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A Study of the Green Jobs Effect of Corporate ESG Performance: Evidence from China

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Abstract: Achieving comprehensive green transformation and deep decarbonization of socio-economic systems constitutes a pivotal pathway toward high-quality development. Green employment, as the core link between ecological governance and economic growth, requires further exploration of its development mechanisms. Drawing upon Huazheng ESG rating data, this study employs a sample of Chinese A-share listed green enterprises spanning 2013–2023 to empirically scrutinize how corporate ESG performance shapes green employment scales and the intricate transmission channels involved. The findings indicate that corporate ESG performance significantly promotesgreen employment growth, a conclusion that remains valid after robustness and endogeneity tests, including replacing explanatory variables, adding control variables, lagging core explanatory variables, and using instrumental variable methods. Mechanism tests indicate that ESG performance primarily influences green employment through three pathways: production-scale expansion effects, increased R&D investment, and enhanced green innovation capabilities. Heterogeneity analysis shows that these promotional effects are more pronounced in state-owned enterprises, technology-intensive enterprises, and high-tech enterprises. This study specifically focuses on the green employment sector, delves into multiple mechanism pathways, and conducts heterogeneity analysis based on China's institutional context—including property rights nature, factor intensity, and technological level—to provide a more detailed microlevel perspective andempirical support for understanding ESG's employment effects and formulating targeted policies. The research conclusions offer theoretical and empirical support for enterprises to promote green employment and achieve synergies between economic and social sustainability through ESG practices.

Keywords: ESG, green jobs, production scale, technological innovation, firm heterogeneity

1. Introduction

The acceleration of industrialization has led to a sustained increase in global energy demand, resulting in a sharp rise in carbon emissions that poses a severe challenge to the global climate system. The world is striving to find new technologies and measures to mitigate or alter the trajectory of global warming [1]. Against this backdrop, the implementation of ESG principles has become a strategic path to resolving the challenges of sustainable development. ESG refers to a company's comprehensive performance in environmental, social, and governance aspects. It is the concrete expression of green development concepts at the microlevel and an important way to measure a company's sustainability and social responsibility [2]. As the core carriers of market economic activities, companies' ESG practices not only influence their own sustainable development but are also reshaping the structural characteristics of the labor market, with green employment being a prominent manifestation of this evolutionary process. As the ESG concept has gradually become mainstream, it has been widely tested, practiced, and popularized in the practical field, attracting the interest of scholars worldwide [3, 4].

There is no globally unified definition of the connotation of green work, but the mainstream view can be summarized as an employment form that "balances environmental friendliness and decent work." The European Commission defines it as "positions that directly handle information, technology or materials for maintaining or restoring environmental quality and require corresponding professional knowledge, training or experience" [5]. Subsequent research pointed out that the renewable energy sector is the core carrier of green jobs and an important engine for promoting employment growth [6]. Domestic academic circles further emphasize that green employment must simultaneously meet the triple standards of "environmental sustainability, resource conservation, and decent work" and provide workers with secure, dignified, and high-value-added positions [7]. As for which economic sectors are most likely to generate green employment opportunities, the existing literature has not reached a consensus: The official statistical framework of the United States includes pollution reduction, recycling, organic agriculture, and non-energy environmental protection

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activities in the category of green employment, while the industry classification at the international level presents a diversified pattern due to differences in national conditions [8].

A review of existing literature reveals that while previous studies have examined the independent impact of ESG on corporate value and employment, few have systematically analyzed the level of green employment and its underlying mechanisms. Therefore, this paper analyzes the following three aspects: 1.1 the impact of ESG performance on corporate performance; 1.2 the factors influencing green employment; and 1.3 the linkage mechanism between ESG and employment.

1.1. The impact of ESG performance on corporate operating results

The impact of a company's ESG performance on its operating results shows a multi-path synergy effect. At the microlevel, ESG first enhances market recognition through the signaling mechanism: A high ESG rating can significantly boost investors' confidence in enterprises and simultaneously stimulate the vitality of green technological innovation [9]. On this basis, ESG information has been systematically incorporated into the asset pricing framework, promoting the continuous flow of capital into the field of sustainable development [10]. Further research has found that when enterprises have poor financial performance and are accompanied by ESG controversies, they are more inclined to actively improve ESG performance in order to restore social reputation and obtain financing convenience [11]. Empirical results taking the Chinese capital market as a sample also show that ESG ratings effectively promote the green transformation of enterprises through two channels: market incentives and external supervision [12].

The interaction effect between macro policies and enterprise value has been systematically tested. The integrated model constructed based on the stakeholder theory shows that the overall performance of ESG and its three sub-dimensions of environment, society, and governance all have a significant enhancing effect on enterprise value, among which enterprise innovation plays a core intermediary role in the transmission path. The degree of improvement of the institutional environment positively reinforces this relationship. Furthermore, property rights attributes and regional development levels constitute important boundary conditions: For non-state-owned enterprises (SOEs) and enterprises located in the eastern region, the effect of ESG on enhancing value is more obvious [13]. Further research using the policies of new energy demonstration cities as quasi-natural experiments has found that the government's energy transition policies have significantly improved the ESG performance of enterprises, and this effect is more prominent in large enterprises and low-carbon industries. In contrast, small high-carbon enterprises face stronger resistance to transformation, highlighting the necessity of differentiated policy design and precise support [14].

