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An Empirical Test of Low-Carbon and Sustainable Financing's Spatial Spillover Effect

Yu Sun [1], Huaping Sun [2,3,*], Zhiqiang Ma [1], Mingxing Li [1] and Dan Wang [4]

[1] School of Management, Jiangsu University, Zhenjiang 212013, China; sunyu8986@163.com (Y.S.); mzq@ujs.edu.cn (Z.M.); mingxingli6@ujs.edu.cn (M.L.)
[2] School of Finance and Economics, Jiangsu University, Zhenjiang 212013, China
[3] School of Economics and Management, Hebei University of Technology, Tianjin 300401, China
[4] School of Finance and Economics, Zhenjiang College, Zhenjiang 212028, China; danwang215@163.com
* Correspondence: shp797@163.com or shp@ujs.edu.cn

Abstract: In this paper, the panel data of 30 provinces in China from 2011 to 2019 are analyzed by the spatial measure model and the threshold regression model. The results show that the air quality level is positively correlated with green finance, but there is no spatial effect. The spatial effect of the three influencing factors, including the degree of openness, the level of infrastructure, and the level of education, is the crowding-out effect. At the same time, variables such as human resource level, air quality, and infrastructure construction level all have threshold effects in the relationship between green finance and economic development. The research conclusions suggested that local governments at all levels should formulate policies according to the actual situation to promote the development of provinces' intensive, intelligent, and green development, and build a regionally-linked green finance development model, thereby promoting the improvement of green finance.

Keywords: green finance; spatial Dubin model; influencing factors; threshold effect

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1. Introduction

The report of the 19th National Congress of the Communist Party of China proposed to "speed the ecological environment system's reform up and build a beautiful China", and the meeting highlighted the development of low-carbon and sustainable financing as a method of green development. Although China has gradually slowed down in recent years and has entered steady growth, the protection of environmental resources still has a long way to go. At present, China's economic growth has quietly entered a new normal. The unsustainability of economic development will become increasingly prominent. Environmental pollution will increase the frequency of extreme weather and lead to the extinction of rare species. Not only that, but environmental pollution also has a strong negative externality. Environmental pollution not only harms the sustainable development of economy, but also causes social contradiction, which is unfavorable to the harmony of society. There is no doubt that green finance's development is an important way for China to transform a strategic choice and economic growth to promote sustainable development. Thus, the greening of financial resources is an important driving force of high-quality economic development. Although some scholars have studied the construction, operation, and green finance's implementation and their impact on economic growth at the macro level and have also discussed green finance policies' impact on enterprises' behavior at the micro level, few scholars have studied the economic growth. Does the level of economic development promote the low-carbon and sustainable financing? Is there a difference in space? Which influencing factors have a threshold effect? Furthermore, with the deepening of inter-regional financial exchanges, does green finance have a spatial spillover effect on surrounding areas? In view of this, we use China's inter-provincial panel data and use spatial measurement models to analyze the spatial spillover effects which

will contribute to China's sustainable development. This paper aims to carry out in-depth research on the above issues through theoretical derivation and empirical analysis, in order to fully reflect the connotation between green finance and economic development.

2. Literature Review

2.1. Research on Low-Carbon and Sustainable Financing

Since the 1980s, Western scholars have gradually paid attention to green finance research, and related theoretical research has also been abundant. Salazar [1] considered that low-carbon and sustainable financing is a financial innovation, and that is aimed at protecting the environment, and it is a bridge that connects the environmental protection industry and the financial industry. Cowan [2] considered that the proposal of green finance is to solve the actual problem of paying environmental protection costs, and it is an interdisciplinary subject of environmental economics and finance. Jeucken [3] considered that the combination of financial industry and the green environment economy produces green finance. According to the G20 Green Finance Research Group [4], green finance is defined as an investment and financing economic activity that can reduce the emission of environmental pollutants, improve the efficiency of resource utilization, mitigate climate change, and support sustainable human development. Ma [5] concluded that low-carbon and sustainable financing requires the financial industry to carry out financial services that are based on the basic principles of environmental protection and sustainable development. Cai et al. [6] concluded that green finance is a new financial pattern that integrates environmental protection and economic profits. It analysed the publications on green finance, and their intellectual structure and networking. Gilchrist et al. [7] concluded that environmentally responsible practices not only enhance shareholder value but also the value accrued to nonfinancial stakeholders. They provided an updated overview of research developments in relation to green bonds and syndicated loans. Lastly, they discussed the limitations in the nascent green finance research. Many researchers, including [8–10], have shown immense interest in the relationship between economic growth and energy consumption.

