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RESEARCH ARTICLE

The Synergistic Impact of Green Finance and ESG Concepts on Rural New-Quality Productivity

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Abstract

The development of rural new-quality productivity is crucial for achieving high-quality rural economic growth and overcoming developmental challenges. This study examines the impact of green finance and ESG (Environmental, Social, and Governance) principles on the development of rural new-quality productivity. Utilizing multiple regression analysis on data from 11 prefecture-level cities in Zhejiang Province, the study finds that: (1) The development of green finance and ESG concepts both have a positive effect on the development of rural new-quality productivity. The impact of green finance is more pronounced in regions dominated by the secondary industry, while the development of ESG concepts has a better effect in areas dominated by the primary and tertiary industries. (2) The influence of ESG concepts on rural new-quality productivity is affected by regional economic levels, with more significant effects observed in economically developed regions. (3) There is a positive and additive synergistic effect between the development of green finance and ESG concepts on rural new-quality productivity, which is more pronounced in resource-based cities. Based on these findings, the paper proposes policy recommendations to provide references and insights for the development of rural revitalization in contemporary times.

Keywords: green finance; ESG; new-quality productivity; rural revitalization; multiple linear regression model

Introduction

As the Rural Revitalization Strategy advances, the expansion of rural industries and the sustainability of rural ecosystems are increasingly constrained by multifaceted challenges, including resource scarcity, environmental degradation, and inadequate financial resources. Consequently, high-quality rural development has emerged as a crucial issue in China's economic development. To achieve this goal, rural areas urgently need to identify new

growth drivers and sources of impetus. New-quality productivity, a form of productivity driven by innovation and catalyzed by the modern technological revolution, is well-suited to meet this demand and can provide strong support for the transformation and upgrading of the rural economy. In January 2025, the Central Committee of the Communist Party of China and the State Council issued the Comprehensive Rural Revitalization Plan (2024–2027), which explicitly emphasized that to realize high-quality development, new-quality productivity must be regarded as the core driving force. It is imperative to firmly grasp new-quality productivity to continuously advance the substantial progress of Chinese-style modernization.

Green finance, as a financial model dedicated to environmental friendliness and sustainable development, has gradually been recognized as a key pathway to promoting the transformation and high-quality development of the rural economy (Shi Daimin and Shi Xiaoyan, 2022). By linking economic development with ecological protection, green finance promotes the efficient use of resources and sustainable economic growth. Green finance policies provide a favorable financing environment, significantly enhancing firms' levels of green innovation (Lietal, 2018), and exert pressure on firms to adopt green emission-reduction measures (Fanetal, 2021), thereby facilitating green transformation and achieving a dual improvement in economic and environmental benefits. According to Wen Tao and He Qian (2023), the core of green finance lies in directing capital towards projects that are conducive to environmental protection. In practice, the social impact and governance structure of projects are equally important. The integration of green finance and the ESG (Environmental, Social, and Governance) philosophy is essential. Green finance provides necessary financial support for rural projects, promoting novel practices such as renewable energy and smart agriculture. Meanwhile, the ESG evaluation and supervision mechanism encourages firms to focus more on environmental protection, social responsibility, and governance improvement. This not only aligns firms with the trend of sustainable social development but also opens up effective pathways for reducing financing costs and enhancing operational efficiency (Qiu Muyuan, 2019). It more effectively directs capital towards projects that meet sustainable development goals, thereby jointly promoting the innovation and sustainability of rural development.

In recent years, scholars have begun to pay attention to the integration of green finance and ESG.Chen Guojin , Ding Saijie , Zhao Xiangqin, et al. (2021) first incorporated green finance policies and green transformation into the asset pricing model of sustainable investment (ESG) to analyze the theoretical mechanism through which green finance policies function. Cao Qun and Xu Qian (2019) suggested constructing a financial ESG system that emphasizes the internal implementation of ESG principles by financial institutions and focuses on the ESG factors of real economy clients to promote the development of ESG in China. However, due to the relatively recent emergence of the concept of new-quality productivity, there is currently a lack of literature on the role of the integration of green finance and ESG in promoting new-quality productivity in rural areas.

To fill this research gap, this study aims to integrate green finance policies, the ESG philosophy, and new-quality productivity in rural areas. Using panel data from the 11 prefecture-level cities in Zhejiang Province, this study seeks to: (1) analyze the mechanism through which green finance promotes the development of new-quality productivity in rural areas and investigate the impact of regional industrial structure on the development of new-

quality productivity in rural areas; (2) conduct a multidimensional quantitative evaluation of corporate social responsibility fulfillment in China, comprehensively examine the regional economic development imbalances among different prefecture-level cities in Zhejiang Province, and analyze the impact of ESG development on the development of new-quality productivity in rural areas; and (3) construct a multiple linear regression model to explore the different effects of green finance and the ESG philosophy on the development of new-quality productivity in rural areas, influenced by regional economic development levels, regional industrial structures, and regional resource dependency. Based on the research findings, innovative approaches to developing new-quality productivity in rural areas will be proposed to enhance rural productivity levels and provide a basis for prioritizing, regionalizing, and multi-staged advancement of rural revitalization. The research structure of this article is shown in the Figure 1.

