Green Finance and New Quality Productivity of Enterprises

Tingting Wang *

School of Economics and Management, Northeast Petroleum University, Daqing, China, 163318

* Corresponding Author Email: 19845944@163.com

Abstract. How to achieve the coordinated development of new quality productivity and economic environment has become a hot issue. This study utilizes the financial statement data of A-share listed companies from 2015 to 2022 as the research sample to empirically examine how the development of green finance affects the new quality productivity of enterprises. The results show that the development of green finance promotes the development of new quality productivity by improving the ESG concept of enterprises and alleviating the financing constraints of enterprises, among which the attention of local governments to green development plays a moderating role. Through the analysis of the heterogeneity, it was found that the green financial of the non-state-owned enterprises, non-pollution, and new mass productivity play a more significant role in promoting. Finally, the reliability of the conclusion is verified by the endogeneity test and robustness test. This research not only provides green financial empirical evidence but also promotes the development of new enterprise productivity and is also beneficial to the state to formulate relevant policies to provide the reference.

Keywords: Green Finance, New Quality Productivity of Enterprises, ESG development concept, Financing Constraints.

1. Introduction

As the public pays more and more attention to green, low-carbon development, an important way to promote the development of green carbon green finance has become a hot topic in society. According to IIGF statistics, at the end of 2023, the total issuance of green bonds in China reached approximately 3.62 trillion yuan. Additionally, in 2023, Chinese entities are expected to issue around 237.248 billion yuan in new overseas green bonds. The data mentioned above emphasize the importance of green bonds and highlight the necessity for further progress in green financial development.

In promoting the process of enterprise value, green financial development can alleviate the financing constraints, promote enterprise innovation [1], promote green technology development, and play a role in aspects of enterprise green transformation, and new quality to improve enterprise productivity. As a financial tool that can realize the coordinated development of the economy and environment [2], green finance not only plays an important role in promoting the construction of an environment-friendly society, maintaining the stability of the financial market, and promoting the development of a green economy but also promotes high-quality economic development and achieves the goal of "dual carbon" and green transformation.

Across the world, an important trend is that the new round of green scientific and technological revolution is accelerating, and the cluster innovation of emerging technologies is reshaping the world economy. Based on this, China's economic development mode, driven by the cost advantage of factors, with a large flow of resources and environmental consumption, is no longer sustainable. New mass productivity became a new round of technological revolution and industrial revolution of the world's new engine development direction, leading the entity economy and building a modern industrial system [3], not only is beyond a single western industrialized new path of development of productive forces, the momentum [4] of low carbon energy structure transformation, It is also an important way to promote scientific and technological innovation, develop emerging industries, improve humanistic quality, form a green and low-carbon path, and promote high-level opening-up, which has become the carrier of technology, economy, civilization, ecology, and major-country diplomacy [5] in China's modernization and boost high-quality economic development. Based on this, studying the effect of

green finance new quality, and the productivity of the enterprise to promote the development of our country's economy high quality has important research significance [6].

However, the existing literature rarely empirically examines the impact of financial instruments such as green finance on the new quality productivity of enterprises. Based on this, this paper uses the financial statements of listed companies, the empirical test developing green financial impact on the new enterprise productivity, and puts forward policy Suggestions according to the results of the study.

Compared with the existing literature, the marginal contributions of this paper include: first, this paper considers the impact of green finance on the new quality productivity of enterprises through empirical methods, and constructs a theoretical research model among green finance, ESG development concept, financing constraints and the new quality productivity of enterprises. Secondly, this study performs a heterogeneity analysis based on the property rights and pollution characteristics of various companies, comparing how the development of green finance influences the new quality productivity across different firms. Thirdly, we introduce ESG development philosophy and financing constraints to test whether ESG development philosophy and financing constraints will play a mediating effect between the development of green finance and the formation of new quality productivity.