2.2. Research on the Measurement of Green Finance's Development Level

Salzman [11] believed that the development of green finance should be evaluated from the perspective of financial institutions by examining the contribution of financial institutions to environmental protection. Zhou et al. [12] built a green financial development indicator system based on the rapid economic development stage of China, and the new normal economic development stage measured the green development status of eastern, central, western, and northeastern regions of my country, respectively. The level of green development is relatively high, and all parts of the country should learn from the green financial development policies of the central region. Soundarrajan [13] found that green finance is closely related to financial industry development, environmental improvement, and economic development. Wang [14] found that green finance can not only directly promote the investment growth of enterprises, but also indirectly improve the investment of enterprises by adjusting the debt maturity structure. Wei et al. [15] proposed that green financial policies can bring about positive environmental effects, which improve the environmental quality mainly through the upgrading of industrial structure. Weng [16] considered that green finance has just started in China, and there is not only a big gap with foreign countries in terms of product categories, service scope, and development speed, but Cao [17] considered that there are also many problems in the green financial system, such as incomplete policy systems, insufficient continuous development momentum, and inconsistent standards. Li et al. [18] provided a framework for evaluating green finance via linkage analysis based on input–output theory. They worked out the relationship between finance and the environmental protection sector by calculating industrial linkages in two Chinese provinces from 2002 to 2018. The development of low-carbon and sustainable financing in China mainly adopts the government-led "top-down" model [19,20].

2.3. Research on Green Finance's Spatial Spillover Effect

The green's positive external effects finance and the research on sustained economic growth are relatively abundant, but green finance's spatial spillover effects are relatively scarce. From sustainable development's perspective, green finance aims at solving global environmental pollution and climate change issues through the best financial tools and financial product portfolio, and achieves sustainable economic, social, and environmental development.

Sun et al. [21] constructed the PVAR model to study the relationship between the development of low-carbon and sustainable financing and economic growth; the results show that low-carbon and sustainable financing is the main trend of financial innovation in the new era, which can effectively promote sustainable development between regions. Pei [22] constructed a PVAR (Panel Vector Auto-Regression) model to describe that green capital investment has a positive effect on green industry and sustainable financing growth. Some scholars [23] found that green investment should be controlled within a reasonable range. Liu et al. [24] considered that the green financial innovation in the central region can effectively promote regional economic development. Xie et al. [25] found that green credit pairs can significantly promote regional green economic growth based on the data from thirty provinces in China. Yu [26] took five economic regions in China as the research object, and through constructing an evaluation system of high-quality development level and green finance, selected the relevant index data from 2011 to 2018 to calculate the high-quality development's comprehensive level in each region; moreover, the coupling correlation degree and coordination degree between the two systems in each region are calculated by using the empirical model, and the results are compared. The results show that low-carbon and sustainable financing has a significant positive effect on high-quality development, but the effect has a threshold effect; only by determining the reasonable pace of development of low-carbon and sustainable financing can we promote high-quality development effectively. Zhang [27] and Zhou [28] used the spatial Dubin model to explore the impact of financial agglomeration on regional economic resilience. The results show that the increasing degree of financial agglomeration not only contributes to the improvement of the resilience of the local economy, but also has a significant spatial spillover effect.