1.2. Factors influencing green employment

The generation of green employment is not an isolated phenomenon but the result of the deep coupling of structural changes in the economic system and the technological innovation network. Empirical evidence indicates that the circular economy model is more likely to generate green jobs due to its characteristics of resource reuse and value chain extension [15]. The econometric model constructed based on the ten-year sequence data of the Environmental Goods and Services Sector further indicates that the scale of private investment, the expansion of total value added, and the existing employment base are the three core variables determining green employment creation [16].

The employment dividend brought about by the transformation of the energy structure shows significant heterogeneity in both spatial and industrial dimensions. A case study of the development of renewable energy in the Czech Republic shows that the expansion of sub-sectors represented by biomass energy has created a large number of new jobs [17]. Meanwhile, cross-national panel evidence further clarifies the dynamic interplay among renewable energy consumption, economic growth, trade flows, capital accumulation, and labor demand [18]. At the level of the technological innovation network, the network centrality of venture capital institutions has been proven to play a key catalytic role: Institutions located at the core of the network have significantly enhanced the green technological innovation level of enterprises through three mechanisms: knowledge spillover, reputation certification, and regulatory pressure transmission. This effect is particularly prominent in private enterprises and high-tech industries, providing important empirical evidence for optimizing green financial policies and accelerating low-carbon transformation [19].

The impact of enterprise digital transformation on environmental performance shows significant nonlinear characteristics: Digital investment must first go through the period of technology absorption and adaptation and then ultimately improve environmental performance through the U-shaped intermediary path of technological innovation. Moreover, the hometown identity of senior executives positively reinforces this process, providing a theoretical and policy connection framework for coordinating digital strategies and environmental governance [20].

1.3. The linkage mechanism between ESG and employment

ESG performance is deeply coupled with the labor market through three mechanisms: policy intervention, capital reallocation, and human capital upgrading. In terms of the policy transmission path, the pilot policy of low-carbon cities has increased the scale of enterprise employment [21]. Meanwhile, environmental regulations have significantly promoted employment growth in high-tech industries through the channel of technological progress, but have had no significant impact on highly polluting industries [22, 23]. Macro-level time-series work from Turkey further reveals that carbon-pricing and low-carbon-investment policies can leverage green employment growth at the national level; the dynamic effects closely mirror Vector Auto-Regression findings for other emerging economies, offering a common policy reference for countries at similar development stages [24]. Cross-national evidence indicates that high ESG scores significantly enhance employee satisfaction by improving the workplace environment and strengthening organizational identity, thereby optimizing the human capital structure [25].

The interaction between the capital market and the labor market is becoming increasingly close: Funds constrained by ESG demonstrate stronger risk resistance under stress scenarios, and their asset allocation tilts toward green employment-intensive industries accordingly, promoting the synchronous expansion of capital and jobs [26]. However, this coupling effect has obvious structural differences – non-SOEs and enterprises in the eastern region are more likely to achieve employment growth driven by ESG [20], while targeted support for low-carbon industries by local governments can further enhance the creation efficiency of green jobs [14].

Consequently, prior scholarly investigations predominantly concentrate on ESG's social value proposition, investment attractiveness, decarbonization trajectories, and environmental regulatory compliance. Scholarly inquiry into the nexus linking ESG performance with green employment generation and its fundamental transmission channels remains underdeveloped. This investigation redresses the identified research void through empirical analyses interrogating how ESG deployment shapes corporate green employment magnitude and mediating mechanisms, supplemented by heterogeneity assessments contingent upon firm-level attributes. Beyond furnishing novel theoretical perspectives on the ESG-green employment interface, this study provides actionable benchmarks for regulatory authorities and enterprise executives seeking to catalyze green job creation and advance sustainability imperatives. Through granular scrutiny of ESG performance implications for green employment, the research guides enterprises toward intensified fulfillment of environmental and social obligations concurrent with economic value creation, thereby propelling synergistic socio-economic advancement.

2. Theoretical Analyses and Research Hypothesis

2.1. Corporate ESG performance directly affects the level of corporate green jobs

The stakeholder theory holds that an enterprise is essentially a collection of multiple stakeholders. As core members, employees' employment choices and willingness to stay directly determine whether the organization can continue to operate. Data from integrated resort staff confirm that ESG practices across the three dimensions enhance employees' self-esteem and organizational commitment, thereby significantly reducing turnover intention—a finding that empirically validates the tripartite causal linkage extending from green practice through psychological empowerment to talent retention [27]. The resource-based view further posits that superior ESG performance constitutes an inimitable intangible resource: it simultaneously strengthens firms' sustainable-capability base and forges a positive corporate image, thereby markedly enhancing the efficiency of human capital investment [28]. Furthermore, the continuous investment of enterprises in social responsibility sends a long-term and stable signal to employees, meets their demand for job security, and thereby enhances attractiveness and retention rate [29].

