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Research on the impact of green finance development on air quality

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Abstract: *Green finance is an important measure to promote sustainable economic development under the goal of "double-carbon". Green finance has also had a significant impact on air quality as it suppresses carbon emissions. This paper based on empirical research that green finance has effectively improved air quality, and path inspection finds that green finance has mainly improved air quality by promoting green innovation. The analysis of regional heterogeneity shows that compared with the eastern region, green finance has a more obvious impact on air quality in the central and western regions.*

Keywords: *green finance; air quality; environmental pollution; mesomeric effect*

1. Foreword

The concept of green finance was put forward at the end of the last century. In recent years, with the "establishment of green finance system, the development of green credit, green bonds and the establishment of green development fund" has been frequently mentioned in many important national conferences, the attention of green finance is gradually increasing. At present, the research focus of scholars mostly focuses on the inhibitory effect of green finance on carbon emissions, and there are still few studies on the role of green finance in air quality.

In theoretical logic, the impact of green finance on air quality may be due to the following reasons. On the one hand, green finance forms financing constraints on polluting enterprises, forcing funds to gradually withdraw from polluting enterprises, so as to gradually eliminate enterprises with higher pollution levels and improve air quality. Secondly, under the general awareness of environmental protection, consumers have a consumption preference for green enterprises, which improves the goodwill of green enterprises, but also leads to investors' investment preference for green enterprises, reduces the borrowing cost of green enterprises, creates a good external financial environment for green enterprises, and reduces environmental pollution. Moreover, the main goal of the development of green finance is to reduce carbon emissions, and exhaust emissions are often directly proportional to carbon emissions. When green finance has an inhibitory effect on carbon emissions, the emissions of various waste gas will also be suppressed accordingly. Finally, according to previous research, green finance will promote the development of green innovation, and the upgrading of technology is bound to reduce exhaust emissions and optimize air quality. In conclusion, this paper believes that green finance is one of the important ways to improve air quality and achieve green development.

Based on this, this paper studies the impact and action mechanism of green finance on air quality through empirical methods through the data of green finance, air quality and macroeconomic conditions in China from 2011 to 2019. The empirical research shows: first, the development of green finance has a significant effect on air quality; second, green finance mainly improves air quality through green innovation; third, compared with the eastern region, green finance has a more obvious impact on air quality in the central and western regions. The incremental contribution of this paper lies in: first, linking the development of green finance and air quality, studying the relationship between the two through empirical analysis, and broadening the practical significance of green finance; second, clarifying the path and mechanism of green finance in the process of improving air quality, and explaining the intermediary effect of green innovation; third, discovering the different effects of green finance on air quality improvement in different regions, which is conducive to the optimization of green finance policy and makes green finance play a greater effect in air quality improvement.

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2. Literature review

2.1. The impact of green finance on enterprise technological innovation

Green finance refers to the financial services provided for project investment, financing and risk management in the fields of environmental protection and energy conservation, including green credit, green insurance and green development fund. Scholars from all over the world have made many progress in their research on green finance in green innovation. Debnath And Sen (2015) believe that environmental regulation and green finance jointly play a role in promoting enterprise green innovation[1][2]; Ramanath (2017) believes that there is a positive "U" -shaped relationship between green finance and enterprise green innovation, that is, the former has a "threshold" effect in promoting the effect of the latter[3]; He Lingyun et al. (2019) believe that the impact of green finance is mainly focused on the impact on the green innovation of enterprises[4]; Yanlin Sun et al. (2019) found that green credit has a positive effect on the technological progress of enterprises, and this effect is more significant in private enterprises[5]; Flammer (2020) Find green bonds to promote enterprises to carry out green innovation activities[6].

2.2. Impact on air quality

The current literature discussion on affecting air quality focuses on technological innovation. In this regard, most of the findings suggest that technological advances can improve air quality. Thomas (1999) and others found that with the development of science and technology, the efficiency of energy use has gradually improved, making the emissions of air pollutants have produced great changes[7]; Cheng Aihua (2011) found that technological advances play a key role in China's decades of SO2 emission reduction[8]; Du Wencui (2013) found that the main methods for different industrial countries to improve air quality were different. The industrial countries and quasi-industrial countries adopted the energy efficiency improvement and improvement method and pollution control technology methods respectively, showing differences [9]; Xie Ronghui (2021) believes that green technology progress has played a key role in China in improving environmental quality[10].