2.4. Research on the Measurement of Influencing Factors of Green Finance

Li [29] used the 2017 low-carbon and sustainable financing innovation pilot zone policy as a quasi-natural experiment. This paper explores whether low-carbon and sustainable financing has a significant impact on enterprises 'financing innovation and its mechanism of action, whether it can be found that the green financial reform and innovation experimental has a significant role in promoting enterprises' green innovation, and whether the policy has a more significant role in promoting the large-scale enterprises, state-owned enterprises and non-pollution enterprises in enterprise characteristics' heterogeneousness In the heterogeneousness of the financial environment, this policy has a more significant effect on enterprises' promotion in regions where the banks are less competitive. Sun [30] used data from 87 countries from 2000 to 2016, analyzed how aging and resource dependence affected technological innovation, and conducted an empirical test using the least squares variable tool. The results show that aging is not an obstacle to technological innovation, but will promote the development of technological innovation. However, resource dependence, which is consistent with most studies, has negative effects on technological innovation. All countries in the world should improve the efficiency of resource utilization, guard against the crowding out effect of natural resource dependence on human capital investment, pay attention to human capital investment, deal with the increasingly serious aging phenomenon, and raise the level of regional technological innovation. Zhu [31] used the SDM (the spatial Doberman model) to explore the impact of policy incentives, financial fundamentals, and environmental pollution on green finance. The results show that the number of cities that introduce green finance in Midwestern Sectional Figure Skating Championships is higher, and the eastern region is the bearing area

for green finance's growth. Policy incentives and financial basis enhance green finance's scale significantly, while environmental pollution plays a restraining role. Policy measures in different regions can work in concert with the financial base to promote green finance. In eastern China alone, policy incentives can mitigate environmental pollution's negative effects. The study shows that the eastern region is under policy incentives' impetus and the financial basis of the homeostasis transformation, and the Midwestern Sectional Figure Skating Championships has to deal with the resistance that is caused by environmental pollution.

In summary, the existing domestic and foreign literature has explored the spillover effects of green finance space, which can be used as a reference for the development of this article. Early foreign research on green finance mainly focused on the conceptual level, and there are few empirical studies on green finance. Secondly, the studies in domestic literature mostly stays in green finance's connotation, and there is little literature on green finance's spillover effects to better promote sustainable development. Based on this, in order to study green finance's spatial spillover effects, this paper uses spatial measurement methods to carry out relevant empirical studies on green finance's spatial spillover effects, and at the same time conducts research on the threshold effects of influencing factors. Because the selection of indicators and methods are different, and there are big differences in research throughout the research at home and abroad, there are still areas needing to be explored and improved in depth.

3. Research Design

3.1. Model Construction

SAR, SEM and SDM models are the main contents of spatial metrology models. The SDM model is a general form of the SAR and the SEM model.

$$y_{it} = c + \rho\sum_{j=1}^{n} W_{ij}y_{it} + \alpha X_{it} + \sum_{j=1}^{n} W_{ij}X_{it}\gamma + \mu_i + \lambda_t + \varepsilon_{it} \quad (1)$$

After analyzing the spatial effects, the panel threshold model is used to further study whether the nonlinear relationship between the control variables is in the level of low-carbon and sustainable financing at the same time as economic development. Its model construction is shown in Formula (2):

$$GF_{it} = \beta_0 + \beta_1 LnGDP(x_{it} \le \gamma) + \beta_2 LnGDP(x_{it} > \gamma) + \beta_j x_{jit} + \varphi_i + \varepsilon_{it} \quad (2)$$

Among them are representatives of the threshold variable, and representatives of the threshold value. If the threshold value γ is set reasonably, the model established here is a dual threshold model. At the same time, there may be a single threshold and multiple thresholds, which only need to be reset. In this case, the model is suitable.

3.2. Spatial Auto-Correlation Test

The results of spatial regression estimation have research significance only when there is a significant spatial correlation. We use global Moran's I index to test economic variables' spatial correlation before spatial econometric analysis. The calculation formula of global Moran's I index is shown in Formula (3). We use the geographic adjacency matrix to set the adjacency standard.

$$I = \frac{\sum_{i=1}^{n}\sum_{j=1}^{n} W_{ij}(X_i - \overline{X})(X_j - \overline{X})}{\sum_{l=1}^{n}(X_i - \overline{X})^2} \quad (3)$$

When the value of $I > 0$, it means that the observed value has a positive spatial correlation in the region. The larger the Moran index is, the more obvious the spatial correlation is.

3.3. Variable Selection and Description

In order to obtain some data, this paper calculates the green finance development level of thirty provinces in China from 2011 to 2019 by the entropy method. The missing data are all calculated using the five-year average method. At present, some data in the paper still lacks of systematicness and coherence, so the selected indicators are currently available indicators [32]. It is shown in Table 1.