On the labor supply side, the stakeholder theory holds that enterprises with ESG advantages regard their employees as core stakeholders and generate a significant "talent attraction" effect by optimizing the working environment and providing fair treatment. Empirical research shows that the improvement of ESG performance of enterprises is accompanied by the growth of corporate value, and higher corporate value is transformed into more stable employment security and broader career development space, thereby continuously attracting external labor to join. Furthermore, such enterprises are not only accountable to shareholders, but also fulfill comprehensive responsibilities to multiple subjects such as employees, communities, and the public. This responsibility orientation directly enhances employee satisfaction and loyalty [30]. The improvement of employee satisfaction, in turn, enriches corporate profits, verifying the consistency between employee interests and corporate interests. Agency theory further points out that a good corporate governance structure can alleviate the information asymmetry between management and shareholders, enhance the transparency of decision-making, and thereby create a fair and just organizational atmosphere. Sound internal processes reduce the burden on employees through efficiency optimization and enhance their sense of identification with the enterprise. Institutional theory emphasizes that enterprises that abide by regulations and social norms are more likely to gain social trust. This trust not only attracts capital but also enables employees to have confidence in the prospects of the enterprise, ultimately forming a virtuous cycle of "enterprise–employee" common growth [31].

2.2. Production scale-up effect

Based on the resource dependence theory, the continuous development of enterprises cannot do without the stable supply of external resources, and a strong ESG proposition is becoming a keyway for enterprises to obtain these resources, enter new markets, and expand existing market shares. Specifically, outstanding ESG performance can precisely meet the global market's demand for sustainable development, enabling enterprises to break through geographical and industry barriers and achieve significant expansion of market size [32]. From a resource-based perspective, ESG, as a unique strategic resource for enterprises, can bring about sustained competitive advantages: on the one hand, good ESG performance significantly enhances the return on assets and directly boosts the company's market value, providing capital accumulation for enterprises to further expand their production scale [33, 34]. On the other hand, high-quality ESG information disclosure effectively expands the scale of ESG investment and accelerates investment growth by reducing the information asymmetry between investors and enterprises. Moreover, this effect is particularly significant in regions where Corporate Social Responsibility reporting is mandatory. Sufficient capital inflow provides a solid guarantee for enterprises to expand production [35].

Adhering to sustainable development practices enables companies to maintain their competitiveness in the long term. In this process, companies that actively fulfill their social responsibilities and disclose information send positive signals to the market regarding their operational stability and sense of social responsibility based on signal transmission theory, thereby strengthening investor confidence. As the primary participants in market activities, investors' attention toward companies is positively correlated with their investment preferences. When capital inflows occur, companies' financial pressures are effectively reduced, enabling them to allocate more resources to deepening social responsibility practices and expanding production scale. This creates a sustainable virtuous cycle: "improved ESG performance – increased capital inflows – expanded production scale – deepened ESG practices." From the perspective of economies of scale theory, when a company expands its production scale, it can reduce raw material costs through bulk purchasing, improve equipment utilization rates through large-scale production, thereby lowering the production cost per unit and enhancing overall efficiency. The improved efficiency, in turn, enables the company to allocate more resources to further expand production capacity and hire more employees, creating a scenario where production scale and job creation grow in tandem.

According to market signaling theory, robust ESG credentials function as favorable market cues, signaling a firm's elevated ethical norms and robust societal accountability, which consequently enhance its competitive stature and reputational equity. As representatives of public interest, governments often encourage green production and sustainable development, offering incentives such as tax breaks and subsidies to companies that meet ESG standards. These policy supports further reduce operational costs, creating favorable conditions for production-scale expansion. Meanwhile,

as consumer awareness of green concepts and social responsibility grows, the public demonstrates a stronger purchasing preference for products with sustainable development characteristics. This strengthening of consumption trends, based on the demand-pull theory, drives companies to accelerate business expansion, gradually forming incremental demand for human resources through capacity expansion and supply chain extension, thereby driving the creation of new job positions. In summary, a company's ESG advantages attract market demand, capital inflows, and policy support, driving production-scale expansion from both the demand and supply sides. This expansion, in turn, increases overall employment levels by directly increasing the number of employees and indirectly stimulating the development of related industries.

2.3. Technological innovation effects

The theory of sustainable development holds that the long-term survival of an enterprise depends on its harmonious balance of the three bottom lines of the environment, society, and economy. Under this framework, enterprises with outstanding ESG performance are regarded as active practitioners of sustainable concepts and tend to invest more resources in green technological innovation to achieve the coordinated growth of environmental and economic benefits [36]. Empirical evidence shows that good ESG performance can significantly enhance the promoting effect of environmental regulations on green innovation by improving the governance level of the board of directors, demonstrating a positive interaction between internal corporate governance and external policy demands [37]. From the perspective of resource basis, high-level ESG enterprises usually have accumulated multiple strategic resources such as technology, management, and brand. Such distinctive and inimitable assets constitute a robust platform enabling firms to amplify R&D expenditure and expedite green technological breakthroughs. Subsequent scholarly inquiry reveals a pronounced U-shaped association linking ESG scores to green innovation: During periods of inferior ESG performance, firms typically concentrate resources on enhancing governance structures and operational efficacy, potentially constraining green innovation expenditures in the near term. As ratings progressively improve, green innovation becomes reconfigured as a pivotal driver of expansion, prompting a corresponding reorientation of resource deployment toward sustainable technology domains [38]. Multilevel empirical evidence corroborates this finding: microlevel analysis demonstrates that stronger ESG performance markedly elevates green invention patent counts [39]; macro-level cross-country evidence from 118 nations likewise affirms ESG's robustly positive influence on green innovation [40].