2.3. The impact of green finance on air quality

At present, there are still few studies on the impact of green finance on air quality. Li Wenjing (2016) believes that the development of green finance has realized the optimal allocation of capital and significantly improved the local environmental quality[11]; Su Dongwei (2018) believes that green credit can affect the investment and financing behavior of heavily polluting enterprises and thus affect the exhaust emissions[12]; Qiao Bin (2021) believes that green credit can significantly improve the air quality of all provinces and regions and the financial market develops well, and the air quality improvement effect of green credit is better[13].

2.4. Literature review

Through the review of the previous literature, it is found that when studying the influence and role of green finance, the existing literature mainly discusses green finance from the aspect of technological innovation. Previous studies shows that the development of green finance has effectively promoted technological innovation. In terms of the research on the factors affecting air quality, most of the studies focus on the perspective of technological innovation, and believe that with the innovation and development of technology, air quality has been greatly improved. However, when studying the relationship between green finance and air quality, only some scholars have found the impact of green credit on exhaust emissions, and few scholars have studied the impact of green finance on air quality and further explored its role path. Therefore, this paper from the perspective of air quality test green financial development on air quality and its path, the green finance in the actual effect of air quality evaluation, open open economy through green finance to improve air quality of environmental governance ideas, further play to the role of green finance, realize the optimal allocation of social capital, improve regional air quality.

3. Theoretical analysis and hypothesis are proposed

This paper believes that green finance can promote the improvement of air quality through the

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following ways. On the one hand, the green finance through green enterprises provide lower lending rates, reduce the financing cost of green innovation, and in the government and social public groups under the advocacy of low carbon life, investors and consumers have more preference for green enterprises, to enhance the enthusiasm of the enterprise green innovation, promote enterprises continuously green innovation, and reduce pollution emissions, so as to improve the air quality. On the other hand, by increasing the lending rate of polluting enterprises, green finance eliminates the highly polluting enterprises in the industry, and forces polluting enterprises to carry out green innovation, so as to purify the air quality.

Based on the above analysis, the paper proposes the following hypothesis:

H1: The development of green finance will significantly promote the improvement of air quality.

4. Data description and model setting

4.1. Data description

The data of this paper selected panel data from 30 provinces from 2011-19 to 2019. Due to the lack of some data, a total of 270 observed values were obtained after collation. Data sources: China Statistical Yearbook, China Environmental Statistical Yearbook, wind database, China Tai'an database.

4.2. Kernel variable

4.2.1. Explained variable

In this paper, referring to the study of Ye Li et al. (2019), the smoke (powder) dust emission (SP) is used as the explained variable to measure the air quality of a province [14].

4.2.2. Core explanatory variables

This paper refers to the construction method of green Finance Index (GFI) of Song Yuru (2022), and uses the green finance index of each province to measure the development level of green finance in each province [15-16]. The green finance index is specifically composed of the indicators in Table 1, and the green finance index data is calculated by the entropy method.

Table 1: The Construction of the Green Finance Index

Level 1 indicators	Characterization index	Indicator instructions	Indicator attributes
green-credit policy	The proportion of interest expenditure in high-energy consumption industries	Interest expenditure of six energy-intensive industries / total industrial interest expenditure	—
Green investment	Investment in environmental pollution control in GDP	Investment in environmental pollution control / GDP	+
Green insurance	Agricultural insurance depth	Agricultural insurance income / gross agricultural output value	+
government support	Proportion of fiscal spending on environmental protection	Expenditure on fiscal and environment protection / general fiscal budget expenditure	—

4.2.3. Controlled variable

This paper, referring to the previous research, add the following control variables: per capita GDP (GDP), urban population density (PD), the average number of students (AE), per capita road area (AR), in addition, also control the province fixed effect, remove the influence of different provinces itself, makes the empirical results more robust.

4.3. The model assumes

To verify hypothesis H1, the following model is constructed using the practice of Qiao Bin (2021)[13]:

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$$SP_{i,t} = \alpha_1 + \beta_1 GFI_{i,t} + \delta_1 Controls_{i,t} + \mu_i + \varepsilon_{i,t} \quad (1)$$

In model (1), i and t refer to provinces and years, respectively. Among them, the dependent variable $SP_{i,t}$ is the t-th year's smoke (powder) dust emissions from a certain province i; The core explanatory variable $GFI_{i,t}$ is the green finance index of a certain province i in the t-th year; $Controls_{i,t}$ is the control variable; In addition, μ_i represents the fixed effect of the province, and $\varepsilon_{i,t}$ represents the error term. The coefficient β_1 is the most important, and if β_1 is significantly less than 0, it indicates that the development of green finance will significantly suppress smoke (powder) emissions, that is, the development of green finance will significantly promote the improvement of air quality, that is, hypothesis H1 is valid.