Table 1. Low-carbon and sustainable financing evaluation index system.

Primary Index	Characterization Index	Formula	Unit
Green Credit	Interest expense ratio of high energy consumption industry	Industrial interest expenses/total industrial interest expenses of six energy-intensive industries	%
Green Investment	Investment in environmental pollution as a proportion of Gross Domestic Product (GDP)	Investment in environmental pollution/GDP	%
Green Insurance	Depth of agricultural insurance	Value is output by agricultural insurance income/gross agricultural	%
Government Support	Share of public expenditure on environmental protection	Expenditure on fiscal environment protection/general budget expenditure	%

The spatial spillover effect consists of spatial correlation and spatial dependence. Spatial dependence considers that economic activities' main body forms a dependence under the spatial interaction, which leads to variables' spatial correlation between regions. Spatial relevance depends on the spatial structure, and it must be related to the order and distance of the subject in geography and space. Factors causing spatial dependence therefore include externalizations, spillover effects, and so forth. The New Economic Geography School is committed to focusing its research on distance and spatial distribution and to considering the impact of transportation and spatial distance fully on economic activities. In later research, scholars realized spatial factors' importance gradually. Based on the above research, this paper selected local economic openness [33–35], human resource level, air quality [36–38], infrastructure [39], economic scale [40–42], the number of students in general higher education [43], and other relevant indicators to conduct empirical research. The variable description is shown in Table 2.

Table 2. Description of related variables and data sources.

Variable	Descriptions
Green Finance (GF)	There is a discussion in the preceding paragraph of the paper (Table 1)
Open	Total's ratio imports and exports to gross domestic product
Pop	Human resource levels are expressed in birth rate
AQ	Air quality is expressed as industrial SO_2 emissions
Infra	The degree of infrastructure construction is expressed in kilometers per capital
GDP	Economic size is expressed in terms of gross domestic product
Edu	Number of persons enrolled in general higher education

Based on the availability of data, this paper uses the entropy method to calculate the level of green finance development in 30 provinces, municipalities, and autonomous regions (except Tibet, Hong Kong, Macao, and Taiwan) from 2011 to 2019. The indicator data comes from the 2011–2019 China Statistical Yearbook, the Provincial Statistical Yearbook, and the China Insurance Yearbook. Table 3 shows the descriptive statistics of the variables [44]. According to the descriptive analysis of the above variables, green finance is generally underdeveloped, and the mean value is small, which indicates that the development level of green finance in China is not high, which also reflects the importance of this study. At the same time, it can also be seen that the standard deviation of air quality index and

infrastructure construction index is relatively high, that is, it can be seen that the air quality and infrastructure construction level of different provinces in China are greatly different. In view of this analysis result, the spatial effect and threshold effect of these variables will be further analyzed in the following paragraphs. Variables' descriptive statistics are shown in Table 3.

Table 3. Variables' descriptive statistics.

Variable	Obs	Mean	Std Dev	Min	Max
GF	270	0.185	0.108	0.0621	0.793
Pop	270	0.271	0.303	0.0170	1.548
AQ	270	11.25	2.588	5.360	17.89
Infra	270	47.94	39.21	0.267	182.7
LnGDP	270	0.00381	0.00237	0.000514	0.0142
LnEdu	270	9.748	0.879	7.223	11.59
Open	270	3.734	0.782	1.092	4.785

4. Spatial Effect Test and Empirical Analysis

4.1. Spatial Effect Test

As is visible from Table 4, the Moran's *I* index of low-carbon and sustainable financing in China is significant and positive at the 1% level. It shows that low-carbon and sustainable financing has a positive spatial agglomeration effect. Since there are many types of space panel models, to avoid deviations in further testing, selection and model settings of space panel models are required. The main test steps are as follows: firstly, use the LM statistic to test the auto correlation between the dependent variable of the spatial lag and the spatial error. Secondly, use Wald and LR statistics to choose whether the spatial Dubin model will become a spatial lag model or a spatial error.; Hausman statistics are used to select fixed effects and random effects to determine better panel effects. Finally, use the LR test result to choose the time fixed effect model, the space fixed for effect model, and the time and space double fixed effect model [45–47]. Specific results of the model test are shown in Table 5.

Table 4. Global spatial correlation of green finance.