2. Research hypotheses

Green finance focuses on strengthening technological innovation and promoting the development of productivity at the level of greening. Green finance effectively alleviates the financing constraints of enterprises by providing low financing cost channels, creating a low financing risk environment, and enriching financing channels for enterprises. Furthermore, by facilitating the efficient allocation of financial resources, green finance provides enterprises with adequate funding to enhance their research on essential core technologies, thereby fostering the growth of core competitiveness. Of enterprises, and ultimately promoting the development of new quality productivity of enterprises.

Hypothesis 1: The development of green finance will contribute to enhancing the new quality productivity of enterprises.

The impact of green finance on the new quality productivity of different types of enterprises may be different. Under the traditional financial system, state-owned enterprises and non-state-owned enterprises as a result of information processing ability have different characteristics, the financial resource access and use the green financial development can reduce the bank loans to non-state enterprises discrimination, effectively improve the non-state enterprise credit availability, easing especially non-state-owned, private and other types of enterprises financing constraints, As a result, the debt financing cost of non-state-owned enterprises is reduced. So that non-state-owned enterprises have sufficient funds to carry out technological innovation and finally realize the development of new quality productivity.

Hypothesis 2: Green finance has the potential to enhance new quality productivity in both state-owned enterprises (SOEs) and non-state-owned enterprises (non-SOEs), with a more pronounced effect observed in non-SOEs.

Hypothesis 3: Green finance will facilitate the advancement of productive capabilities productive forces in both polluting and non-polluting enterprises, with a more substantial impact on enhancing the efficiency of non-polluting firms.

In contrast to polluting enterprises, green finance is more capable of gaining the trust and longer-term support from the stakeholders of polluting enterprises by reducing the information asymmetry between non-polluting enterprises and investor. Subsequently, it can effectively reduce the transaction costs of non-polluting enterprises, offer opportunities for non-polluting enterprises to obtain more resources and environment necessary for sustainable development, enable enterprises to increase their research and development efforts on environmental protection technologies and purchase environmental protection devices, ultimately facilitating the green transformation of non-polluting

enterprises and thereby promoting the development of new-quality productive forces of non-polluting enterprises.

3. Model design and variable description

3.1. Sample selection and data sources

This article selects the a-share listed companies from 2015 to 2022 financial statements and the prefecture-level green financial index and other data to construct panel data from 2015 to 2022, and to handle the relevant data for the following: first, to eliminate mismanagement of ST and * ST listed company samples; Second, the samples with incomplete information on key variables are eliminated; Thirdly, samples from the financial industry and the real estate industry were excluded; Fourth, the tail reduction of winsor2 is implemented, and 21,982 samples are finally obtained. The date utilized in this research is sourced entirely from the Wind database.

3.2. Model Design

To evaluate hypothesis 1, this study develops the subsequent regression model (1):

$$\mathrm{NPro_{it}} = \alpha_0 + \alpha_1 \mathrm{Finance}_{it} + \alpha_2 \sum Control_{it} + \mu_i + \gamma_t + \varepsilon_{it} \quad (1)$$

To test the existence of the regulating mechanism path of local governments' attention to green development, the following model is established:

$$\mathrm{NPro_{it}} = \beta_0 + \beta_1 \mathrm{Finance_{it}} + \beta_2 \mathrm{Atten_{it}} + \beta_3 \mathrm{Finance_{it}} * \mathrm{Atten_{it}} + \emptyset_2 \sum \mathrm{Control_{it}} + \mu_i + \gamma_t + \varepsilon_{it} \quad (2)$$

In this model, NPro is the explained variable, which denotes the new quality productivity of firms; Finance is an explanatory variable, representing the advancement of green finance in corporations; Atten is the moderating variable, representing local governments' attention to green development; Control is a series of control variables; γ_t is the year fixed effect, μ_i is the enterprise fixed effect; ε is the random disturbance term; Subscripts i and t represent individual firms and time, respectively.