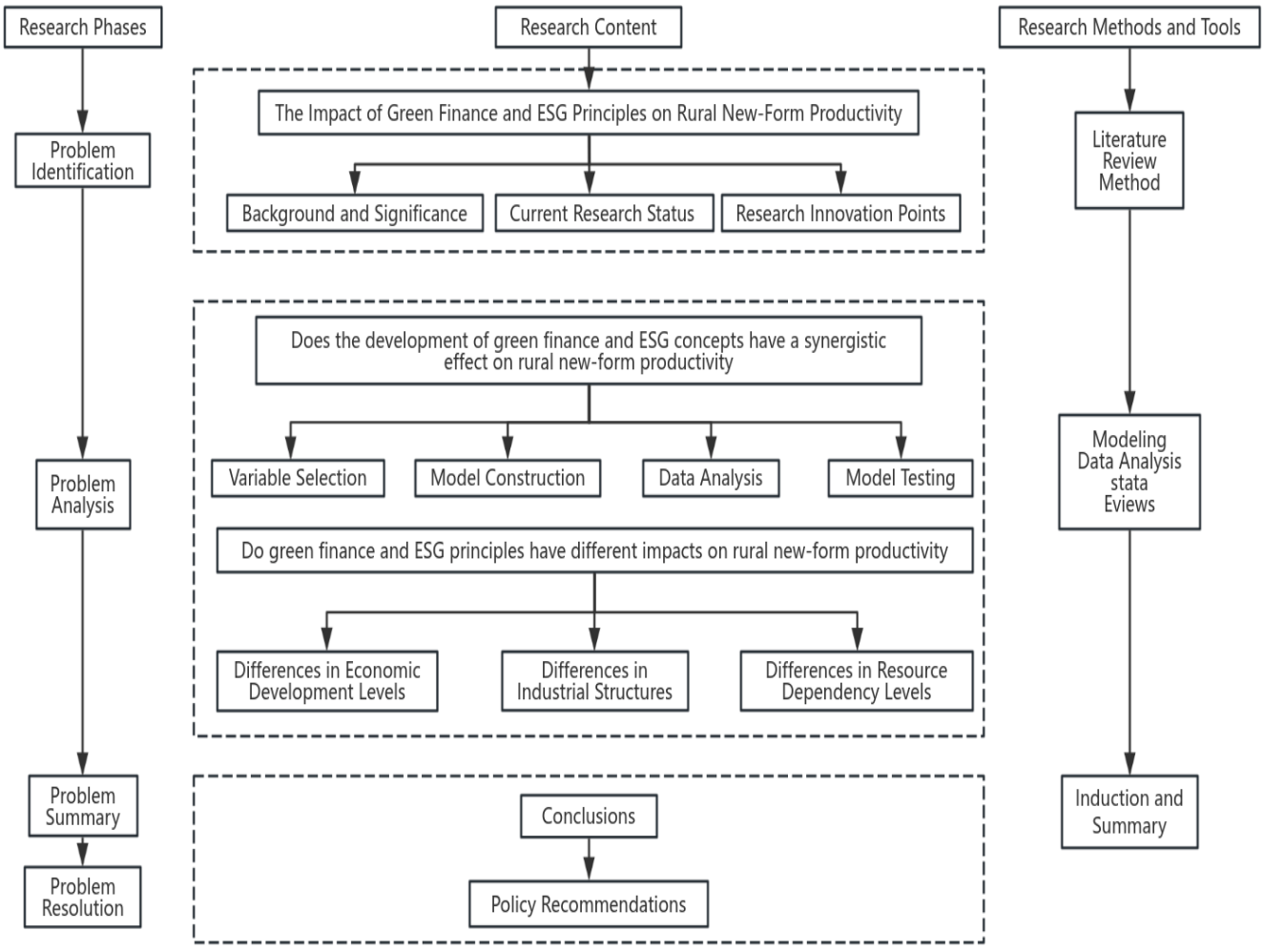

Figure 1. Structure Diagram of the Article

Literature Review

The Definition and Characteristics of New-Quality Productivity

In September 2023, General Secretary Xi Jinping first proposed the concept of new-quality productive forces during his inspection in Heilongjiang. New - quality productive forces are a form of advanced productive forces in which innovation plays a leading role. They break away from the traditional economic growth mode and the development path of productive forces, feature high -technology, high-efficiency, and high-quality, and are in line with the new development philosophy (Xinhua News Agency, 2024). As shown in the Figure 2, new-quality productive forces not only emphasize technological innovation and efficient resource utilization, but also attach great importance to the protection of the ecological environment and sustainability, fully reflecting the emphasis on environmental and social responsibilities in the process of economic development. Essentially, they are green productive forces (Zhou Hongchun, 2024).

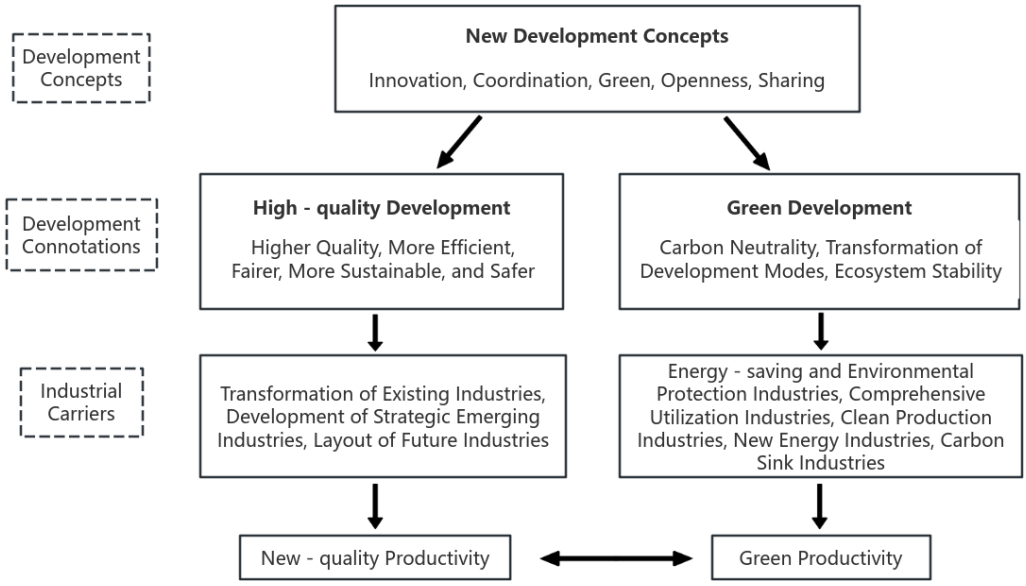

Figure 2. The Connotation, Characteristics and Industrial Carriers of "New-Form Productivity Being Green Productivity"

New-form productivity represents a leap from traditional productivity. Most traditional productivity theories are based on the material production paradigm of industrial society, emphasizing the decisive role of capital, labor, and other traditional factors in economic operation (Yan Qiang, Xu Guonan, Yi Lanli, 2025). In the new development phase, the traditional economic growth model no longer fits the development trend of the times. The in-depth development of a new round of technological revolution and industrial transformation provides a

historical opportunity to promote the transformation and upgrading of China's industries and the development of new-form productivity, offering a new path for the qualitative change of traditional productivity (Ren BaoPing, Dou Yuanbo, 2024). New-form productivity, dominated by scientific and technological innovation and achieving breakthroughs in key disruptive technologies, is a qualitative leap from traditional productivity (Zhou Wen, Xu Lingyun, 2023).

It represents a qualitative enhancement in the composition of productive forces. It is not a simple continuation of traditional productivity but a comprehensive innovation and upgrading of core elements such as workers, means of production, and objects of labor through scientific and technological innovation and technological breakthroughs. Pu Qingping and Xiang Wang (2023) believe that new-form productivity mainly includes "high-quality" workers, "new medium" means of production, and "new material" objects of labor, representing an advanced form of productivity. Among them, "high-quality" workers are a new type of talent distinct from traditional workers and technical workers, mastering digital technology and adapting to digital intelligent equipment (Shi Jianxun, Xu Ling, 2024). "New medium" means of production focus on advanced machinery and equipment using high technology, significantly improving production efficiency and quality. The "new material" objects of labor include both material objects and non-material objects such as computing power and data (Zhou Wen, Xu Lingyun, 2023).

New-form productivity is the combination of "new" and "quality" in productive forces. It is not only about being "new" but even more about "quality." Zhang Hui and Tang Qi (2024) believe that the "new" in new-form productivity mainly reflects new production factors and new ways of factor combination, while "quality" is manifested as a high-quality industrial base and development momentum. Jiang Yongmu and Qiao Zhangyuan (2024) believe that the "new" in new-form productivity mainly reflects new factors, new technologies, and new industries, with its "quality" manifested in high quality, multiplicity, and dual efficiency, and its "force" represented by five major productive forces: digital, collaborative, green, blue, and open.

