.

(2) Suggestions for the applicability of the financial industry, industrial enterprises, and energy-saving and environmental protection enterprises. At present, with the continuous consumption of various natural resources, many types of environmental pollution from industrial enterprises have been exposed, and the pollution control and renewable energy development of energy-saving and environmental protection enterprises are still in a relatively weak position. The financial industry should actively promote green financial businesses, give play to the green development concept of green finance, and make the necessary fund allocations by using the pollution data of industrial enterprises, such as linking the three waste emissions of industrial enterprises with the loan amount and loan interest rate, forcing the green transformation of high-pollution industrial enterprises, and supporting renewable energy research and the development of energy-saving and environmental protection enterprises with more funds.

(3) Suggestions for the applicability of government departments to better play the role of policy makers. Government departments take on a macro-control role mainly through the formulation and implementation of policies. According to the development status of green finance in China, government entities can appropriately carry out other pollutant emission trading pilots (such as sulfur dioxide and industrial dust) on the basis of existing carbon finance, expand carbon finance to three wastes (wastewater, waste gas, and solid waste), enhance the green development momentum of green finance to the economy and society, and weaken the regional heterogeneity of green finance's positive impact. In addition, government departments can also levy taxes according to the pollution emissions of enterprises via a progressive tax system and, at the same time, put the tax amount into the green financing market, support the green technology innovation of energy-saving and environmental protection enterprises, improve the development level of green finance in multiple dimensions, and expand the green development space of the economy and society.

5.3. Limitations and Research Prospects

The contradiction between economic development and the ecological environment has existed for a long time. It is impossible for green finance to improve the ecological environment and promote the green development space of the economy and society overnight. There are some limitations in this paper based on the provincial panel data of China. First, the specific development of the cities, districts, and counties in China has not been fully considered. Second, the study does not fully look at the dynamic and long-term impact of green financial development on the future green development space of China's economy and society. Third, there are many factors that affect the green development space of the economy and society. This paper does not consider the cross-influence of other influencing factors, as well as the development level of green finance on the green development space of the economy and society. Based on the above unresolved limitations, a follow-up study could make the calculation of green finance and economic and social green development space more detailed. At the same time, it could focus on the non-linear, real-time dynamic, and cross-impact of green finance development on the economic and social green development space and consider the implementation effect of green-finance-related policies.

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Notes

[1] Energy-saving and environmental protection enterprises are listed companies in the energy-saving and environmental protection sector of China's A-share market. The six non-polluting industries are those other than the production and supply of electricity and heat, non-metallic mineral products, ferrous metal smelting and rolling processing, chemical raw materials and chemical products manufacturing, petroleum processing and coking and nuclear fuel processing, and non-ferrous metal smelting and rolling processing industries.

[2] The level of urbanization is measured by the proportion of urban population to total population. The advanced industrial structure is measured by the ratio of tertiary industry to secondary industry.

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