When companies engage in ESG rating activities, they are essentially conducting a systematic review and optimization of their own ESG practices. Based on the theory of dynamic capabilities, this review and optimization can transform the benefits generated by ESG into a driving force for green technological innovation. Technological progress is an important driver of economic growth, and green technological innovation, as an important component of technological progress, also plays a significant role in promoting economic growth. The application of new technologies can create new industries and job opportunities, a process consistent with Schumpeter's theory of "creative destruction," which posits that innovation eliminates outdated production methods while fostering new industrial forms. According to the theory of emerging industries, the green economy, as an emerging industry, has generated a large number of employment opportunities through its rapid development. The application of green technologies not only increases the quantity of jobs but also enhances their quality, such as by providing positions with higher skill requirements to improve employees' career development opportunities. Green technology innovation gives rise to new professional fields, such as environmental engineers and sustainability consultants. These positions not only number in large quantities but also typically require high levels of professional skill, aligning with the view in human capital theory that "technological progress drives human capital upgrading." The research, development, and application of green technology involve multiple stages, including design, manufacturing, installation, and maintenance, each of which requires corresponding labor, thereby creating a multiplier effect on employment across the entire industrial chain. As consumer demand for green products and services increases, companies must expand their production and service scales to meet market needs. This process, based on the theory that demand drives employment, further stimulates job creation. According to agency theory, companies can clarify the rights and responsibilities of management and shareholders in green technology innovation through high-level corporate governance, mitigate agency problems, and enhance green innovation efficiency [41], thereby accelerating the conversion of green technology into actual productive capacity and ultimately achieving the goal of innovation-driven employment growth.

In summary, companies with strong ESG performance, based on sustainability theory and the resource-based view, are more inclined to invest resources in green technology R&D. This not only enhances the company's green innovation capabilities but also creates new market opportunities for the company. By strengthening their green technology innovation capabilities, companies can drive the development of high-efficiency and low-environmental-impact products, thereby aligning with the growing market demand. This increased demand promotes business expansion, increases the demand for labor, and directly or indirectly improves employment levels. ESG advantages, by promoting the enhancement of green innovation capabilities, bring new market opportunities and development space for companies. This not only contributes to the sustainable development of companies but also creates more employment opportunities for society. The characteristic of green technology innovation, which increases both the quantity and quality of employment, fully demonstrates the importance of ESG practices in promoting dual socio-economic benefits and aligns with society's current pursuit of high-quality employment.

Synthesizing the preceding arguments, this study formulates three empirically grounded hypotheses for subsequent testing:

Hypothesis 1: ESG performance significantly promotes green employment growth in enterprises.

Hypothesis 2: The production-scale expansion effect plays an intermediary role in ESG performance, promoting green employment growth in enterprises.

Hypothesis 3: Improving enterprise R&D investment and enhancing green innovation capabilities play an intermediary role in ESG performance, promoting green employment growth in enterprises.

3. Research Design

3.1. Model construction and variable selection

Based on the assumptions, this paper employs a two-way fixed effects model with both year and industry fixed effects. Equation (1) presents the baseline regression specification examining how corporate ESG performance influences firm employment levels.

$$\text{InEmploy}_{i,t} = \beta_1 \text{ESG}_{i,t} + \beta_2 \text{Controls}_{i,t} + \sum Year_{i,t} + \sum Ind_{i,t} + \varepsilon_{i,t} \quad (1)$$

In equation (1), the subscripts i, t identify the firm and year, respectively. *Controls* stands for the vector of control variables, and ε is the idiosyncratic error. The key regressor, ESG, is the Huazheng rating assigned to firm i at the end of year t. This rating scale comprises nine rungs—AAA, AA, A, BBB, BB, B, CCC, CC, and C—numerically coded from 9 (highest) to 1 (lowest), where a higher value signals stronger overall environmental, social, and governance performance. This assignment method intuitively reflects a company's comprehensive performance in environmental, social, and governance aspects. The higher the value, the more outstanding the company's ESG practices, and the more advanced it is in addressing environmental challenges, fulfilling social responsibilities, and improving corporate governance. The coefficient β^1 measures the impact of a company's ESG performance on green employment. If β^1 is greater than 0, it indicates a positive correlation between the two, meaning that ESG performance promotes the growth of green employment in the company. Referring to the research by Kunapatarawong & Martínez-Ros [42], the dependent variable InEmploy is once more computed as the natural logarithm of the number of employees in listed company i during year t plus one.

$\text{Controls}_{i,t}$ represents control variables. We selected Tobin's Q as a measure of corporate growth potential, using the ratio of market value to assets. Yoon et al. [43] found that higher ESG ratings are associated with lower management efficiency. As company size increases, this negative relationship moderates in the positive direction. Therefore, following the study by Duan et al. [44], this paper includes the following control variables in the empirical model: firm size (Size), operationalized as the natural logarithm of period-end total assets; return on assets (ROA), calculated as the ratio of net income to period-end total assets; leverage ratio (Lev), defined as total liabilities divided by period-end total assets; and revenue growth (Grow), measured by the year-on-year change in operating revenue (current-year revenue divided by prior-year revenue). Additionally, we account for unobserved heterogeneity through industry fixed effects $Ind_{i,t}$ and year fixed effects $Year_{i,t}$, with $\varepsilon_{i,t}$ representing the random error term.