From the perspective of the development of the industry field of new-form productivity, the academic community has extensively covered multiple dimensions including agriculture, publishing, manufacturing, sports, tourism, and cultural tourism industries, with particularly outstanding research results in the agricultural field (Wang Shengxia, Li Maolan). Huang Jiqun (2024) believes that agricultural new-form productivity, as an important part of new-form productivity, not only has the common characteristics of new-form productivity but also, due to the particularity of the agricultural sector, exhibits unique attributes of high publicness, technologicalization, digitalization, and industrialization. Its essence is the deep integration of "new" and "quality" in the agricultural context, highlighting the concepts of innovation, coordination, green development, openness, and sharing. As shown in the Figure 3. Mechanism Diagram of Rural New-Form Productivity, rural new-form productivity is driven by new technological revolutionary breakthroughs, innovative allocation of all factors, and deep transformation and upgrading of industries, supported by a mutually promoting cycle system of education-talent-technology, and characterized by disruptive agricultural technological innovation, high-quality agricultural workers, breaking through the boundaries of agricultural development, penetration and symbiosis of multiple

factors, and digitalization and green transformation, ultimately anchoring the goal of an "agricultural powerhouse," becoming a key force in promoting high-quality agricultural development, reshaping the agricultural productivity pattern, and helping agriculture complete a qualitative leap in the new era and move towards a path of sustainable development.

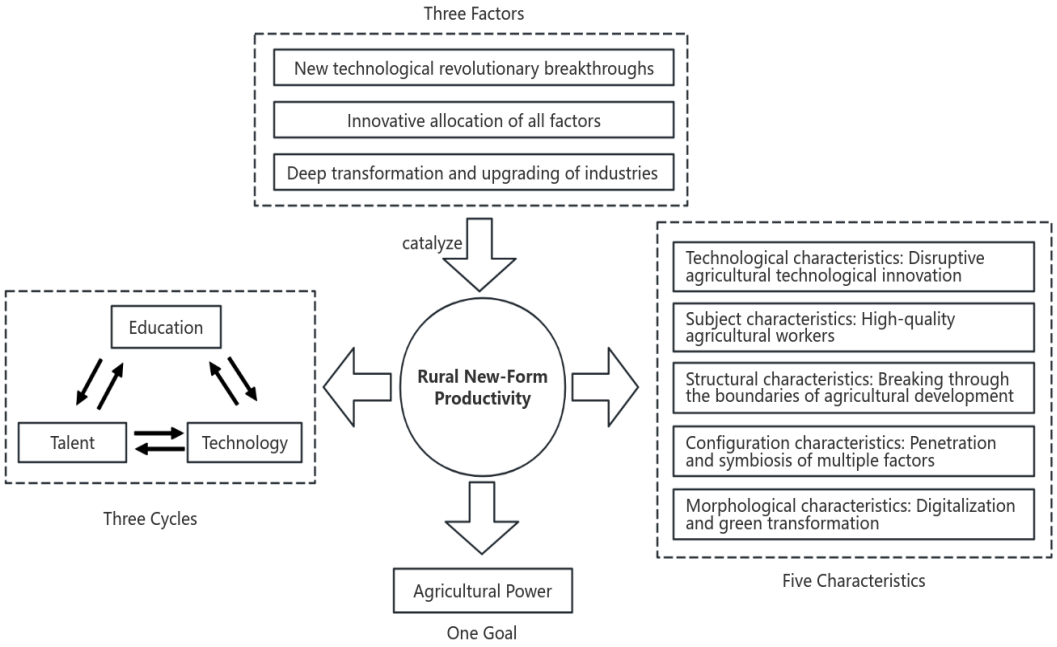

Figure 3. Mechanism Diagram of Rural New-Form Productivity

The Impact of Green Finance on Rural New-Quality Productivity

Green finance, also known as Environmental Finance or Sustainable Finance, is at the core of environmental protection, leading to comprehensive changes in the business philosophy, operational processes, and management policies of the financial industry, with the aim of achieving sustainable development (Li Xiaoxi et al., 2015). Salazar (1998) posits that green finance serves as a bridge between the environment and finance, improving capital allocation mechanisms to steer capital towards green and environmentally friendly industries. Cowan (1999) views green finance as an interdisciplinary field that combines green economics and finance, focusing on the coordinated advancement of economic growth and environmental protection. Scholtens (2006) suggests that the use of green financial instruments can resolve the contradictions between resources and the environment, thereby achieving sustainable development.

As an innovative financial model linking economic development and ecological environmental protection, green finance plays a crucial role in promoting enterprise innovation and industrial green transformation. Wen Shuyang and Liu Hao et al. (2022) constructed an economic growth model that integrates environmental constraints and

the financial sector, demonstrating that green finance plays a key role in driving green innovation and promoting high-quality economic development. Li et al. (2018) found that green financial policies can significantly enhance the green innovation level of enterprises by providing a favorable financing environment for green enterprises. Additionally, the implementation of green financial policies exerts pressure on enterprises to adopt green emission reduction measures (Fan et al., 2021), promoting enterprise green transformation and achieving dual benefits of economic and environmental efficiency (Wang Yao et al., 2019). Green finance focuses on environmental objectives, aiming to coordinate financial activities with environmental and ecological considerations to achieve sustainable economic and social development. Its development can further optimize the rural financial service system and enhance financial support for agriculture, rural areas, and farmers (Ma Jun et al., 2021). Moreover, green finance can influence the investment and financing behavior of heavily polluting enterprises through green credit and green bonds, providing financial support for the development of rural new quality productivity on the basis of achieving green development (Su Dongwei and Lian Lili, 2018).

In recent years, green finance has effectively promoted rural economic development through multi-channel and multi-advantage comprehensive effects. On one hand, green finance has reduced the financing costs of rural enterprises and farmers through innovative green credit and green bonds, guiding capital towards eco-friendly green projects such as ecological agriculture and clean energy, promoting the green transformation of rural production and lifestyle, and further guiding enterprise green innovation (Wang Xin and Wang Ying, 2021). On the other hand, green finance also focuses on strengthening policy coordination and risk assessment to ensure the quality and sustainability of capital allocation, effectively preventing financial risks and ensuring the stable development of the rural economy. Green finance not only improves the efficiency of capital use, reduces the misallocation and waste of financial resources, but also promotes environmental protection and ecological restoration in rural areas, enhancing the ecological environment quality of rural areas. At the same time, it helps to optimize the rural economic structure, promote rural industrial upgrading, and improve the development level of rural new quality productivity. In addition, green finance also broadens the coverage of financial services, improves the accessibility and convenience of financial services, narrows the urban-rural development gap, and promotes balanced urban-rural development. Based on the above analysis, the following hypotheses are proposed:

H1a: The development of green finance has a significant promoting effect on the development of rural new quality productivity.

