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# The Impact of green finance on ESG performance in Chinese listed companies: a moderating effect of fin-tech

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## Abstract

With the concept of sustainable development, the role of green finance in promoting corporate environmental, social and governance (ESG) performance has become increasingly prominent. This paper takes the impact of green finance on corporate ESG performance as the core of the study to explore its key role in enhancing corporate sustainability. Meanwhile, fintech is introduced as a moderating variable to analyze its moderating effect in the relationship between green finance and ESG. Based on the theoretical analysis and empirical data, the study finds that green finance has a significant positive impact on corporate ESG performance, especially the most significant in terms of environmental performance. Fintech plays a positive moderating role in it, which can enhance the efficiency and transparency of green financial resource allocation and further promote the realization of corporate ESG objectives. The research in this paper provides theoretical support and practical reference for promoting the development of green finance, building intelligent financial ecosystems and optimizing corporate ESG management.

## CCS Concepts

• Applied computing; • Law, social and behavioral sciences; • Economics;

## Keywords

Green Finance, ESG, moderating effect, Fin-tech

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## 1 Introduction

China's economy has maintained a high rate of development since the reform and opening. Nevertheless, the traditional crude and episodic development model has led to significant resource consumption and environmental degradation in the process of rapid

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economic development, thereby presenting China's ecological environment with even greater challenges. The 19th CPC National Congress report unequivocally emphasizes the necessity of vigorously advancing the development of ecological civilization and the comprehensive implementation of the green development concept of "lucid waters and lush mountains are invaluable assets." [1]. Additionally, the Central Working Conference in October 2023 highlighted five significant articles in the financial sector, of which green finance is a critical component. Green finance, as a policy tool to support the green transformation of the real economy, is distinct from traditional finance in that it possesses both financial resource allocation and environmental regulation characteristics. It is not only a practical method for the government to assume the role of financial regulation of the market in environmental governance, but also a useful complement to the traditional means of environmental regulation [2].

The requirements of businesses, investors, and the public are being transformed by the need for sustainable development as social issues such as climate change, environmental protection, and public health become more prominent [3]. Environmental, Social, and Governance (ESG) has evolved into a critical reference standard for companies and investors in the context of social responsibility and sustainable development, because of the United Nations' promotion of the Sustainable Development Goals (SDGs) in 2015. In the financial investment sector, it has become a prevailing practice for capital market investors to incorporate ESG concepts into their investment decisions. As of October 2022, 843 A-share listed companies received an average score of 1.36 (out of a total score of 5) under FTSE's ratings, which is on the low side, according to the ESG Action Report 2022,2023. FTSE and MSCI only cover approximately 14% of Chinese listed companies. To accomplish sustainable economic development, it is imperative to improve the environmental, social, and governance (ESG) performance of China's listed companies.

In this context, the accelerated advancement of FinTech offers new technical support for green finance. Financial technology (FinTech) is a cutting-edge financial framework that employs technologies such as blockchain, artificial intelligence, cloud computing, and big data to enhance financial efficiency and optimize resource allocation. It enhances the efficiency of identifying green initiatives and the ability of risk assessment, in addition to expanding the boundaries of green financial products and services. In this regard, financial institutions can more precisely determine the environmental performance of enterprises and implement dynamic monitoring of ESG indicators with big data analysis. On another hand, blockchain technology contributes to the enhancement of

investor confidence in corporate sustainable development and the improvement of transparency and traceability in ESG disclosure. Furthermore, the digital transformation of green financial instruments has been expedited by FinTech, which has also facilitated the innovative development of green credit, green bond, and carbon financial markets. It is conceivable that FinTech plays a significant moderating role in the process of green finance, which is designed to enhance ESG performance.

## 2 LITERATURE REVIEW

According to the relevant stakeholder theory, its core view is that corporate should not only satisfy the maximization of shareholders' interests but also need to satisfy the interests of relevant stakeholders, such as the government, society, the public and investors [4]. The rise of green finance is not only a reflection of capital flow to green industry, but also an externalized expression of corporate awareness of multi-stakeholder responsibility. Through the mechanism of green finance, enterprises respond positively in terms of environmental responsibility, social responsibility and governance structure, thus enhancing overall ESG performance and promoting the realization of sustainable development goals [5].