3.2. Data sources

This paper measures green employment based on the employment status of employees in green enterprises. Regarding the classification of green enterprises, this paper draws on the approach by Hu et al. [45]. To single out green firms, we first eliminate polluters by cross-checking each company's core business against three regulatory lists: the "Environmental Supervision Classification Catalogue for Listed Firms," the "Guidelines on Environmental Information Disclosure for Listed Firms," and the "Industry Classification Standard for Listed Companies." Any company whose main operations lie in mining (codes B06, B07, B08, B09), the specified manufacturing sub-sectors (C17, C19, C22, C25, C26, C28, C29, C30, C31) or power/heat generation and supply (D44) is dropped from the sample. The remaining firms are then screened against the "Green Industry Catalogue" issued by the National Development and Reform Commission; only those whose primary activities explicitly match items in that document are labeled as green enterprises.

This study selected green enterprises from A-share listed companies in China between 2013 and 2023 as the research sample and then implemented a rigorous data cleaning process as described below: (1) excluded data samples of listed companies classified as ST; (2) excluded data samples of financial listed companies; (3) excluded data samples of listed companies with missing values in core variables; (4) applied trimmed-in-tail processing to the data at the top and bottom 1%; and (5) partially missing values were filled using data manually collected from listed company annual reports and financial websites. A total of 8,905 sample observations were obtained.

3.3. Descriptive statistics

Table 1 presents the summary statistics for the key variables. The ESG rating reports a median of 4.000, a maximum of 8.000, and a minimum of 4.000, implying that the majority of sample firms are rated around grade B while the upper bound attains grade A, delivering satisfactory discrimination. The mean value of 4.125

Table 1
Descriptive statistics

VarName	Obs	Mean	SD	Median	Max
ESG	8905	4.125	1.087	4.000	8.000
lnEmploy	8905	7.905	1.262	7.829	11.292
lnyysr	8905	21.820	1.537	21.709	28.449
lnGreenpatent	8905	0.633	1.057	0.000	7.062
lnRDSpendSum	8905	15.285	7.086	18.038	25.025
Age	8905	13.467	6.820	12.000	33.000
Focus	8905	0.437	0.197	0.401	0.972
Size	8905	22.562	1.340	22.429	28.697
Roa	8905	0.036	1.155	0.029	108.366
Lev	8905	1.315	2.683	1.049	86.692
Grow	8905	0.122	0.415	0.070	15.888
tobinQ	8905	2.019	2.588	1.585	192.705

is marginally higher than the median, and the distribution tails off toward higher ratings, indicating that overall ESG performance still has considerable space for improvement and underscoring the necessity of continuous ESG upgrading. The employment variable lnEmploy shows a median of 7.829, a maximum of 11.292, and a minimum of 7.905, displaying a reasonable spread and good variability. The five control variables are also well-behaved: no extreme values or outliers are detected. After winsorizing all continuous variables at the 1% and 99% quantiles, no influential extremes reappear, and no anomalous observations are found, evidencing an ideal distribution and reliable data quality.

4. Descriptive Statistics

4.1. Benchmark regression results

Table 2 summarizes the baseline regression results for the effect of ESG performance on corporate green employment. In column (1), which controls only for year and industry fixed effects, the ESG coefficient is 0.338 and significant at the 1% level, indicating that better ESG performance is associated with higher green employment levels. After additional control variables are included and both year and industry effects remain fixed, the ESG estimate is still significant at the 1% level and equals 0.049. This implies that, all else equal, a one-grade increase in the ESG rating raises the level of green employment by approximately 4.9%. Overall, the baseline results demonstrate that an ESG advantage meaningfully contributes to the expansion of firms' green employment, thereby confirming Hypothesis 1.

Table 2
Benchmark regression results

	(1)	(2)
Variables	lnEmploy	lnEmploy
ESG	0.338***	0.049***
	(0.011)	(0.007)
Size		0.817***
		(0.007)
Roa		-0.030***
		(0.011)
Lev		-0.001
		(0.003)
Grow		-0.062***
		(0.018)
tobinQ		0.027***
		(0.005)
_cons	6.149***	-10.265***
	(0.095)	(0.153)
Industry, year fixed effects	Yes	Yes
N	8905	8905
adj. R^2	0.173	0.700

Note: *p < 0.05, ** p < 0.01, *** p < 0.001

4.2. *Robustness test*

4.2.1. Replacement of explanatory variables

Since no single benchmark exists for gauging corporate ESG performance, we rerun the regression by adopting the Bloomberg ESG rating as the key explanatory variable in order to strengthen the robustness of our findings and reduce any distortion that might arise from differences in disclosure quality. The Bloomberg ESG scores range from 0 to 100, with higher values denoting superior ESG performance. As reported in Table 3, the estimated coefficient is 0.004 and remains significant at the 1% level. This outcome confirms that ESG performance continues to exert a statistically significant positive effect on the scale of corporate green employment after the explanatory variable is replaced, thereby providing additional support for Hypothesis 1 and underscoring the reliability of the baseline results.

Table 3
Replacement of explanatory variables

	(1)	(2)
	lnEmploy	lnEmploy
BloombergESG	0.039***	0.004***
	(0.001)	(0.001)
_cons	7.067***	-9.720***
	(0.080)	(0.191)
Controls	Yes	Yes
Industry, year fixed effects	Yes	Yes
N	8095	8095
adj. R^2	0.326	0.696

Note: *p < 0.05, ** p < 0.01, *** p < 0.001

4.2.2. Adding possible missing control variables

In order to mitigate the effect of possible omitted control variables in the model, therefore, further regressions are conducted by adding firms' years on the market (Age) and equity concentration (Focus) as control variables. Table 4 reports the regression results after adding the inclusion of these control variables, and it can be observed that the coefficients of the core explanatory variables are still significant at the 1% level and the regression results are consistent with those of the baseline regression, which further validates the fact that ESG performance contributes to the level of green employment in firms. Hypothesis 1 still holds; thus, the conclusions drawn in this study are stable and reliable.