To further examine if the concepts of ESG development and the reduction of financial constraints can serve as significant mediators between the advancement of green finance and the new quality productivity of enterprises. This paper establishes Model (3) and Model (4) as follows:

$$\mathrm{ESG_{it}} = \alpha_0 + \beta_1 \mathrm{Finance_{it}} + \beta_2 \sum \mathrm{Control_{it}} + \mu_i + \gamma_t + \varepsilon_{it} \quad (3)$$

$$\mathrm{FC_{it}} = \tau_0 + \tau_1 \mathrm{Finance_{it}} + \tau_2 \sum \mathrm{Control_{it}} + \tau_3 \mathrm{ESG_{it}} + \mu_i + \gamma_t + \varepsilon_{it} \quad (4)$$

$$\mathrm{NPro_{it}} = \pi_0 + \pi_1 \mathrm{Finance_{it}} + \pi_2 \mathrm{ESG_{it}} + \pi_3 \mathrm{FC_{it}} + \pi_2 \sum \mathrm{Control_{it}} + \mu_i + \gamma_t + \varepsilon_{it} \quad (5)$$

3.3. Variable measurement and description

(1) Explained variable

Enterprise new quality productivity (NPro) is the explained variable in this paper. The measurement methods of NPRO can be divided into two types: one is statistical measurement [7] from the three dimensions of scientific and technological productivity, green productivity, and digital productivity, and the other is statistical strategy [8] from the two dimensions of labor force and labor tools grounded in the two-factor theory of productivity. To enhance the comparability and integrity of data, this paper uses text mining metrics to measure the new quality productivity of enterprises.

(2) Explanatory variables

Green Finance (Finance) is the explanatory variable of this paper. Green finance refers to financial means to facilitate economic activities including environmental enhancement, climate change mitigation, and the efficient utilization of resources. Drawing on the work of Liu Hu [9] ake et al., this study develops a green finance index for 272 prefecture-level cities in China and employs this index as an explanatory variable for analysis.

(3) Control variable

Based on the existing literature, this study selects variables including company size (Size), debt-to-equity ratio (Lev), return on assets (ROA), board size (Board), duality of roles, shareholding percentage of the top ten shareholders (Top10), whether audited by a Big Four firm, and the proportion of independent directors (Indep). Specifically, company size is quantified using the natural logarithm of total assets, while board size is determined by taking the natural logarithm of the number of directors. A value of 1 is assigned if the chairman and CEO are the same individual; otherwise, it receives a value of 0. Additionally, if a company is audited by one of the Big Four firms, it is coded as 1; otherwise, it is coded as 0.

(4) Mediating variable

ESG development concept is the mediating variable in this paper. At present, domestic and foreign ESG evaluation systems can be roughly divided into three categories: environmental items, social items, and corporate governance items. Among them, Huazheng Company and Wind Company have relatively complete ESG indicators. Based on the completeness and availability of data, this paper uses the ESG index of Huazheng Company as the explanatory variable for research.

Financing constraints (FC) is the mediating variable in this paper. At present, the financial constraints index can be roughly divided into the SA index, FC index, WW index, and KZ index. Considering the availability and completeness of data, this paper selects the FC index as the mediating variable for research.

(5) Moderating variable

Local governments' attention to green development (Atten) reflects the importance of local governments to green development. This paper refers to the practice of Liu Jian [10] et al. (2024), establishes a green development attention lexicon containing 143 keywords, uses Python software to text the annual government reports of each city, and calculates the proportion of the number of words in the green development attention lexicon in the total number of words in the government report. This data is multiplied by 100 as the local government's attention to green development.

4. Empirical analysis

4.1. Descriptive analysis

Table 1 lists the descriptive statistics of each variable interpreted variable NPro mean value is 3.240, ranging from 1.10 to 4.91 because the average is far less than the maximum, and there are many differences between different enterprises' new quality, and the level of productivity, and lower overall level of the enterprise in new mass productivity there is a big room to improve.

Table 1. Results of descriptive analysis

Variable	Obs	Mean	Std. dev.	Min	Max
NPro	21,982	3.238	0.754	1.098	4.912
Finance	21,982	0.370	0.155	0.000	0.624
Size	21,982	22.256	1.293	19.941	26.355
Lev	21,982	0.406	0.198	0.056	0.899
ROA	21,982	0.044	0.066	-0.257	0.228
Board	21,982	2.107	2.194	1.609	2.639
Dual	21,982	0.305	0.460	0.000	1.000
Top10	21,982	0.596	0.149	0.238	0.905

4.2. Benchmark regression

To deeply study the impact of green finance on the new quality productivity of enterprises, this paper uses Model (1) to conduct multiple regression analysis. In Column (1) of Table 2, which does not include control variables and fixed effects, the coefficient for the degree of green finance development (Finance) is observed to "exhibit a significant positive value at the 1% significance level.