Unlike traditional finance, green finance focuses on the integration of environmental factors and finance, and is committed to balancing environmental protection and economic development, which is highly compatible with the concept of green and sustainable development in China at the current stage, and is an effective means of realizing the country's "dual-carbon" goal [6]. Green finance includes different types of financial instruments used to finance environmental measures such as renewable energy, energy conservation, sustainable waste management and biodiversity protection. The development of green finance is an important driving force in realizing low-carbon emission reduction and sustainable economic development [7]. China attaches great importance to the development of green finance, through the construction of pilot zones for green financial reform and innovation and the increase of green financial products to help promote the green transformation and development of enterprises [8]. These measures are aimed at encouraging and promoting sustainable development, looking to future projects and generating positive spillover effects [9].

Environmental, Social and Governance (ESG) investing has gained a lot of attention since the United Nations in 2004 with the growing interest in green development and sustainability [10]. ESG metrics have been used as proxies for investment strategies, integrating ESG concerns with financial objectives in investment decisions. Some of the literature highlights the evolution of CSR and ESG and related issues suggesting that ESG can be seen as an evolution of the CSR concept. [11]

Specifically, cutting-edge technologies such as big data, artificial intelligence and blockchain have significantly improved the efficiency and accuracy of ESG data management. These technological tools enable companies and investors to access, analyze and apply ESG information more efficiently, to make more scientific and reasonable decisions, and thus strongly promote the deepening and landing of ESG practices. Recent studies have shown that ESG ratings can significantly mostly influence the green innovation

behavior of enterprises and become an important mechanism to guide the sustainable transformation of corporate.

Currently, existing research suggests that the green finance system can promote the improvement of corporate ESG performance. However, the above studies, on the one hand, use the DID model to explore the impact of green development policies on corporate ESG or use only green credit to represent the green finance, which lacks comprehensiveness. Green finance is a complete financial system, including green policies and green financial markets [12,13]. Existing studies are less likely to combine fintech and green finance to study their synergistic effects. Therefore, this study firstly utilizes the entropy value method to form a green financial indicator system with seven indicators, including green credit, green investment, green support, green insurance, green bond, green fund and green equity (including carbon finance), and then uses fintech as a moderating variable to explore the impact of the combination of these seven indicators on the ESG performance of corporate.

## 3 DATA PROCESSING

### 3.1 The source of the data

The study utilizes data from listed firms in Shenzhen and Shanghai from 2013 to 2023 to analyze how green finance impacts corporate ESG performance. Data source of the baseline sample primarily comprises two components: The first part of the data primarily comprises firm-level information, including ESG data, financial data predominantly sourced from the Huazheng ESG database and CSMAR database, the second part mainly includes the macroeconomic data matching the company-level data, primarily sourced from the public papers of the Bureau of Statistics and the People's Bank of China, as well as various related yearbooks.

According to previous scholars' research, this paper selects the following variables for research, and the results are shown in Table 1

### 3.2 Data processing

This paper focuses on constructing panel data from 2013-2023: (1) firstly, real estate firms and financial industries are removed. (2) discontinuous data are removed. (3) 1% double-tailed treatment is carried out. Finally, this study obtained 16004 balanced panel data

As table2 shows, the maximum value of ESG performance is 92.93, and the minimum value is 36.62, indicating that there is a big difference in the ESG performance of different enterprises. The minimum value of green finance is 0.07, and the maximum value is 0.928, which shows that there is a big difference in the development level of green finance in Chinese provinces, and the maximum value of FT is 7.363, and the minimum value is 0. It shows that the development of the level of financial technology of each listed company is not consistent.

Table 3 reports the pairwise correlation coefficients among the key variables used in the analysis. None of the pairwise correlations exceed 0.7, indicating that multicollinearity is unlikely to be a significant concern in the subsequent regression analyses.

**Table 1: Variable Selection Results**

Variable category	variable symbol	variable	measurement method
Explained variable	GF	Green finance	Entropy Method to calculate green finance index including green credit, green bond, green insurance, carbon finance, green investments, green fund and green support.
Explanatory variable	ESG	ESG	Huazheng ESG index
Moderating variable	FT	Fin-tech index	Use python to grasp word frequencies from annual report including “AI”, “Big Data” and “Block-chain”. Then the number of word frequencies is summed and added to 1 and processed in natural logarithm to obtain the index.
Control variable	$control_1$ $control_2$ $control_3$ $control_4$	Size Lev Roa TOP 1	logarithmic measure of total assets of the enterprise for the year The book value of total debts divided by total assets. The book value of net income divided by the total asset. The shareholding ratio of the largest shareholder