5. Analysis of the empirical results

5.1. Benchmark regression results

5.1.1. Descriptive statistics

Descriptive statistical results for each variable are shown in Table 2:

Table 2: Descriptive statistical results

VARIABLES	N	mean	sd	min	max
SP	270	0.403	0.304	0.0154	1.798
GFI	270	0.185	0.108	0.0621	0.793
GDP	270	0.547	0.263	0.164	1.642
PD	270	0.287	0.115	0.0764	0.582
AE	270	0.259	0.0796	0.108	0.561
AR	270	0.156	0.0469	0.0404	0.262

5.1.2. Empirical test

Table 3: Empirical analysis results of the impact of green finance on air Quality

VARIABLES	SP	SP	SP	SP	SP
GFI	-0.914***	-1.046*	-1.075**	-1.119**	-1.202**
	(-3.33)	(-1.96)	(-2.01)	(-2.09)	(-2.24)
GDP		0.047	0.049	0.120	0.194
		(0.29)	(0.30)	(0.69)	(1.10)
PD			0.168	0.150	0.100
			(0.66)	(0.59)	(0.39)
AE				-0.715	-0.152
				(-1.18)	(-0.22)
AR					-1.260*
					(-1.71)
Constant	0.572***	0.571***	0.528***	0.687***	0.727***
	(11.06)	(10.98)	(6.28)	(4.31)	(4.53)
Observations	270	270	270	270	270
R-squared	0.044	0.045	0.046	0.052	0.064
Number of region	30	30	30	30	30
region FE	YES	YES	YES	YES	YES
F test	0.00101	0.00435	0.0102	0.0131	0.00826
r2_a	-0.0756	-0.0798	-0.0823	-0.0805	-0.0718
F	11.09	5.565	3.847	3.237	3.194

t-statistics in parentheses

*** p<0.01, ** p<0.05, * p<0.

Table 3 shows the regression results of the model. Table 3, column (1) shows the results of regression without control variables, columns (2) - (4) shows the progressive addition of control variables, and column (5) shows the results of all control variables. From Table 3 in columns (1) - (5),

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the regression coefficient of GFI is significantly negative and remains essentially significant at the 5% level. The results show that green finance has a significant inhibitory effect on the smoke (powder) dust emission, which greatly improves the air quality. This conclusion supports the hypothesis of H1 that the development of green finance will significantly improve air quality.

5.2. Robustness test

Table 4: Results of the robustness test

VARIABLES	SP	SO
GFI	-1.202**	-2.854***
	(-2.24)	(-3.93)
GDP	0.194	0.037
	(1.10)	(0.16)
PD	0.100	-0.452
	(0.39)	(-1.31)
AE	-0.152	-4.339***
	(-0.22)	(-4.65)
AR	-1.260*	-4.271***
	(-1.71)	(-4.27)
Constant	0.727***	2.896***
	(4.53)	(13.33)
Observations	270	270
R-squared	0.064	0.508
Number of region	30	30
region FE	YES	YES
F test	0.00826	0
r2_a	-0.0718	0.437
F	3.194	48.58

t-statistics in parentheses
*** p<0.01, ** p<0.05, * p<0.1

5.3. Impact mechanism test

Through the above empirical inspection, it is found that green finance has a real effect on improving air quality, but the mechanism of green finance on air quality is still not clear. In order to understand this problem, this paper carries out further research. Based on previous research, it is assumed that the impact path is: green finance, green innovation and innovative air quality. To verify this path of influence, stepwise regression was used to test the presence of this mediation effect.modelling:

$$GP_{i,t} = \alpha_2 + \beta_2 GFI_{i,t} + \delta_2 Controls_{i,t} + \mu_i + \varepsilon_{i,t} \quad (2)$$

$$SP_{i,t} = \alpha_3 + \beta_3 GFI_{i,t} + \gamma_3 GP_{i,t} + \delta_3 Controls_{i,t} + \mu_i + \varepsilon_{i,t} \quad (3)$$

The control variables in model (2) and model (3) are completely consistent with the above model (1) variables, and the empirical results are shown in Table 5. Where column (1) represents the empirical results of model (1), column (2) represents the empirical results of model (2), and so on. The empirical results show that it can be seen from column (2) that the development of green finance has a positive effect on green innovation, and it is significant at the level of 1% respectively. It can be seen from column (3) that the coefficient of GP and GFI is significantly negative. Based on the three empirical results, it can be seen that there is an intermediary effect, that is, the influence path of green finance and green innovation air quality is confirmed.