This indicates that the development of green finance positively influences new quality productivity without accounting for other factors. After introducing eight control variables such as Size and Lev, Column (2) and Column (3) control the year fixed effect and enterprise fixed effect respectively, and the coefficient of green finance development level is still significantly positive. The coefficient for the level of green finance development remains significantly positive, with significance at the 1% level. These findings support the notion that advancing green finance can effectively enhance the new quality productivity of enterprises, thereby providing strong evidence for Hypothesis 1.

Table 2. Benchmark regression results

	(1) NPro	(2) NPro	(3) NPro	(4) NPro
Finance	0.155 * * *	0.138 * * *	0.075 *	0.441 * * *
	(0.033)	(0.032)	(0.031)	(0.041)
Size		0.099 * * *	0.079 * * *	0.535 * * *
		(0.005)	(0.005)	(0.009)
CONTROLS	YES	YES	YES YES	YES
_cons	3.181 * * *	1.923 * * *	243.511 * * *	8.508 * * *
	(0.013)	(0.132)	(4.925)	(0.227)
code	NO	YES	NO	NO
year	NO	NO	YES YES	NO
N	21982.00	21982.00	21982.00	21982.00
r2	0.001	0.031	0.128	0.205

t statistics in parentheses, * p < 0.1, ** p < 0.05, *** p < 0.01, (the same applies hereinafter)

4.3. Heterogeneity analysis

(1) Heterogeneity analysis of property rights

From the perspective of ownership attributes, the research samples are divided into non-state-owned enterprises and state-owned enterprises for testing. The results of columns (1) and (2) of Table 3 show that green finance is more effective in promoting the new quality productivity of non-soes, which may be because banks have loan discrimination against non-soes. Compared with soes, non-soes face greater market competition pressure, so they pay more attention to their image and innovative development, hoping to improve their new quality productivity through the development of green finance. At the same time, the administrative color of non-state-owned enterprises is relatively weak, and the motivation to develop green finance is stronger. Consequently, non-state-owned enterprises demonstrate a greater capacity to enhance their new quality productivity through the development of green finance compared to state-owned enterprises, thereby confirming Hypothesis 2.

(2) Heterogeneity analysis of pollution attributes

From the perspective of pollution attributes, the research samples were divided into polluting enterprises and non-polluting enterprises for testing. The results of columns (3) and (4) in Table 3 show that green finance has a greater impact on the new quality productivity of non-polluting enterprises. This may be because polluting enterprises are more likely to achieve green transformation than non-polluting enterprises, thus improving their image and reputation in society so that they can develop sustainably. Simultaneously, green finance can reduce the transaction cost of non-polluting enterprises and increase their R&D efforts on environmental protection technology, so that the advancement of green finance has a more pronounced effect on enhancing the new quality productivity of polluting enterprises, thereby confirming Hypothesis 3.

Table 3. Heterogeneity analysis

	(1) NPro	(2) NPro	(3) NPro	(4) NPro
Finance	0.564 * * *	0.350 * * *	0.258 *	0.452 * * *
	(0.074)	(0.049)	(0.12)	(0.040)
Size	0.618 * * *	0.498 * * *	0.536 * * *	0.531 * * *
	(0.020)	(0.010)	(0.030)	(0.010)
CONTROLS	YES	YES	YES	YES
_cons	10.515 * * *	7.487 * * *	7.827 * * *	8.478 * * *
	(0.414)	(0.274)	(0.858)	(0.235)
P-value	0.00		0.00	
N	7567.00	14415.00	1833.00	20592.00
r2	0.198	0.222	0.201	0.203

4.4. Robustness analysis

(1) Replace the explained variable

Referring to the practice of Song Jiaet al., NPro_b is generated as a proxy indicator of enterprise new quality productivity [8]. The results of Column (1) in Table 4 show that when control variables and fixed effects are added at the same time, green finance has a notably beneficial impact on promoting the new quality productivity of enterprises, which again verifies Hypothesis 1.