4.2.3. Lagged core explanatory variables

In the benchmark regression, we examine how current-year ESG performance affects firms' green employment levels; however, such influence may be delayed and only surface in subsequent years. Consequently, we lag the core explanatory variable—ESG ratings—by one period and re-estimate the baseline model. Table 5 presents these results: the estimated coefficient on the lagged ESG term is 0.042 and remains significant at the 1% level, indicating that ESG performance continues to exert a significant positive effect on green jobs one year later. Among control variables, firm size, return on assets, and Tobin's Q all display significant positive associations with green employment, while leverage and growth rate show significant negative associations. The adjusted R^2 reaches 0.701, demonstrating strong explanatory power. Overall, the findings confirm that our regression results are robust and reliable, and Hypothesis 1 remains valid.

4.2.4. Instrumental variables method

There may be a bidirectional causal relationship between ESG performance and a company's green employment level: good ESG

Table 4
Addition of potentially omitted control variables

	(1)	(2)
	lnEmploy	lnEmploy
ESG	0.352***	0.052***
	(0.012)	(0.007)
Size		0.847***
		(0.007)
Roa		-0.049***
		(0.012)
Lev		-0.003
		(0.003)
Grow		-0.060***
		(0.018)
tobinQ		0.028***
		(0.006)
Age		0.003*
		(0.001)
Focus		0.032
		(0.040)
_cons	6.065***	-11.000***
	(0.099)	(0.160)
Industry, year fixed effects	Yes	Yes
N	8905	8905
adj. *R*2	0.177	0.710

Note: *p < 0.05, ** p < 0.01, *** p < 0.001

Table 5
ESG lagged one-period regression

	(1)
	lnEmploy
ESG	0.042***
	(0.008)
_cons	-10.319***
	(0.162)
Controls	Yes
Industry, year fixed effects	Yes
N	8905
adj. R^2	0.701

Note: *p < 0.05, ** p < 0.01, *** p < 0.001

performance may promote employment expansion, while companies with larger employment scales may also have more resources to invest in ESG practices. To alleviate endogeneity issues, this paper draws on the research of Zhang [46] and Chen et al. [47] and uses the instrumental variable (IV) for two-stage least squares estimation. The logic behind the construction of IV is as follows: the average ESG performance of other companies in the same region and year is correlated with the ESG performance of individual companies (regional environmental commonality), and as a macro-level regional variable, it theoretically does not directly influence individual companies' employment decisions, thereby satisfying the exogeneity requirement.

Table 6
Instrumental Variables Method

	(2)	(2)
Variables	first stage	Second stage
	ESG	lnEmploy
IV	0.018***	
	(0.006)	
ESG		0.0625***
		(6.689)
Controls	Yes	Yes
Constant	-9.614***	-9.283***
	(1.130)	(-53.24)
Industry and year fixed effects	Yes	Yes
Observations	8528	8,528
R-squared	0.552	0.574

Note: *p < 0.05, ** p < 0.01, *** p < 0.001

The results of the two-stage regression in Table 6 show that in the first stage, IV5 is significantly positively correlated with the ESG of individual enterprises ($\beta = 0.9638$, $p < 0.01$), and the F value is much higher than the empirical threshold of 10, rejecting the assumption of a weak instrumental variable. In the second stage, the ESG coefficient corrected by instrumental variables was significantly positive ($\beta = 0.8377$, $p < 0.01$), indicating that after excluding endogeneity issues, for every 1 standard deviation increase in ESG performance, the green employment level of enterprises significantly increased by approximately 83.8%, verifying the causal positive relationship between the two. And it further strengthened the robustness and credibility of the research conclusion.

5. Impact Mechanism Test and Heterogeneity Analysis

5.1. Analysis of mediating effect of production scale

In this paper, we refer to the study of Mao et al. (2023), who used operating income to measure the production scale of enterprises and took the logarithm of operating income to deal with lnyysr. After the main effect regression, the transmission mechanism test is conducted to verify the role played by the production scale (lnyysr) in the process of ESG performance on the level of green employment in enterprises.

As displayed in Table 7, column (1) regresses firms' ESG advantage on the mechanism variable production scale (lnyysr); the estimated slope is 0.024 and significant at the 1% level, indicating that fulfilling ESG responsibilities significantly enlarges firms' scale of production. Column (2) then regresses this mediator (lnyysr) on firms' green employment level, yielding a coefficient of 0.569 that is also significant at the 1% level, demonstrating that an expanded production scale markedly raises firms' green employment. In column (3), when both ESG advantage and production scale are entered together, the coefficient on corporate ESG advantage remains positive at 0.035, and the coefficient on the production-scale mediator equals 0.566; both estimates pass the 1% significance test. Consequently, the production-scale expansion effect acts as a mediating channel through which ESG performance promotes the growth of green employment in enterprises, thereby verifying Hypothesis 2.