Table 5: Influences the mechanism test results

VARIABLES	SP	GP	SP
GP			-0.042*
			(-1.67)
GFI	-1.202**	4.923***	-0.996*
	(-2.24)	(3.55)	(-1.82)

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GDP	0.194	2.797***	0.311
	(1.10)	(6.08)	(1.64)
PD	0.100	1.412**	0.159
	(0.39)	(2.14)	(0.62)
AE	-0.152	4.805***	0.049
	(-0.22)	(2.69)	(0.07)
AR	-1.260*	-6.401***	-1.527**
	(-1.71)	(-3.35)	(-2.03)
Constant	0.727***	-2.342***	0.629***
	(4.53)	(-5.63)	(3.69)
Observations	270	270	270
R-squared	0.064	0.620	0.075
Number of region	30	30	30
region FE	YES	YES	YES
F test	0.00826	0	0.00552
r2_a	-0.0718	0.565	-0.0638
F	3.194	76.79	3.145

t-statistics in parentheses
*** p<0.01, ** p<0.05, * p<0.1

5.4. Analysis of regional heterogeneity

Table 6: Analysis of regional heterogeneity

VARIABLES	Eastern Province SP	SP
GFI	-1.254*	-2.541**
	(-1.88)	(-2.05)
GDP	0.352	-0.188
	(1.52)	(-0.57)
PD	-0.321	0.417
	(-0.52)	(1.62)
AE	-3.105**	3.247***
	(-2.36)	(3.62)
AR	0.022	-1.852**
	(0.01)	(-2.15)
Constant	1.465***	0.227
	(3.63)	(1.34)
Observations	99	171
R-squared	0.115	0.181
Number of region	11	19
Company FE	YES	YES
F test	0.0674	1.76e-05
r2_a	-0.0453	0.0526
F	2.151	6.489

t-statistics in parentheses
*** p<0.01, ** p<0.05, * p<0.1

This paper further analyzes the regional heterogeneity impact of green finance on air quality. Since the reform and opening up, a large number of foreign capital has entered the mainland, and the eastern region of China has developed rapidly by relying on its coastal advantages of convenient communication and transportation. However, the central and western regions are located in the hinterland with inconvenient transportation, and are in the blank area of foreign trade for a long time, thus opening the gap between the economic construction of the two regions. With the continuous development of economy and society, the traffic situation in the central and western regions has improved, but in the face of the complex transportation network accumulated over the years and the good business environment bred in the eastern region, it is still at a disadvantage in attracting foreign investment. The different economic forms and economic scale have a huge impact on social capital, and will inevitably affect the role of green finance in the process of air quality improvement. Therefore, this paper divided the provinces into eastern, central and western provinces for regression analysis, and the regression results are shown in Table 6.

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As can be seen from Table 6, the coefficient of green finance is negative and significant, and the coefficient in the Midwest region is larger than the absolute value in the eastern region. This suggests that green finance has played a role in improving air quality in both regions, but at different efforts. This also meets the urgent needs of many resource-intensive enterprises, making entrepreneurs more enthusiastic about the development of green finance and more willing to optimize production through green finance financing. This invisibly expands the impact of green finance in the central and western regions, thus making the inhibitory effect on air pollution more obvious. On the other hand, the development of green finance in the central and western regions is relatively slow, the green finance market is not mature, and various preferential incentive policies have not been well transmitted to enterprise decision makers. There is a large space for the development of green finance, and the activity and heat of the green finance market are still on the rise.

6. Conclusion and policy recommendations

In the context of carbon peak and carbon neutrality, green finance has been developed to a large extent. However, most scholars focus on the role of green finance in promoting the reduction of carbon emissions. The effective role of green finance in other areas, especially in reducing exhaust emissions and optimizing air quality, has not received attention. To this, in order to study the role of green finance in air quality improvement and clear the role of the path, this paper adopts 30 provinces in China, the green finance on the quality of air is studied, the results show: green finance promoted the improvement of air quality, further research found that its influence mechanism for the green innovation mediation effect on air quality, and in different areas of air quality is different. This greatly enriches the practical significance of green finance and is conducive to promoting the attention of green finance and further development. On the capital level, enhance the influence of green finance, improve the capital market confidence in the development of green finance, broke the rumor of "green finance is a stunt", stabilize the green financial market, improve the green financial capital preference, promote more capital to join the green finance, solve the current green financial sector facing the amount of funds, participation is not wide, the problem of market confidence is not enough. On the social level, the green financial improvement of air quality will make the atmospheric environment optimization, improve the level of residents living environment, enhance residents' happiness, at the same time make more ordinary people attention, understanding, support the development of green finance, let the concept of green finance into the homes, create a better green financial ecosystem. At the enterprise level, the sustainable and effective development of green finance will make more and more enterprises to pollution emissions, under the continuous optimization of green finance, high pollution enterprises gradually exit the market, low pollution enterprises occupy the market, form a virtuous cycle, new green innovation technology also emerging, eventually form the green revolution of the whole industry. Based on the research conclusion, the paper puts forward the following policy suggestions:

1) We will expand the development of green finance.