Year	Spatial Adjacency Matrix	
	I	*p*-Value
2011	0.391	0.000
2012	0.381	0.000
2013	0.373	0.000
2014	0.373	0.000
2015	0.370	0.000
2016	0.349	0.000
2017	0.337	0.000
2018	0.379	0.000
2019	0.384	0.000

According to the Table 5, the four effect results show that the statistics and significance level of the spatial error model are better than those of the spatial lag model. The SAR model should therefore be selected for model regression. To ensure that the spatial model's estimation results are more robust, the LR test continues to be used for judgment [48]. According to the results in Table 5, the Wald and LR test significantly reject the two null hypotheses. The results show that the SDM model cannot be reduced to the SAR or the SEM model. The SDM model therefore needed to be selected for construction of the model in this article. Then, the Hausman test was used to determine whether the fixed effect or the random effect is selected. It showed that the fixed-effect model is better than the random-effect model when the original hypothesis is excluded at the 1% significance level. The LR test shows that the space-fixed effect and the time-fixed effect significantly reject

the null hypothesis. We should therefore choose the SDM model with two-way fixed effect as the regression's next work.

Table 5. Selection test of the spatial metrology model.

Panel Effect	Statistic Quantity	*p*-Value
LM Lag	7.857	0.0050
LM Lag (robust)	1.024	0.0120
LM Error	38.984	0.0000
LM Error (robust)	32.151	0.0000
Wald Spatial Lag	83.62	0.0000
Wald Spatial Error	112.66	0.0000
LR Spatial Lag	33.08	0.0030
LR Spatial Error	845.14	0.0000
Hausman test	23.68	0.0003

4.2. Empirical Analysis

In order to reduce heteroscedasticity factors' influence, the two indicators of economic development level and the number of college students were transformed into a natural logarithm.The SDM regression results are shown in Table 6.

Table 6. SDM regression results.

Variable	Random Effect	Time Fixation Effect	Space Fixing Effect	Double Fixing Effect
Open	−0.172 ***	0.2207 ***	−0.1817 ***	−0.1725 ***
	(−11.34)	(9.11)	(−12.54)	(−11.98)
Pop	0.0015	0.0019	0.0013	0.009
	(1.4)	(0.65)	(1.28)	(0.87)
AQ	0.00016 **	−0.0011 ***	0.0001 **	0.00014 **
	(2.2)	(−5.71)	(2.38)	(2.11)
Infra	−14.078 ***	6.395 *	−12.931 ***	−16.813 ***
	(−3.85)	(1.74)	(−3.55)	(−4.56)
LnGDP	0.0948 ***	0.1024 ***	0.0755 ***	0.0873 ***
	(4.28)	(5.42)	(3.21)	(3.75)
LnEdu	−0.107 ***	−0.0529 **	−0.1091 ***	−0.101 ***
	(−5.24)	(−2.52)	(−5.30)	(−4.97)
W * Open	0.0568 *	−0.05	0.07 **	0.1598 ***
	(1.75)	(−0.74)	(2.2)	(4.14)
W * Pop	−0.007 ***	0.0003	−0.00685 ***	−0.0097 ***
	(−3.69)	(0.07)	(−3.8)	(−3.86)
W * AQ	−0.004 ***	0.002 ***	−0.00045 ***	−0.00019
	(−4.78)	(5.25)	(−4.86)	(−0.01)
W * Infra	−7.763	−32.56 ***	−11.674 **	−43.191 ***
	(−1.48)	(−5.52)	(−2.22)	(−5.43)
W * LnGDP	−0.08 ***	−0.1844 ***	−0.0685 **	−0.1555 ***
	(−2.70)	(−4.77)	(−2.22)	(−4.18)
W * LnEdu	0.20***	0.099 **	0.2454 ***	0.2066 ***
	(5.02)	(2.16)	(5.95)	(4.41)
Rho	4.43 ***	0.93	4.44 ***	2.14 **
Log-likelihood	688.385	401.204	807.229	823.771

Note: ***, ** and * are significant at 1%, 5%, and 10% confidence levels, respectively. The data in the parentheses are *Z*-values.