H1b: The impact of green finance on the development level of rural new quality productivity is influenced by regional industrial structure.

The Impact of ESG Concepts on Rural New Quality Productivity

ESG stands for Environment, Social, and Governance, marking a shift in corporate evaluation criteria from a single financial performance dimension to a comprehensive consideration of environmental sustainability, social responsibility, and corporate governance (Yuan Rongli, 2022). Current systematic research on the ESG system

mainly focuses on the relationship between corporate social responsibility and financial performance and ESG information disclosure. Lu Zhengwei and Fang Qi (2018), Clark et al. (2015) have shown that corporate social responsibility helps to improve financial performance, while Dimson et al. (2015), Chen et al. (2014) found that corporate investment in ESG does not increase financial costs but can reduce total financial costs. Mervelskemper and Streit (2017) demonstrated that ESG information disclosure helps to improve and enhance corporate social responsibility performance; Devilliers and Vanstadan (2011) further found that enterprises facing greater environmental risks or with poor environmental reputations are more inclined to disclose ESG information. In rural areas, the introduction of ESG concepts helps to enhance the sustainable development capabilities of rural enterprises. Research indicates that through ESG evaluation and supervision mechanisms, enterprises can be encouraged to pay more attention to environmental protection, social responsibility, and the improvement of governance structures, which not only promotes enterprises to adapt to the trend of social sustainable development but also opens up effective ways for enterprises to reduce financing costs and improve operational efficiency (Qiu Muyuan, 2019).

The dissemination and in-depth development of ESG concepts have multiple positive effects on the development of rural new quality productivity. Firstly, from an environmental perspective, ESG concepts focus on environmental protection and the rational use of resources, which aligns with the original intention of new quality productivity, emphasizing green development. In the process of rural economic development, ESG concepts require producers to reduce environmental pollution during production, protect rural ecological resources, actively seek new ways for industrial green transformation, guide industrial green transformation, encourage enterprise green innovation, and achieve dual benefits of economy and environment. Secondly, in terms of social aspects, ESG concepts focus on farmers' income growth, social employment opportunities, and social equity issues, which are closely related to the labor dimension emphasized by the development level of rural new quality productivity. Both pursue high-quality development, and the development of ESG concepts guides social and economic behavior. Under the guidance of this concept, enterprises invest more funds in projects that support and enrich farmers, providing financial support for the diversified development of the rural economy and effectively enhancing the rural economy's risk resistance. At the same time, ESG concepts also emphasize the social responsibilities that enterprises should bear, including protecting farmers' rights and interests and providing fair employment opportunities, which helps to build harmonious rural social relations and lays a social foundation for the sustainable development of the rural economy. Finally, in terms of governance, ESG concepts emphasize the responsibility and transparency of enterprises, which align with the modern governance system emphasized by rural new quality productivity. In rural economic development, ESG concepts require enterprises to establish and improve governance structures, strengthen internal control and risk management, and improve the transparency of information disclosure. These requirements can effectively help enterprises enhance their social image and reputation, and enhance the trust and support of investors and consumers. At the same time, ESG concepts also encourage enterprises to actively participate in rural social welfare undertakings, such as the construction of rural education, healthcare, and culture, contributing to the comprehensive development of rural society. Through these

measures, the governance system and governance capacity of the rural economy can be modernized, providing strong support for the sustainable development of the rural economy. Based on the above analysis, the following hypotheses are proposed:

H2a: The development of ESG concepts has a significant promoting effect on the development of rural new quality productivity.

H2b: The impact of ESG concept development on the development level of rural new quality productivity is influenced by regional economic development levels.

The Synergistic Effect of Green Finance and ESG Concepts

With the in-depth understanding of the concept of sustainable development, green finance and ESG concepts have gradually become important tools for promoting economic transformation. In recent years, scholars have begun to focus on the integration of green finance and ESG. Chen Guojin, Ding Saijie, and Zhao Xiangqin et al. (2021) first incorporated green financial policies and green transformation into the sustainable investment (ESG) asset pricing model, analyzing the theoretical mechanism of the role of green financial policies. Cao Qun and Xu Qian (2019) suggested constructing a financial ESG system that focuses on the implementation of ESG concepts within financial institutions and pays attention to the ESG factors of real economy clients to promote the development of ESG in China.

Green finance provides funding for rural green industries and sustainable development projects through innovative products such as green credit and green bonds, promoting the development of ecological agriculture, clean energy, etc., and facilitating the green transformation of rural economies. It reduces financing costs, guides funds to environmental protection projects, and improves the efficiency of fund use. Meanwhile, it strengthens risk assessment to ensure economic stability. Green finance not only supports rural ecological protection but also promotes industrial upgrading and narrows the urban-rural gap, serving as a powerful tool for achieving the development of new-quality productivity and sustainable development in rural areas.The ESG (Environmental, Social, and Governance) concept promotes rural revitalization by advocating corporate responsibility in environmental protection, social affairs, and governance. It directs funds to environmental protection and social responsibility projects, enhances the quality of the rural ecological environment, pays attention to the interests of farmers and low-income groups, and strengthens the sustainability and social inclusiveness of the rural economy. ESG not only enhances the social influence of enterprises but also injects long-term development momentum into the development of new-quality productivity in rural areas.

The two approaches have different focuses: green finance focuses on financial services, while the ESG concept focuses on corporate social responsibility construction, complementing each other. To sum up, green finance and the ESG concept in Zhejiang Province have a synergistic effect, serving as important means to achieve the development of new-quality productivity in rural areas and important supports for realizing rural revitalization. Based on the above analysis, the following hypotheses are proposed.

H3a: The development of green finance and the ESG concept has a synergistic effect, jointly promoting the development of new-quality productivity in rural areas.
H3b: The degree of regional resource dependence will affect the effect of green finance and the ESG concept on the development level of new-quality productivity in rural areas.

Methodology

Data and Variable

To thoroughly analyze the combined impact of green finance and ESG (Environmental, Social, and Governance) concepts on the development of new-quality rural productivity, this study utilizes panel data from 11 prefecture-level cities in Zhejiang Province spanning from 2000 to 2022. The data on green finance are sourced from the China Financial Yearbook, while other data are primarily obtained from the Guotai Security Database, the National Bureau of Statistics, the Zhejiang Provincial Bureau of Statistics, the China Rural Statistics Yearbook, the China Urban and Rural Construction Statistics Yearbook, and the People's Bank of China. To ensure data integrity, missing values were filled using interpolation methods, and stationarity and heteroscedasticity tests were conducted to enhance the reliability of model estimation. This study constructs a detailed variable system, including one core explanatory variable, two explained variables, and five control variables.