(2) The core explanatory variables are replaced

Referring to the practice of Liu Hu ake et al., Finance_b is generated to replace the original variable of green finance development level [9]. The results of Column (2) of Table 4, which again verifies Hypothesis 1.

(3) Abnormal years are excluded

To mitigate the influence of atypical years on the research findings, this study omits data from the three-year period between 2020 and 2022 and performs regression analysis. The regression outcomes presented in Column (3) of Table 4 further validate Hypothesis 1.

Table 4. Robustness test

	(1) NPro_b	(2) NPro	(3) NPro
Finance	0.010 * *		0.392 * * *
	(0.000)		(0.060)
Size	0.00	0.321 * * *	0.594 * * *
	(0.000)	(0.01)	(0.010)
Finance_b		3.496 * * *	
		(0.07)	
CONTROLS	YES	YES	YES
_cons	5.243 * * *	6.989 * * *	9.751 * * *
	(0.020)	(0.220)	(0.310)
N	19822.00	21982.00	14173.00
r2	0.000	0.295	0.190

4.5. Endogeneity test

Allowing for the presence of reverse causality and omission bias may lead to endogeneity problems. In this paper, we use 2SLS estimation and control fixed effects to solve the endogeneity problem.

(1) 2SLS estimation is used

A high level of new-quality productivity in enterprises will also contribute to the high-quality development of the economy, thereby fostering the advancement of green finance to some extent. This study utilizes the one-period lagged term of green finance development as an instrumental variable in regression analysis to address the endogeneity issue arising from reverse causality. The Hausman test indicates that the model rejects the null hypothesis with a probability of p=0, suggesting that green

development is indeed an endogenous explanatory variable. Additionally, results from the Sargan-Basman test reveal that the statistic for green development as an endogenous explanatory variable is 0.0011, which is below 0.05, and the F-value from the first-stage regression result stands at 23, exceeding 10. Thus, there are no concerns regarding weak instrument size. The regression findings presented in columns (1) and (2) of Table 5 support Hypothesis 1, confirming its robustness.

(2) The fixed effects are controlled.

Considering that taking the lagged period of the level of advancement in green finance as an instrumental factor for regression to reduce the degree of endogeneity is limited, on the basis of setting individual fixed effects and year fixed effects as mentioned earlier in this paper, the interaction effect between individuals and years is set to mitigate the macro-systemic environmental changes that may be brought about by the development of green finance. The regression results in Columns (3) and (4) of Table 5 verify Hypothesis 1, and the conclusion of Hypothesis 1 is robust.

Table 5. Endogeneity test results

Variable	2SLS		Rule out systematic changes in macro factors	
	First stage Finance (1)	Second stage NPro (2)	NPro (3)	NPro (4)
L.Finance	0.921 * * *			
	(0.003)			
Finance		0.151 * * *	0.441 * * *	0.258 * * *
		(0.032)	(0.041)	(0.040)
Size	0.001 *	0.098 * * *	0.535 * * *	0.394 * * *
	(0.001)	(0.005)	(0.009)	(0.009)
CONTROLS	YES	YES	YES	YES
code*year				0.000***
				(0.000)
_cons	0.061 * * *	1.923 * * *	8.508 * * *	106.855 * * *
	(0.014)	(0.132)	(0.227)	(2.567)
N	17323.00	21982.00	21982.00	21982.00
r2	0.810	0.030	0.200	0.270

5. Mechanism Study

(1) Moderating effect of local government's attention to green development

As local governments place greater emphasis on green development, they become increasingly motivated to implement green policies. This shift positively influences enterprises' investments in green initiatives and the advancement of green technologies, thereby enhancing their new quality productivity. To investigate whether heightened attention from local governments towards green development can moderate the effect of green finance on enterprises' new quality productivity, we conduct regression analysis using Model (2). The results presented in Column (1) of Table 6 reflect calculations without control variables and fixed effects, while Column (2) includes these factors. The findings indicate that the coefficients for Finance are significantly positive after adjustments, with the estimated coefficient for Finance×Atten also being positive and significant at the 1% level. These results suggest that as local government focus on green development increases, the effectiveness of green finance in fostering new quality productivity among enterprises improves.