Due to the existence of the spatial lag term of the independent variable in the SDM model, the above-mentioned estimated coefficients cannot directly reflect the independent variable's marginal effect on the dependent variable. The direct effect and the indirect effect constitute the space effect of the independent variable together, so further decomposition of the effect is needed. Direct spatial effects refer to the local effects of independent variables, while indirect spatial effects refer to the effects of local independent variables on

surrounding areas. The reason direct effect of the explanatory variable is different from the estimate of its coefficient is that there is a feedback effect. The feedback effect is generated because its influence on the neighboring area will be transmitted to the neighboring area and the neighboring area's influence will be transmitted back to itself. The decomposition results are shown in Table 7.

Table 7. Spatial effect decomposition of SDM.

Variable	Direct Effect	Indirect Effect	Total Effect
Open	−0.1378 ***	0.1235 ***	−0.0143
	(−9.55)	(3.38)	(−0.33)
Pop	−0.0016 *	−0.00929 ***	−0.0109 ***
	(−1.82)	(−4.04)	(−4.2)
AQ	0.00016 ***	0.0000028	0.00019
	(2.84)	(0.21)	(1.27)
Infra	−29.378 ***	−45.049 ***	−74.428 ***
	(−7.73)	(−5.69)	(−7.48)
LnGDP	0.05 ***	−0.136 ***	−0.0865 ***
	(2.66)	(−4.18)	(−2.67)
LnEdu	−0.049 ***	0.185 ***	0.135 **
	(−2.58)	(4.06)	(2.53)

Note: ***, ** and * are significant at 1%, 5%, and 10% confidence levels, respectively. The data in the parentheses are *Z*-values.

The results show: (1) Openness' degree. Openness' degree has a spatial crowding-out effect. The higher the degree of economic openness of surrounding provinces, the more resources and technologies they can attract, thus forming competition and migration of technologies and resources in cities and neighboring provinces. The degree of provinces' openness results in investment competition and crowding-out among countries. (2) Human resources' level. The human resource level's coefficient is significantly negative, indicating that the human resource's impact level on green finance's development is significantly negative. The larger the population, the higher the cost of environmental protection and the greater the weakening effect on green finance. The impact of human resources' level is manifested as a space that crowds affect at the same time. (3) Air quality level. The air quality level is correlated with green finance positively, but there is no spatial effect. It can be seen that the air quality level has little effect on green finance at the same time development. The main reason is that waste gas pollution's treatment has stimulated green investment. (4) Infrastructure level. The infrastructure level's coefficient is significantly negative. The spatial effect is also a crowding-out effect. It shows that the damage of infrastructure construction to the environment is more and more obvious. If green finance's concept is introduced into infrastructure construction, the damage to the ecology will be less and economic development will be more sustainable. (5) Level of economic development. Economic development's level is significantly positive, indicating that economic development's level is a direct factor that affects green finance's level. The impact of economic development's level is embodied in the competitive relationship spatially, that is, the crowding-out effect. Neighboring provinces' high economic level will not only increase green finance's level in the region, but also attracts investment that might otherwise be invested in neighboring provinces, making a horizontal province for it. This is consistent with the crowding-out effect that is caused by "market squeeze." (6) The coefficient of education level is negative and significant, which means that the education level's spatial impact is manifested as a spatial crowding-out effect. Provinces compete to attract outstanding talents to form migration and competition of labor capital in neighboring provinces. Talent flow causes green finance's level between provinces to have crowding-out effects and competition.

After analyzing the spatial effect, it is necessary to analyze the threshold data analysis. Firstly, before the threshold data analysis, it is necessary to verify whether the model has a threshold and significance value level. To test whether there is a threshold model, the

number of thresholds is determined. In this paper, the Bootstrap method is used to simulate the sampling of 300 search thresholds. The threshold data test results are shown in Table 8.

Table 8. Threshold effect test.