Dependent Variable

Although numerous studies have explored how to measure the development level of new-quality rural productivity (NPF), a unified measurement standard has not yet been established in academia due to different research purposes. Based on data availability and comprehensive representativeness, this study constructs a scientific and comprehensive rural new-quality productivity development system with four first-level indicators and 12 second-level indicators, as detailed in Table 1. Explanatory variables are given in table 2.
Green Finance Index (GFI): This is one of the core explanatory variables in this study, representing the comprehensive index of green finance development in various regions. Drawing on the research methodology of Liu Huakai and He Chun (2024), this study employs a multi-dimensional evaluation system consisting of seven indicators: green credit, green bonds, green investment, green equity, green insurance, green support, and green funds, and calculates it using the entropy method. The specific indicators include the proportion of investment in environmental pollution control, the proportion of credit for environmental protection projects, the coverage rate of environmental liability insurance, the number of green bonds issued, and the market share of green funds, etc.
Corporate Social Responsibility (CSR): This is another core explanatory variable, representing the comprehensive index of corporate social responsibility in various regions. CSR refers to the responsibilities that enterprises should bear for the environment, society, and governance while pursuing economic benefits. The CSR

index is commonly used to measure the performance and impact of enterprises in terms of social responsibility.

Table 1. Rural New-Quality Productivity Development System

First-level Indicators	Second-level Indicators	Meaning of Second-level Indicators
Laborers	Employment Structure of Laborers	Tertiary industry employment / Total employment
	Laborer Income	Per capita net income of farmers
	Laborer Output	Per capita GDP
	Laborer Quality	Average years of education for rural residents
Objects of Labor	Green Invention Achievements	Annual number of green patent authorizations
	Green Resources	Rural greening rate
	Pollution Control Quality	SO_2 emissions / GDP
Means of Labor	Digital Infrastructure	Proportion of administrative villages with internet broadband access
	Traditional Infrastructure	Per capita road area
	Energy Utilization Potential	Comprehensive utilization rate of livestock and poultry manure
Organization of Production	Level of Intelligence	Number of e-commerce enterprises
	Level of Greening	Investment in industrial pollution control

Table 2. Secondary Indicators of Green Finance and Corporate Social Responsibility (CSR)

Primary Indicator	Secondary Indicator	Definition of Secondary Indicator
Green Finance (GFI)	Green Credit	Total scale of green credit
	Green Bonds	Total amount of green bonds issued
	Green Investment	Total amount of green investment issued
	Green Equity	Depth of development of green equity
	Green Insurance	Balance of green insurance investment
	Green support	Environmental Protection Expenditure Ratio
	Green Fund	Market share of green funds
Corporate Social Responsibility (CSR)	Environmental Responsibility	Fund issuance by enterprises in environmental protection
	Corporate Governance	Fund issuance by enterprises in corporate governance
	Social Responsibility	Fund issuance by enterprises in social responsibility
	ESG Strategy Fund Inflow Scale	Net inflow of enterprise ESG strategy funds

Control Variables

In addition to green finance and CSR, other factors such as rural economic development (RED), rural greening awareness (RGA), government intervention (GOV), education level (EDU), and infrastructure construction (INF) also influence the development of new-quality rural productivity to a certain extent. These variables affect the development speed and effectiveness of new-quality rural productivity by influencing regional economic development levels and residents' quality of life. Specific details are presented in Table 3.

Table 3. Variable Selection

Variable Type	Statistical Variable	Symbol	Formula for Measurement
Explained Variables	Development Level of New-Quality Rural Productivity	npf	Natural logarithm of 12 second-level indicators
Explanatory Variables	Green Finance Index	gfi	Natural logarithm of the green finance index
	Corporate Social Responsibility	csr	Corporate social responsibility index
Control Variables	Rural Economic Development Level	red	Per capita net income of farmers
	Rural Greening Awareness	rga	Rural greening rate
	Government Intervention Degree	gov	Fiscal regulatory expenditure
	Education Level	edu	Proportion of rural primary and secondary school teachers with a bachelor's degree or above
	Infrastructure Construction	inf	Proportion of villages with hardened roads

Model Construction

Based on the research purpose of examining the impact of green finance and ESG concepts on the development of new-quality rural productivity, the following multiple linear regression models are constructed:

$$npf = \beta_0 + \beta_1 gfi + \beta_3 red + \beta_4 rga + \beta_5 gov + \beta_6 edu + \beta_7 inf + \varepsilon \quad (1)$$

$$npf = \beta_0 + \beta_2 csr + \beta_3 red + \beta_4 rga + \beta_5 gov + \beta_6 edu + \beta_7 inf + \varepsilon \quad (2)$$

$$npf = \beta_0 + \beta_1 gfi + \beta_2 csr + \beta_3 red + \beta_4 rga + \beta_5 gov + \beta_6 edu + \beta_7 inf + \varepsilon \quad (3)$$

Note: Model (1) examines the impact of green finance on the development level of new-quality rural productivity; Model (2) examines the impact of ESG concepts on the development level of new-quality rural productivity;

Model (3) examines the combined impact of green finance and ESG concepts on the development level of new-quality rural productivity.

In these models, β0 represents the constant term, β1 to β7 represent the regression coefficients corresponding to each variable, npf represents the development level index of new-quality rural productivity, gfi and csr represent the green finance index and corporate social responsibility index, respectively, red, rga, gov, edu, and inf represent the control variables, and ε represents the error term. To reduce heteroscedasticity and avoid the influence of large differences in variable units on regression coefficients, the development level index of new-quality rural productivity, green finance, corporate social responsibility, rural economic development level, rural greening awareness, government intervention degree, education level, and infrastructure construction are all unit-transformed.

Descriptive statistics

Using StataMP18 software for statistical analysis of variables, the descriptive statistics of each variable are listed, including the mean, standard deviation, minimum, and maximum values, to gain a general understanding of the distribution of the variables.

Table 4. Descriptive Statistics for Key Variables

Variable	Observations	Mean	Standard deviation	Minimum	Maximum
npf	253	0.340	0.075	0.201	0.501
gfi	253	0.341	0.076	0.204	0.493
csr	253	0.286	0.132	0.080	0.509
red	253	31.448	2.056	26.822	35.342
rga	253	8.538	2.159	4.331	13.949
gov	253	3.044	2.733	0.354	14.687
edu	253	15.199	3.419	8.340	24.032
inf	253	15.305	3.545	8.580	23.347
gep	253	0.025	0.009	0.007	0.057
gef	253	4.292	1.946	0.974	9.474

As shown in Table 4, the mean value of the development level index of new-quality rural productivity (npf) is 0.340, with a maximum value of 0.501 and a minimum value of 0.201, indicating that the overall development level of new-quality rural productivity in Zhejiang Province is relatively high, but there are certain differences. The mean value of the green finance index (gfi) is 0.341, with a maximum value of 0.493 and a minimum value of 0.204, and a standard deviation of 0.042, indicating that the development level of green finance in the sample

is relatively concentrated and has a small fluctuation. The standard deviation of the corporate social responsibility index (csr) is also less than the mean value, indicating that the sample concentration of each variable is good. The distribution of other indicators is also within a reasonable range.