Table 7
Analysis of production scale-up mechanisms

	(1)	(2)	(3)
	lnyysr	lnEmploy	lnEmploy
ESG	0.024***		0.035***
	(0.006)		(0.006)
Controls	Yes	Yes	Yes
lnyysr		0.569***	0.566***
		(0.011)	(0.011)
_cons	-2.531***	-8.917***	-8.832***
	(0.126)	(0.138)	(0.139)
Industry, year fixed effects	Yes	Yes	Yes
N	8905	8905	8905
adj. R^2	0.864	0.764	0.765

Note: *p < 0.05, ** p < 0.01, *** p < 0.001

Table 8
Analysis of technology upgrading mechanisms

	(1)	(2)	(3)	(4)	(5)	(6)
	lnGreenpatent	lnEmploy	lnEmploy	lnRDSpendSum	lnEmploy	lnEmploy
ESG	0.106***		0.047***	0.136***		0.046***
	(0.010)		(0.007)	(0.040)		(0.007)
lnGreenpatent		0.022***	0.017**			
		(0.008)	(0.008)			
lnRDSpendSum					0.024***	0.023***
					(0.002)	(0.002)
_cons	-5.791***	-10.257***	-10.169***	-5.140***	-10.262***	-10.146***
	(0.209)	(0.160)	(0.160)	(0.839)	(0.152)	(0.152)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Industry, year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
N	8905	8905	8905	8905	8905	8905
adj. R^2	0.205	0.699	0.700	0.715	0.704	0.705

Note: *p < 0.05, ** p < 0.01, *** p < 0.001

5.2. Analysis of mediating effect of technological innovation

This paper employs two distinct yet complementary indicators to capture firms' technological innovation activities. First, to quantify the scale of research and development outlays, we measure overall R&D input by the annual R&D expenditure and then apply a natural-logarithm transformation, generating the variable lnRDSpendSum. Second, to gauge the specifically green dimension of innovative capacity, we count the yearly number of green patent applications filed by each firm; this count is likewise log-transformed to create lnGreenpatent. Once the baseline effect of ESG performance on green employment is established, we proceed to examine whether and how these two innovation channels—R&D spending volume and green patenting intensity—transmit the influence of ESG onto firms' green employment levels by conducting a formal mediation analysis.

As shown in Table 8, column (4) presents the regression of firms' ESG advantages on the mechanism variable investment (lnRDSpendSum), yielding an estimated coefficient of 0.136 that is significant at the 1% level. This indicates that stronger ESG advantages lead to higher levels of corporate investment. Column (5) displays the regression of the mechanism variable investment (lnRDSpendSum) on firms' green employment level, with an estimated coefficient of 0.024 and significance at the 1% level. It shows that increased investment can significantly raise the level of green employment among firms. From the regression results in column (6), it can be observed that the estimated coefficient of corporate ESG advantages on the level of green employment is 0.046, while the estimated coefficient of the mechanism variable investment (lnRDSpendSum) on the level of green employment is 0.023, both significant at the 1% level. It can therefore be concluded that investment (lnRDSpendSum) plays a partial mediating role in the relationship between corporate ESG advantages and green employment levels. Specifically, the fulfillment of ESG responsibilities by firms encourages greater corporate investment, which not only provides financial support for the development of green technological innovation but also contributes to the creation of related job opportunities. This, in turn, promotes an increase in the level of green employment within enterprises.

As shown in Table 8, column (1) presents the regression results of firms' ESG advantages on the mechanism variable green innovation capacity (lnGreenpatent), with an estimated coefficient of 0.106, which is statistically significant at the 1% confidence level. This indicates that firms' ESG advantages can effectively enhance their green innovation capability. Column (2) reports the regression results of the mechanism variable green innovation capacity (lnGreenpatent) on firms' green employment level, yielding an estimated coefficient of 0.022, also significant at the 1% confidence level. It demonstrates that improved green innovation capacity can significantly raise the level of green employment within enterprises. From the regression results in column (3), it can be observed that the estimated coefficient of the impact of enterprise ESG advantage on the level of green employment is 0.046, while the estimated coefficient of the impact of the mechanism variable green innovation capacity (lnGreenpatent) on the level of green employment is 0.017; both coefficients pass the significance test at the 1% confidence level. Therefore, it can be concluded that green innovation capacity (lnGreenpatent) plays a partial mediating role in the process through which corporate ESG advantages influence the level of corporate green employment. In other words, the ESG advantages of enterprises can strengthen their green innovation capabilities, which in turn promotes the enhancement of green employment levels across the firm.

To sum up, an enterprise's ESG advantages can promote an enterprise's green employment level by improving an enterprise's investment and enhancing green innovation ability. Hypothesis 3 is verified.

5.3. Heterogeneity analysis

5.3.1. Heterogeneity analysis of property rights

In order to examine the differences in the impact of ESG performance of enterprises with different property rights on the level of green employment, this paper divides the data into the state-owned enterprise group and the non-SOE group based on the nature of enterprise property rights. And a 0-1 dummy variable is used to differentiate, where 1 represents state-owned enterprises and 0 represents non-state-owned enterprises. Table 9 reports the regression results of property rights heterogeneity. The two columns show the impact of ESG performance on the level of green jobs for SOEs and non-SOEs, respectively. From the regression results, the ESG performance of both SOEs and non-SOEs positively contributes to green jobs at the 1% significance level. However, the estimated coefficient of 0.06 for SOEs is higher than that of 0.031 for non-SOEs. This indicates that the green employment of both SOEs and non-SOEs is significantly and positively influenced by ESG, but the influence of SOEs is greater. The possible reason for this is that business operations take into account the interests of all stakeholders, not just shareholders, and SOEs, due to their public nature, may pay more attention to a wide range of social stakeholders and thus show a stronger sense of responsibility in terms of ESG. Resource-based theory emphasizes the importance of resources within the firm, and SOEs tend to have more resources and financial support, which gives them greater flexibility and durability in implementing ESG strategies. Organizational legitimacy theory states that firms need to conform to social norms and values in order to gain recognition and support from society. SOEs, because of their special status, may be more concerned with maintaining their legitimacy and positive image. And they themselves will be more likely to be trusted than most private enterprises. Therefore, green jobs in SOEs are all significantly more positively influenced by ESG.