Variable	Threshold Type	*p*-Value	F-Value	1%, 5%, 10% Threshold
Open	Single threshold effect	0.180	29.15	58.344; 43.001; 36.749
	Double threshold effect	0.097	32.51	51.873; 37.915; 31.836
Pop	Single threshold effect	0.000	33.71	26.903; 22.554; 18.101
	Double threshold effect	0.560	8.74	44.606; 28.658; 22.003
AQ	Single threshold effect	0.000	88.01	37.151; 29.095; 23.708
	Double threshold effect	0.650	8.76	41.153; 29.665; 25.299
Infra	Single threshold effect	0.000	124.13	83.013; 58.055; 43.849
	Double threshold effect	0.980	3.21	184.961; 121.957; 79.096
LnEdu	Single threshold effect	0.446	24.92	87.516; 68.488; 56.052
	Double threshold effect	0.200	26.71	79.113; 45.041; 34.779

It can be seen that variables, such as human resource level, air quality, and infrastructure construction level, all have threshold effects in the relationship between economic development and low-carbon and sustainable financing. Table 9 shows the threshold regression estimation results when human resource level, air quality, and infrastructure construction levels are used as threshold variables, respectively.

Table 9. Panel threshold regression estimate.

Threshold Variable	Estimated Value	*T*-Value
GDP (6.745 < Pop ≪ 6.97)	0.1108 ***	8.74
GDP (6.97 < Pop ≪ 7)	0.0956 ***	8.25
GDP (3.32 < AQ ≪ 3.41)	0.0922 ***	8.5
GDP (3.41 < AQ ≪ 4.647)	0.0865 ***	7.88
GDP (0.0011 < Infra ≪ 0.0012)	0.2912 ***	12.66
GDP (0.0012 < Infra ≪ 0.0018)	0.0923 ***	9.55

Note: ***, ** and * are significant at 1%, 5%, and 10% confidence levels, respectively.

(1) When the population resource level is lower than the threshold of 6.97, the coefficient of impact of economic development on the low-carbon and sustainable financing is 0.1108, and it is significant at the 1% level; that is, economic development's level rises by 1%, and low-carbon and sustainable financing rises by 0.1108 percentage points. When the threshold is passed, the impact of economic development level on low-carbon and sustainable financing is still positive, but the impact coefficient is reduced to 0.0956, which is significant at the 1% level. Overall, the 19 human resource level's progress has promoted development. It shows that the higher the level of human capital, the stronger people's demand for ecological environment, and the more conducive they are to promoting the development of green finance. With human resource's improvement level of green finance, local governments, however, pay more attention to coordinated development with other aspects in green finance construction's process, so that the human resource level improves green finance. The effect is declining. (2) At the same time, it can be seen that when the air quality level is lower than the threshold data of 3.41, the influence coefficient of economic development on low-carbon and sustainable financing is 0.0922, and it is significant at the 1% level. The financial impact coefficient is reduced to 0.0865. This shows that in green finance's early development stage, reducing waste gas emissions promoted green finance's development, but with economic development's improvement, reducing waste gas emissions has continued to weaken promotion. At the same time, it can be seen that green finance has a restraining effect on the development of polluting industries and a significant promoting effect on the environmental protection industry. At the same time, it is also beneficial to promote the ecological development of local industrial structure.

(3) When infrastructure construction's level of low-carbon and sustainable financing is lower than the threshold data of 0.0012, the coefficient of impact of economic development on low-carbon and sustainable financing is 0.2912, and it is significant at the 1% level; that is, infrastructure construction's level rises by 1%, and low-carbon and sustainable financing rises by 0.2912 percentage points. When the construction level crosses the threshold data, the impact of the economic development level on low-carbon and sustainable financing is significantly reduced to 0.0923, which is significant at the 1% level. This shows that in economic development's early stage, infrastructure construction will promote green finance's improvement obviously, but green finance's improvement will no longer be so obvious, after infrastructure construction's level reaches a certain stage. It may be that before the level of infrastructure reaches the threshold, a large amount of infrastructure investment drives economic development and promotes the development of green finance at the same time. However, when the level of infrastructure construction reaches a certain level, the local development concept is transformed and upgraded. They play a better role in improving the efficiency of environmental pollution control through the sharing of technology and governance experience, and in a disguised way, reduce the role of infrastructure in promoting green finance. The result of threshold effect decomposition is also consistent with the conclusion of related papers [48–50].