Dependence analysis

Dependence analysis is primarily used to examine the interrelationships among variables. This study employs the Pearson correlation coefficient to measure these relationships. A higher correlation coefficient indicates a stronger relationship between variables, laying the foundation for further analysis. The results show that the development level index of new-quality rural productivity (npf) exhibits a positive correlation with green finance (gfi) and corporate social responsibility (csr), and the correlation is relatively high. Green finance (gfi) and corporate social responsibility (csr) also show a positive correlation with rural economic development (red), rural greening awareness (rga), government intervention (gov), education level (edu), and infrastructure construction (inf). This suggests that during the development of green finance and ESG concepts, factors such as rural economic development (red), rural greening awareness (rga), government intervention (gov), education level (edu), and infrastructure construction (inf) play a significant role in promoting the development of new-quality rural productivity. The VIF (Variance Inflation Factor) test results indicate that VIF < 5, confirming that there is no multicollinearity issue in the model, and the model construction is sound.

Results and Discussion

Benchmark Regression

The results in Table 5 show that green finance has a significant positive impact on the development level of new-quality rural productivity, with a regression coefficient of 0.152 (significant at the 1% level), confirming Hypothesis H1a. The corporate social responsibility index also has a significant positive impact on the development level of new-quality rural productivity, with a regression coefficient of 0.050 (significant at the 1% level), confirming Hypothesis H2a. In the combined model (3), both green finance and corporate social responsibility have a significant positive impact on the development level of new-quality rural productivity, confirming Hypothesis H3a. Regarding the control variables, the regression coefficient of rural economic development (red) is -0.004 and is significant in all models, indicating a negative impact on the development level of new-quality rural productivity. This negative correlation also suggests that high-quality economic development has a significant positive impact on the development level of new-quality rural productivity. The regression coefficients of rural greening awareness (rga), government intervention (gov), education level (edu), and infrastructure construction (inf) are all positive and significant, indicating that these factors play a positive role in promoting the development of new-quality rural productivity.

Table 5. Impact of Green Finance and ESG Concepts on the Development Level of New-Quality Rural Productivity

variable	(1)npf	(2)npf	(3)npf
gfi	0.152***		0.133***
	(5.729)		(4.932)
csr		0.050***	0.036***
		(4.067)	(2.937)
red	-0.004***	-0.004***	-0.004***
	(-6.065)	(-5.212)	(-5.401)
rga	0.003***	0.004***	0.003***
	(5.149)	(6.095)	(5.127)
gov	0.003***	0.003***	0.002***
	(4.635)	(6.250)	(4.316)
edu	0.006***	0.006***	0.006***
	(10.818)	(11.414)	(10.696)
inf	0.007***	0.007***	0.007***
	(12.560)	(12.881)	(12.016)
_cons	0.179***	0.186***	0.170***
	(6.824)	(6.865)	(6.551)
N	253	253	253
R2	0.980	0.979	0.981
F	1940.658	1820.765	1718.400

Note: Figures in parentheses represent z-values. *, **, and *** denote significance levels of 10%, 5%, and 1%,

Robustness Tests

To ensure the robustness of the empirical results, this study conducts a robustness test by replacing the explanatory variables with secondary indicators of green finance and corporate social responsibility, respectively. The results are shown in Table 6.

Table 6. Robustness Test Results

variable	(4)npf	(5)npf	(6)npf
geq	0.349***		0.265***
	(3.813)		(2.988)
gef		0.006***	0.006***
		(5.598)	(5.028)
red	-0.004***	-0.004***	-0.004***
	(-6.382)	(-5.565)	(-5.842)
rga	0.004***	0.004***	0.004***
	(5.964)	(5.893)	(5.668)
gov	0.004***	0.003***	0.003***
	(6.688)	(5.338)	(5.144)
edu	0.007***	0.006***	0.006***
	(11.876)	(10.891)	(11.057)
inf	0.008***	0.007***	0.007***
	(14.125)	(12.703)	(12.940)
_cons	0.203***	0.188***	0.190***
	(7.555)	(7.193)	(7.388)
N	253	253	253
R2	0.979	0.980	0.981
F	1806.022	1929.739	1710.918

Note: Figures in parentheses represent z-values. *, **, and *** denote significance levels of 10%, 5%, and 1%, respectively

Based on the research objectives, this study investigates the impact of green rights and corporate environmental responsibility (measured by the issuance of funds for environmental protection by enterprises) on the development level of rural new productive forces. The following multiple linear regression models are constructed:

$$npf = \beta_0 + \beta_1 gep + \beta_3 red + \beta_4 rga + \beta_5 gov + \beta_6 edu + \beta_7 inf + \varepsilon \quad (4)$$

$$npf = \beta_0 + \beta_2 gef + \beta_3 red + \beta_4 rga + \beta_5 gov + \beta_6 edu + \beta_7 inf + \varepsilon \quad (5)$$

$$npf = \beta_0 + \beta_1 gep + \beta_2 gef + \beta_3 red + \beta_4 rga + \beta_5 gov + \beta_6 edu + \beta_7 inf + \varepsilon \quad (6)$$

Note: Model (4) examines the impact of green rights on the development level of rural new productive forces; Model (5) examines the impact of corporate environmental responsibility (measured by the issuance of funds for environmental protection by enterprises) on the development level of rural new productive forces; and Model (6) examines the combined impact of green rights and corporate environmental responsibility on the development

level of rural new productive forces.

The results of Model (4) indicate that green rights have a significant positive impact on the index of the development level of rural new productive forces at the 1% significance level, thereby validating Hypothesis H1a. The results of Model (5) show that corporate environmental responsibility has a significant positive impact on the index of the development level of rural new productive forces at the 1% significance level, thereby validating Hypothesis H2a. The results of Model (6) demonstrate that both green rights and corporate environmental responsibility have a significant positive impact on the index of the development level of rural new productive forces at the 1% significance level, thereby validating Hypothesis H3a. In summary, these findings are consistent with the aforementioned research conclusions.

Heterogeneity Analysis

Heterogeneity tests are employed to examine whether there are differences across various groups, typically conducted through subgroup regressions.