**Table 2: Descriptive statistical results of variables**

Variable	Obs	Mean	Std. Dev.	Min	Max
ESG	16037	73.432	5.071	44.67	92.93
gf	16037	.613	.214	.07	.928
FT	16037	1.581	1.411	0	6.306
Size	16037	22.629	1.301	19.585	26.44
Lev	16037	.426	.192	.046	.925
ROA	16037	.039	.06	-.375	.254
Indep	16037	37.709	5.623	28.57	60

**Table 3: Pairwise correlations**

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)
(1) ESG	1.000						
(2) gf	0.064	1.000					
(3) FT	0.123	0.219	1.000				
(4) Size	0.266	0.004	0.044	1.000			
(5) Lev	-0.048	-0.079	-0.035	0.502	1.000		
(6) ROA	0.195	-0.023	-0.033	0.067	-0.316	1.000	
(7) Indep	0.091	0.021	0.071	0.040	0.003	-0.026	1.000

## 4 Empirical analysis

### 4.1 Model building

4.1.1 *Fixed effect model.* To verify the impact of green finance on corporate ESG performance, this study constructs a fixed effects model incorporating both time and individual effects, as specified below:

$$ESG_{i,t} = \alpha_0 + \alpha_1 GF_{i,t} + \alpha_2 ctrl_{i,t} + u_{i,t} + \varepsilon_{i,t} \quad (1)$$

Among them,  $ESG_{i,t}$  refers to the ESG of firm  $i$  in year  $t$ ,  $GF_{i,t}$  refers to green finance index of firm  $i$  in the year  $t$  and  $ctrl_{i,t}$  refers to control variables. We also introduced  $\mu_{i,t}$  as the fixed effect for time to control the unobservable factors impacting firms' ESG performance.  $\varepsilon_{i,t}$  is the random error term.

4.1.2 *Moderating effect model.* To examine the synergistic impact of green finance and fin-tech on corporate ESG performance, this study constructs a model incorporating both time and individual-level moderating effects, as shown below:

$$ESG_{i,t} = \beta_0 + \beta_1 GF_{i,t} + \beta_2 FT_{i,t} + \beta_3 (GF_{i,t} \times FT_{i,t}) + \beta_4 ctrl_{i,t} + u_{i,t} + \varepsilon_{i,t} \quad (2)$$

Among them,  $ESG_{i,t}$  refers to the ESG of firm  $i$  in year  $t$ ,  $GF_{i,t}$  refers to green finance index of firm  $i$  in the year  $t$ ,  $FT_{i,t}$  refers to the fin-tech of firm  $i$  in the year  $t$ , and  $ctrl_{i,t}$  refers to control variables. We also introduced  $\mu_{i,t}$  as the fixed effect for time to control the unobservable factors impacting firms' ESG performance.  $\varepsilon_{i,t}$  is the random error term.  $GF_{i,t}$  and  $FT_{i,t}$  and its coefficient  $\beta_3$  is the core to-be-estimated coefficient of interest here. A positively significant

**Table 4: Regression results**

	Model1	Model2
gf	1.479 <sup>**</sup> -0.739	1.462 <sup>**</sup> -0.725
Size		1.236 <sup>***</sup> -0.145
Lev		-3.491 <sup>***</sup> -0.513
ROA		2.851 <sup>***</sup> -0.907
Indep		0.062 <sup>***</sup> -0.012
_cons	72.651 <sup>***</sup> -0.413	44.395 <sup>***</sup> -3.14
N	15697	15697
adj. R <sup>2</sup>	0.022	0.045

Standard errors in parentheses \*  $p < 0.1$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$

coefficient  $\beta_3$  indicates the positive moderating effect of FinTech on Green finance–ESG relationship.

## 4.2 Empirical analysis

**4.2.1 Baseline regression.** We employ STATA 18.0 software to conduct our statistical analysis. Table 4 presents the benchmark regression results. After controlling for two-way fixed effects and multiple control variables, the coefficient is 1.479 and 1.462, which is statistically significant at the 5% level. This finding indicates that green finance significantly improves corporate ESG performance. The regression results are shown in Table 4

**4.2.2 Moderating effect.** Based on Equation 2, we perform an empirical analysis of the moderating effects using STATA software. As shown in Table 5, the coefficient of the interaction term M is 0.414 and statistically significant, indicating that financial technology positively moderates the impact of green finance on corporate ESG performance.