2) Enhance the support of green innovation, through the results of this paper, green innovation in green finance in the process of air quality play a strong intermediary effect, therefore, to further enhance the support of green innovation strength can more effectively play the power of green finance, increase the marginal effect of green finance. This also suggests that the government should pay attention to the transformation of green finance to green innovation when formulating green finance policies. With the continuous support for green innovation, it is believed that green finance will play a greater vitality and play a greater role in the improvement of air quality.

3) Fully consider the regional heterogeneity of green finance on air quality, to achieve the overall improvement of national air quality. Empirical results show that green finance, the Midwest regional air quality, has a more significant improvement effect, but given the Midwest financial foundation is backward, in the green financial air quality dividend has stronger backwardness advantage, if appropriate green finance, tilt to the Midwest region in the air quality problem can also achieve "corner overtaking", thus realizing pareto improvement and the overall environmental quality improvement.

References

[1] Denbnath S C.Environmental Regulations Become Restriction or a Cause for Innovation – A Case Study of Prius and Nissan Leaf [J]. Social and Behavioral Sciences,2015,(195):324-333
[2] Sen S .Corporate governance, environmental regulations, and technological change [J]. European Economic Review, 2015. 80 (11):36-61
[3] Ramanathan R .Environmental regulations, innovation and firm performance: A revisit of the Porter hypothesis [J].Journal of Cleaner Production 1 July 2017, Pages 79-92

ISSN 2616-5902 Vol. 6, Issue 2: 167-174, DOI: 10.25236/AJBM.2024.060224

[4] He Lingyun, Liang Xiao, Yang Xiaolei, Zhong Zhangqi. Can green credit promote the technological innovation of environmental protection enterprises [J]. Financial Economics Research, 2019, 34 (05): 109-121.
[5] Yanlin Sun, Shi Bo Shu. The impact of green credit policy on enterprise innovation—Empirical study based on PSM-DID model [J]. Eco-economy, 2019, 35 (07): 87-91 + 160.
[6] Flammer C .2020 .Corporate green bonds .Journal of Financial Economics.working papaer .at SSRN .https://ssrn .com/abstract= 3125518
[7] Thomas M Selden,Anne S Forrest, James E. Lockhart.Analyzingthe R eductions in U.S.Air Pollution Emissions: 1970 to 1990[J].Land Economics, 1999 (1): 1-21.
[8] Shen L , He G , Yan H .Research on the Impact of Technological Finance on Financial Stability: Based on the Perspective of High-Quality Economic Growth[J].Complexity, 2022, 2022.
[9] Du Wencui, Feng Ke. Will urbanization worsen air quality?—Empirical evidence from the emerging economies [J]. Comparison of economic and social systems, 2013 (05): 91-99.
[10] Xie Ronghui. Green technology progress, positive externalities and environmental pollution control in China [J]. The Management Review, and the 2021, 33(06):111-121. DOI: 10.14120/j. cnki. cn11-5057/f.2021.06.009.
[11] Li Wenjing, Zheng Manni. The treatment mechanism of air pollution and its effect—empirical data from prefecture-level cities [J]. The Industrial economy of China, 2016(04): 93-109.DOI: 10.19581/j.cnki.ciejournal.2016.04.008.
[12] Su Dongwei, Lian Lily. Does green credit affect the investment and financing behavior of heavily polluting enterprises? [J]. Financial Research, 2018 (12): 123-137.
[13] Qiao bin. The impact of green credit on air quality [J]. Social scientist, 2021 (06): 7-14.
[14] Ye Li, Li Xinguang. Impact of air quality on inbound tourism income in China [J]. Statistics and decision-making, 2019, 35(08):101-104.DOI:10.13546/j.cnki.tjyjc.2019.08.024.
[15] Yu-ru song. Analysis of the measurement and Distribution characteristics of the Green Finance Development Index in China [J]. Western Finance, 2022(04):29-36.DOI:10.16395/j.cnki. 61-1462/f. 2022.04.009.
[16] Cao Jing, Wang Xin, Zhong Xiaohan. Has the restriction policy improved Beijing's air quality?[J]. Economics (Quarterly Journal), 2014, 13(03):1091-1126.DOI:10.13821/j.cnki.ceq.2014.03.001.