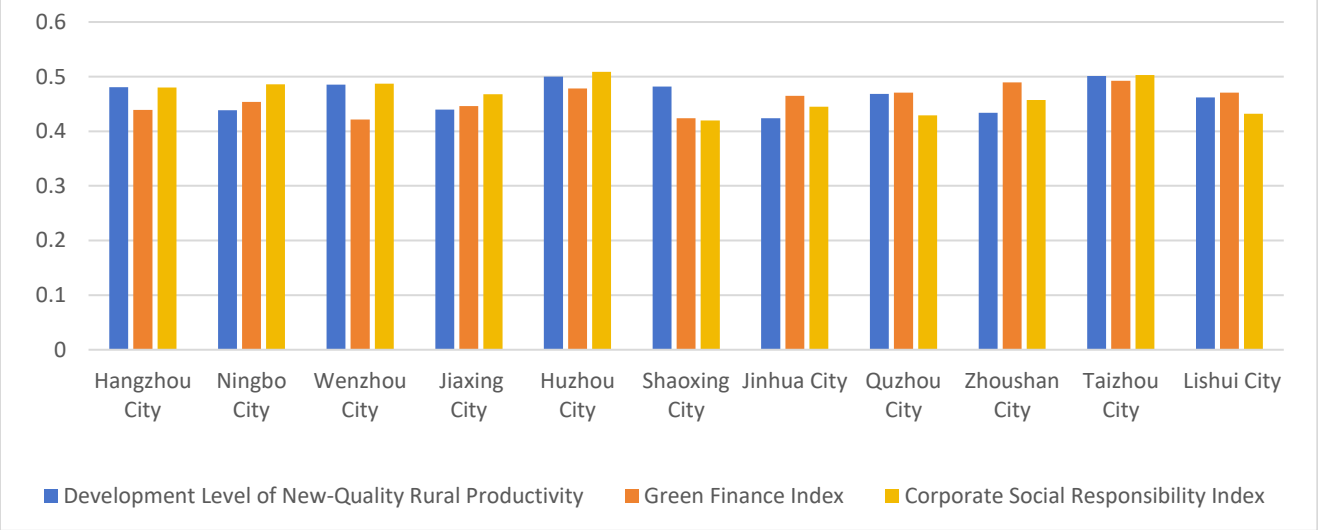

Figure 4. Statistical Chart of Rural New-Quality Productivity, Green Finance Index and Corporate Social Responsibility Index of 11 Cities in Zhejiang Province in 2022

As shown in the Figure 4, there are certain differences in the data among the 11 prefecture-level cities. Furthermore, this study argues that the impact of green finance and corporate social responsibility (CSR) on the development level index of rural new productive forces exhibits heterogeneity across counties in different regions of Zhejiang Province. This section will empirically investigate this hypothesis.

Heterogeneity Analysis Based on Economic Development Levels

Despite the significant positive estimates of green finance and ESG (Environmental, Social, and Governance) principles, regions with different levels of economic development may exhibit certain disparities in their development trajectories. This study categorizes the 11 prefecture-level cities into two groups: economically more developed areas and relatively less developed areas. Table 7 reports the results of the subgroup estimations.

Table 7. Results of Heterogeneity Analysis Based on Economic Development Levels

	(1)		(2)	
variable	economically more developed areas		relatively less developed areas	
gfi	0.154***		0.139***	
	(0.0407)		(0.0369)	
csr		0.0485*		0.0541***
		(0.0281)		(0.0147)
red	-0.00525***	-0.00541***	-0.00311***	-0.00234***
	(0.00114)	(0.00120)	(0.000810)	(0.000828)
rga	0.00333***	0.00442***	0.00344***	0.00360***
	(0.00112)	(0.00113)	(0.000804)	(0.000800)
gov	0.00335***	0.00403***	0.00260**	0.00314***
	(0.000806)	(0.000832)	(0.00104)	(0.000984)
edu	0.00565***	0.00583***	0.00628***	0.00678***
	(0.000976)	(0.00104)	(0.000679)	(0.000657)
inf	0.00566***	0.00603***	0.00740***	0.00774***
	(0.000991)	(0.00104)	(0.000648)	(0.000627)
Constant	0.239***	0.261***	0.146***	0.140***
	(0.0468)	(0.0487)	(0.0316)	(0.0319)
Observations	115	115	138	138
R-squared	0.978	0.975	0.983	0.983
Number of id	5	5	6	6

Note: Figures in parentheses represent z-values. *, **, and *** denote significance levels of 10%, 5%, and 1%, respectively

In the relatively less developed areas, both green finance (GFI) and corporate social responsibility (CSR) have a significant impact on the development level index of rural new productive forces at the 1% significance level, which is consistent with the findings from the full sample. In the economically more developed areas, green finance remains significant at the 1% level, while the coefficient of CSR is 0.0485 and significant at the 10%

level in the northern part of Zhejiang Province. In contrast, in the relatively less developed areas, the coefficient of CSR is 0.0541 and significant at the 1% level. This indicates that the development of ESG concepts positively influences the development of rural new productive forces in both regions, but the impact is stronger in the relatively less developed areas. Hypothesis H2b is thus validated. The observed differences may be attributed to the fact that firms in relatively less developed areas place greater emphasis on social responsibility. A higher proportion of these firms engage in rural development practices by investing in local communities, environmental protection, and job creation, thereby enhancing the development of rural new productive forces. Consequently, the influence of ESG concepts is more pronounced in these areas. The regression results for both regions show significant and positive coefficients for these variables, confirming their positive impact on the development of rural new productive forces. Among the control variables, education level and infrastructure development exhibit relatively large coefficients, suggesting that these factors may play a crucial role in the development of rural new productive forces. An increase in education level can enhance the skills and knowledge of the rural population, promoting economic diversification. Meanwhile, improved infrastructure can reduce transaction costs, attract external investment, and boost economic vitality in rural areas. These two aspects are essential considerations for economic development.

Heterogeneity Analysis Based on Industrial Structure

Given the differences in geographical location, culture, and policy, regions may prioritize different industries in their development. Based on the industrial development emphases of each region, this study categorizes the 11 prefecture-level cities into two groups: areas dominated by the primary and tertiary sectors, and areas dominated by the secondary sector. The subgroup estimation results are presented in the Table 8.

In areas dominated by the primary and tertiary sectors, green finance (GFI) has a significant positive impact on the development level index of rural new productive forces at the 1% significance level, with a coefficient of 0.135. In areas dominated by the secondary sector, GFI also shows a significant positive impact at the 1% level, with a coefficient of 0.190. Corporate social responsibility (CSR) in areas dominated by the primary and tertiary sectors has a significant positive impact on the development level index of rural new productive forces at the 1% level, with a coefficient of 0.0597. In contrast, in areas dominated by the secondary sector, CSR has a significant positive impact at the 5% significance level, with a coefficient of 0.0499. In summary, green finance (GFI) has a significant positive influence on the development of rural new productive forces in both types of regions, but its impact is more pronounced in areas dominated by the secondary sector. Corporate social responsibility (CSR) exerts a stronger positive influence on the development level of rural new productive forces in areas dominated by the primary and tertiary sectors.