**4.2.3 Robust test.** The explanatory variable ESG performance is replaced by Bloomberg score, the higher the score of this variable, the better the ESG-related information disclosure status of enterprises, the robustness test regression results are shown in Table 6, it is known that green finance significantly promotes the ESG performance of enterprises, which is consistent with the previous benchmark regression results.

**4.2.4 Heterogeneity test.**

## 4.3 Research conclusions

**4.3.1 Fin-tech moderates positively of green finance on corporate ESG performance.** According to the empirical results, green fintech promotes corporate ESG performance. With the support of green financial resources, Corporate actively participate in environmental protection and green transformation in accordance with the associated stakeholder theory, which considers the interests of other stakeholders. In addition, fintech plays a positive moderating role

**Table 5: Moderating effect**

	model1
gf	1.569 <sup>*</sup> -0.816
Gf*FT	0.414 <sup>**</sup> -0.206
FT	-0.132 -0.138
Size	1.207 <sup>***</sup> -0.142
Lev	-3.223 <sup>***</sup> -0.487
ROA	3.918 <sup>***</sup> -0.862
Indep	0.067 <sup>***</sup> -0.012
_cons	44.564 <sup>***</sup> -3.099
Individual	YES
Time	YES
N	15057
adj. R <sup>2</sup>	0.051

**Table 6: Robust test**

	M1	Model2
gf	4.977 <sup>***</sup> -1.146	4.430 <sup>***</sup> -1.135
Size		1.456 <sup>***</sup> -0.201
Lev		-2.751 <sup>***</sup> -0.735
ROA		5.079 <sup>***</sup> -1.233
Indep		0.047 <sup>***</sup> -0.017
_cons	15.770 <sup>***</sup> -0.607	-17.027 <sup>***</sup> -4.445
N	12272	12272
adj. R <sup>2</sup>	0.721	0.728

in this relationship. Specifically, with the use of fintech, the contribution of green finance to corporate ESG performance will be further enhanced. It is suggested that FinTech has the potential to enhance the efficiency of financial resource allocation and amplify the guiding function of green finance through data sharing and information transparency, thereby assisting enterprises in achieving a higher level of sustainable development.

**4.3.2 ESG performance of green finance is more pronounced in highly polluted industries.** The positive effects of green finance on ESG are more prominent in highly polluted industries according

**Table 7: Heterogeneity Test**

	High polluted	Non-highly polluted
gf	5.437 *** (1.636)	3.100 *** (1.163)
Size	1.086 *** (0.259)	1.506 *** (0.184)
Lev	-4.753 *** (0.963)	-4.463 *** (0.750)
ROA	1.983 (2.046)	3.917 *** (1.390)
Indep	0.111 *** (0.020)	0.063 *** (0.018)
_cons	45.279 *** (5.660)	38.852 *** (4.080)
N	4916	7356
adj. $R^2$	0.052	0.052

to heterogeneity test. Companies in highly polluted sectors are subject to more rigorous environmental restrictions and external financial pressures than those in non-polluted companies. As a result, these corporates are more driven to carry out green R&D and transformation as well as perform their social obligations to satisfy regulatory requirements and consumer expectations after obtaining green finance support. As a result, green finance is more crucial for encouraging sustainable development and green transformation in highly polluted sectors.

## 5 SUGGESTIONS AND COUNTERMEASURES

### 5.1 promote the integration of fin-tech and green finance

This research revealed that fin-tech has a strong positive moderating effect on the relationship between green finance and ESG. To enhance the efficiency of green finance implementation, policymakers should motivate banks and other financial institutions to accelerate their digital transformation, establish a transparent and efficient information system by utilizing technologies such as block-chain, artificial intelligence, and big data, reducing the information asymmetry between financial institutions and corporate. Simultaneously, fin-tech has the potential to enhance the efficiency and precision of green capital allocation, decrease the financing costs of green initiatives, and help corporate achieve sustainable development in the future.

### 5.2 promote green transformation in heavily polluting sectors

The primary concern in enhancing the ESG performance of corporations is the vigorous development of green finance. While green finance provides funding for green industries to reduce carbon emissions and promote sustainable development, it also exerts pressure on polluting companies. This pressure encourages polluting companies to transform the external requirement of environmental protection into an internal motivation and to prioritize the improvement of corporate environmental performance and the fulfillment

of social responsibility. Consequently, green finance provides an effective guarantee for enterprises to enhance their ESG performance.

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