Table 6. Mechanism test results

	(1) NPro	(2) NPro	(3) ESG	(4) FC	(5) NPro
Finance	5.543***	4.706***	0.322***	-0.073**	0.421***
	(0.796)	(0.881)	(0.092)	(0.021)	(0.043)
Atten	-3.154***	0.107			
	(0.484)	(0.906)			
ESG				-0.012**	0.032***
				(0.000)	(0.001)
FC					-0.052**
					(0.012)
Finance*Atten	-3.464***	-2.808***			
	(0.530)	(0.585)			
Size		0.479***	0.581***	-0.000	0.511***
		(0.010)	(0.022)	(0.000)	(0.010)
CONTROLS	YES	YES	YES	YES	YES
_cons	8.267***	-6.963***	0.011***	0.000	-7.951***
	(0.728)	(1.383)	(0.002)	(0.000)	(0.231)
N	16927	16927	21722.00	20222.00	21722.00
r2	0.017	0.205	0.062	0.000	0.211
Sobel-Goodman			P=0	P=0	P=0

(2) Mediating effect of ESG philosophy

Green finance has the potential to advance the development of the ESG concept by increasing enterprises' awareness of ESG principles, and ultimately realize the advancement of enterprises' new quality productivity by promoting technological innovation. To further explore whether the ESG concept serves as an intermediary in the process of green finance facilitating the advancement of enterprises' new quality productivity, this paper uses Models (3), (4) and (5) for analysis, and the findings are presented in columns (3) through (5) of Table 6.It can be seen that the coefficient of Finance is significantly positive at the level of 1%, indicating that the mediating effect of the ESG development concept exists. According to Sobel's test, the P value is much less than 0.050, which verifies the existence of the mediating effect of ESG development philosophy. Hypothesis 4 of this paper is valid.

(3) Mediating effect of financial constraints

Green finance can give enterprises sufficient funds for technological innovation by alleviating financial constraints, to enhance the advancement of enterprises' new-quality productivity. The results are shown in columns (3) to (5) of Table 6. It can be found that the coefficient of Finance in Column (4) is significantly negative at the level of 1%, indicating that green financial development can alleviate financial constraints. In Column (5), the coefficient of Finance is significantly positive at the level of 1%, indicating that the mediating effect of financial constraints exists.

6. Conclusions and suggestions

Through the above-mentioned research, the following conclusions are obtained in this paper. (1) Green finance significantly promotes the development of enterprises' new quality productivity, and this effect has heterogeneity of property rights and pollution attributes. (2) Green finance promotes the development of firms' new quality productivity by promoting firms to have good ESG performance and alleviating firms' financing constraints. Based on the above research, this paper puts forward the following three policy recommendations.

Firstly, the government should improve the adaptability of financial policies and regulations. The government should strengthen the attention to green development, the risk management of new financial businesses, and the flexibility of financial supervision. Financial policies and regulations that can adapt to the development of emerging industries should be introduced promptly to ensure

that they keep pace with scientific and technological innovation and market development, to create a good financial environment.

Secondly, financial institutions need to prioritize and foster the growth of green finance. They should enhance the development and utilization of financial technology, innovate in financial products and service models, improve risk prevention and control measures, and strengthen the construction of financial infrastructure. These actions will create favorable conditions for developing green financial products that align with the characteristics of emerging industries while enhancing personalization and convenience in service delivery.

Thirdly, enterprises should attach importance to and establish the development concept of ESG. The state should strengthen the extent of ESG information disclosure and supervision. At the same time, enterprises should follow the market-oriented trend, link the importance of ESG work with finance, and work together with relevant stakeholders to establish a healthy and perfect ESG ecosystem.

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