Table 8. Results of Heterogeneity Analysis Based on Industrial Structure

variable	(3) dominated by the primary and tertiary sectors		(4) dominated by the secondary sector	
gfi	0.135***		0.190***	
	(0.0347)		(0.0477)	
csr		0.0597***		0.0499**
		(0.0193)		(0.0191)
red	-0.00504***	-0.00496***	-0.00273***	-0.00149
	(0.000876)	(0.000898)	(0.000999)	(0.00107)
rga	0.00313***	0.00390***	0.00366***	0.00402***
	(0.000870)	(0.000856)	(0.00105)	(0.00111)
gov	0.00303***	0.00352***	0.00115	0.00317**
	(0.000680)	(0.000661)	(0.00151)	(0.00140)
edu	0.00535***	0.00560***	0.00698***	0.00752***
	(0.000765)	(0.000771)	(0.000805)	(0.000826)
inf	0.00707***	0.00697***	0.00637***	0.00734***
	(0.000728)	(0.000764)	(0.000820)	(0.000825)
Constant	0.225***	0.240***	0.124***	0.106**
	(0.0357)	(0.0358)	(0.0385)	(0.0410)
Observations	161	161	92	92
R-squared	0.979	0.978	0.983	0.982
Number of id	7	7	4	4

Note: Figures in parentheses represent z-values. *, **, and *** denote significance levels of 10%, 5%, and 1%, respectively

The analysis of resource heterogeneity examines the differential impacts of green finance and corporate social responsibility (CSR) on the development of rural new productive forces in resource-based cities and non-resource-based cities. The results in Table 9 indicate that green finance has a significant positive impact on the development level index of rural new productive forces in both types of cities at the 1% significance level, with coefficients of 0.178 for resource-based cities and 0.119 for non-resource-based cities. This suggests that while green finance positively influences the development of rural new productive forces in both city types, its impact is more pronounced in resource-based cities. Regarding CSR, the coefficient for resource-based cities is 0.0500, significant at the 1% level, while for non-resource-based cities, the coefficient is 0.0286, significant at the 10% level. These findings demonstrate that CSR has a positive influence on the development of rural new productive forces in both types of cities, with a more substantial impact in resource-based cities. This validates Hypothesis H3b.

Heterogeneity Analysis Based on Resource Endowment

Table 9. Results of Heterogeneity Analysis Based on Resource Endowment

	(3)	(4)
variable	resource-based cities	non-resource-based cities
gfi	0.178***	0.119***
	(0.0404)	(0.0342)
csr	0.0500***	0.0286*
	(0.0165)	(0.0164)
red	-0.00237***	-0.00408***
	(0.000886)	(0.000874)
rga	0.00220**	0.00375***
	(0.000875)	(0.000860)
gov	0.00225*	0.00278***
	(0.00119)	(0.000672)
edu	0.00597***	0.00572***
	(0.000766)	(0.000728)
inf	0.00674***	0.00623***
	(0.000715)	(0.000718)
Constant	0.122***	0.196***
	(0.0333)	(0.0353)
Observations	69	184
R-squared	0.991	0.977
Number of id	3	8

Note: Figures in parentheses represent z-values. *, **, and *** denote significance levels of 10%, 5%, and 1%, respectively

This differential impact may be attributed to the distinct economic and environmental contexts of resource-based cities, which often face more significant environmental challenges and have a greater need for sustainable development practices. Consequently, CSR initiatives may be more effective in promoting rural new productive forces in these regions.

Conclusions

Based on the correlation study between green finance and the development of rural new productive forces, this research reviews and critiques existing studies, focusing on “the impact of green finance and ESG concepts on

the development of rural new productive forces." This focus is conducive to promoting coordinated development among the economy, natural environment, social responsibility, and corporate governance. Utilizing panel data from 11 prefecture-level cities in Zhejiang Province over the period of 2000–2022 as the research sample, this study employs software such as STATA and EViews to conduct empirical analyses. The results demonstrate that: Green finance exerts a continuous and sustained positive impact on the development of rural new productive forces. It significantly promotes rural revitalization in cities dominated by the secondary sector as well as those dominated by the primary and tertiary sectors. However, due to the influence of regional industrial structures, its impact is more pronounced in the former. Thus, adopting green finance as a long-term project through a sustainable model can provide stable financial support, facilitate rural industrial restructuring, and drive the development of rural new productive forces, thereby promoting the green transformation of rural economies.

The development of ESG concepts significantly boosts the development of rural new productive forces. However, influenced by regional economic development levels, ESG concepts have varying impacts on rural new productive forces, with a stronger effect observed in economically more developed regions. In these regions, enterprises place greater emphasis on social responsibility, with more firms engaging in rural revitalization practices through investments in local communities, environmental protection, and job creation. This involvement fosters the development of rural new productive forces. Therefore, the integration of ESG concepts with the development of rural new productive forces offers new impetus and direction for sustainable rural development.

Green finance and ESG concepts exhibit a significant synergistic effect in the development of rural new productive forces, jointly driving the green, circular, and sustainable development of rural areas. However, the degree of regional resource dependence affects the impact on rural new productive forces. Both green finance and ESG concepts have a more substantial impact on resource-based cities. Green finance provides precise financial support for green industries and projects that meet sustainable development requirements in rural areas. Meanwhile, through ESG evaluation and management, enterprises are guided to focus more on environmental protection and social responsibility in rural development, thereby deeply tapping into rural new productive forces and achieving sustainable development.

With the accelerated green and low-carbon transformation of China's agriculture, the demand for related green finance is increasing. It is necessary to further leverage green financial instruments such as green bonds and green asset securitization. At the current stage, the "visible hand" should be used to address externalities, price signal distortions, and other issues faced by green investment and financing. Proactive guidance should be provided for the transformation of non-green industries to stimulate the enthusiasm of all investment and financing parties. For industries and fields involved in non-green loans that need to gradually withdraw and transform, advance guidance should be given to optimize the regional industrial structure as a whole, avoiding industry shocks and impacts on regional economic stability caused by insufficient corporate awareness and slow transformation. Meanwhile, accelerate the green transformation of traditional enterprises in rural areas.

Promoting the development of green finance and ESG practices to enhance environmental governance requires cost-sharing between enterprises and the government. As green finance is still in its initial stage, it relies on

government subsidies to guide social capital inflows. Additionally, since ESG information disclosure and practices focus on long-term benefits, enterprises need to bear certain short-term costs. It is advisable to select representative enterprises that can afford initial investments and better realize ESG benefits in management and operations to lead ESG actions within the sector, gradually expanding the scope of ESG implementation. For relatively underdeveloped regions, appropriately reduce income taxes on green financial products, provide tax incentives for green projects, increase government funding support for specific projects, and attract social capital through relaxed market access conditions and tax policies. Vigorously develop government-social capital cooperation green development funds to promote the growth of rural green industries and new productive forces. Empirical results show that China's economic development exhibits regional imbalances. Therefore, it is necessary to prioritize the promotion of green finance and ESG concepts in relevant regions, giving preferential support to areas where green finance development is below the threshold and to enterprises with weak ESG awareness. Strongly support the development of green finance in resource-based regions and the enhancement of ESG concepts among enterprises in such regions. Establish specialized policy financial institutions to provide dedicated green financial services, tilting toward areas with low green finance development levels to allocate green financial funds reasonably. The ESG concept emphasizes enterprises' responsibilities in environmental, social, and governance aspects. Thus, the government should play a leading role in encouraging enterprises to participate in rural construction, improve rural infrastructure, expand the scope of market and social entities in social services, strengthen corporate ESG practices, and promote the development of rural new productive forces to achieve comprehensive economic, social, and environmental progress.

Declaration

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