5. Policy Recommendations

(1) Construct a green financial development model with regional linkage. The development of green finance in China has spatial spillover effects and strong agglomeration effects, and development's level presents regional imbalance's characteristics; besides, infrastructure and population have a restraining effect on green finance's development between regions. Various provinces should therefore pay attention to the top-level design and handle green finance development's unbalanced and inadequate problems properly among cities and various provinces. Its inhibitory effect on green finance's development in neighboring cities should be controlled, and a regional green finance development model with linkage effects should be formed. China's different regions have different time for green finance, and their development focus and development progress is also different. It is necessary to exchange practical experience between regions, gain experience, and learn lessons from other regions' green finance development experience, and promote regional green finance's coordinated development.

(2) Build a new pattern of opening up and promote the coordinated development of low-carbon and sustainable financing. We found that a degree of regional economic openness has a positive impact on development of green finance. Finance is the modern economy's core "Double Carbon", and the target will generate huge investment and financing needs; relying on government funds would be far from sufficient. We need to give free rein to market mechanism's role and cultivate and develop the carbon financial market. The national carbon emissions that the trade market has officially launched for carbon emission rights' future value will gradually emerge. With the continuous improvement of market rules, we should also enrich the carbon financial instruments with carbon emission quota as the target, and encourage financial institutions to participate in carbon market transactions. We should also innovate and form more and better low-carbon, low-cost development models and green low-carbon investment and financing cooperation models to enhance the financing capacity of green projects. Therefore, all provinces need to build a new pattern of openness, insist on innovation-driven development, and maintain stable economic development. Moreover, we need to strengthen the government's role in the process of economic development, guide social capital's flow to green industries, and accelerate green process of the three major industries; the organic integration of finance and green economy promotes the coordinated development of economy and green finance.

(3) Improve regional economic growth's quality and promote green finance's coordinated development. The traditional economic growth model not only cannot improve green finance's development, but also has a negative impact on green finance. Inter-regional

economic transformation is therefore necessary. Economic development must be green, although green finance can become a new growth point for economic development. Based on this, regional economic development is not measurable solely by the gross domestic product (GDP) level. Economic development's quality should be improved, not just focusing on quantity's improvement, but the simultaneous improvement of quantity and quality. It therefore is necessary to increase the amount of green investment so that its share of GDP will continue to rise, and its level of green finance development needs to be increased. The improvement of inter-regional economic development's quality can, on the one hand, give way to economic development's radiating effect, and at the same time promote green finance's coordinated development among regions.

(4) Formulate pollutant discharge standards to promote environmental protection investment structure's rationalization. Due to the negative spatial spillover effects of pollutant emissions from provinces of China, if pollutant emissions are reduced only by industrial transfer or by reducing the number of plants, this would be "boiling the broth" rather than "drawing from the pot's bottom".Resource utilization's efficiency must be improved to reduce pollution emissions. Most of the investment in industrial pollution sources' treatment is devoted to the remediation process of waste-water and waste-gas, and less attention is paid to production technology's innovation and economic development's improvement models, resulting in lag and poor pollution control effects in the optimization and upgrade of the industrial structure. According to circular economy development's principles, source governance is often better than end governance. Environmental protection must overcome pure end-of-pollution governance, formulate pollutant discharge standards, strictly focus on pollution control's combination and resource utilization, and place emphasis on the application of clean technology and pollution prevention technology to promote the upgrading and optimization of environmental protection investment.

(5) Increase investment in green education and increase environmental protection's public awareness. Educational level has a role in promoting green finance's development. China has increased investment in high-level universities' construction and improved the level of higher education through municipal and provincial joint construction and government assistance to achieve green financial knowledge's popularization and the training goals of higher education talents, thereby improving the public's financial quality and the concept of green environmental protection. Attention should be paid to cross-professional talents' training and increase compound talents' proportion in the financial industry at the same time. Finally, there is a need to strengthen the in-depth integration of production, education, and research, promote green industries' development through technological innovation, transform the latest technological and scientific achievements into technological and scientific forces that support green industries' development, and use technological means to reduce environmental pollution problems and carbon emissions.

In this paper, when discussing the impact of green finance on economic development, indicators such as the proportion of green credit balance are mostly adopted. However, the connotation of green finance is far more than green credit, green insurance, green investment, green bonds, and green trust financial products. However, due to the lack of available data, the indicator system of green finance is not comprehensive, scientific, or systematic. In future studies, more detailed studies can be carried out according to provincial differences.

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