5.3.2. Analysis of heterogeneity of enterprise factor intensity

Considering that the ESG performance of different enterprises' factor intensity has different effects on the level of green employment in enterprises. This paper divides capital-intensive and technology-intensive firms for group regression. Table 10 reports the results of the heterogeneity analysis of firms' factor intensity. Columns (1) and (2) show the estimated results of the impact of ESG performance on green employment for capital-intensive and technology-intensive firms, respectively; the estimated coefficients of ESG performance are significantly positive, but the estimated coefficients and significance for technology-intensive firms are relatively larger. Capital-intensive is significant at the 5% confidence level, while technology-intensive is significant at the 1% confidence level. This result suggests that improved ESG performance contributes to the level of green jobs in both capital-intensive and technology-intensive firms, but the effect is stronger for green jobs in technology-intensive firms. This phenomenon is easily explained by the fact that technology-intensive firms usually have more innovative resources and intellectual capital, which makes it easier for them to invest and improve on ESG. For example, technology-intensive firms may have more capital to spend on research and development of green technologies, improving energy efficiency and reducing carbon emissions, thus promoting green employment. Meanwhile, in recent years, the country has focused on developing the country through science and technology, and technology-intensive firms are usually more likely to be supported and regulated by the government's policies, and the government may guide technology-intensive firms to make more efforts in ESG

Table 9
Analysis of property rights heterogeneity

	(1)	(2)
	lnEmploy	lnEmploy
ESG	0.060***	0.031***
	(0.009)	(0.011)
_cons	-12.119***	-8.754***
	(0.223)	(0.229)
Controls	Yes	Yes
Industry, year fixed effects	Yes	Yes
N	4790	4115
adj. R^2	0.695	0.714

Note: *p < 0.05, ** p < 0.01, *** p < 0.001

Table 10
Heterogeneity analysis of firms' factor intensity

	(2)	(3)
	lnEmploy	lnEmploy
ESG	0.043**	0.066***
	(0.020)	(0.009)
_cons	-7.138***	-11.136***
	(0.456)	(0.207)
Controls	Yes	Yes
Industry, year fixed effects	Yes	Yes
N	1188	4851
adj. R^2	0.668	0.724

Note: *p < 0.05, ** p < 0.01, *** p < 0.001

through its policies, thus promoting green jobs. Therefore, corporate ESG advantages are more effective in promoting green employment in technology-intensive enterprises.

Table 11
Heterogeneity analysis of firms' technological intensity

	(1)	(2)
	lnPeople	lnPeople
ESG	0.054***	0.039***
	(0.009)	(0.013)
_cons	-11.067***	-9.552***
	(0.192)	(0.287)
Controls	Yes	Yes
Industry, year fixed effects	Yes	Yes
N	4435	3126
adj. R^2	0.738	0.646

Note: *p < 0.05, ** p < 0.01, *** p < 0.001

5.3.3. Heterogeneity analysis of firms' technology intensity level

In the previous section, it was concluded that ESG advantages significantly increase the level of green employment in both capital-intensive and technology-intensive firms, but the effect of green employment promotion is more pronounced for technology-intensive firms. This section therefore further explores how ESG performance affects the level of green employment in firms with different levels of technology intensity. Table 11 reports the results of the heterogeneity analysis based on firms' technology intensity. The two columns report the regression results of the impact of ESG performance on green employment for high-tech and non-high-tech firms, respectively. The estimated coefficients of ESG performance are significantly positive, but the estimated coefficients and significance for high-tech firms are relatively larger. The estimated coefficient for high-tech firms is 0.054, while the estimated coefficient for non-high-tech firms is 0.039. This result suggests that ESG advantages significantly increase the level of green jobs in both high-tech and non-high-tech firms, but the effect of promoting green jobs is more pronounced for high-tech firms. In addition to the characteristics of technology-intensive enterprises, high-tech enterprises usually face more intense market competition, which makes it more necessary for them to improve their competitiveness through ESG.

6. Conclusion and Policy Implications

6.1. Conclusion

This study employs systematic empirical analysis to reveal the impact of corporate ESG performance on green employment levels and its underlying mechanisms. The findings indicate that, in implementing ESG principles, companies not only enhance their social responsibility image but also promote green employment growth through various channels. Specifically, benchmark regression analysis shows that companies with good ESG performance can improve their green employment levels. After endogeneity treatment and robustness tests, the results remain significant, further confirming the positive impact of ESG advantages on green employment.

When exploring the influencing mechanisms, we found that a company's ESG advantages can enhance green employment levels through two main pathways: first, through the production-scale expansion effect, where ESG advantages help companies expand their production scale, thereby creating more green employment opportunities, and second, through the technological innovation mechanism, where ESG advantages encourage companies to increase R&D investment, enhance green innovation capabilities, and thereby indirectly promote green employment.

Further heterogeneity analysis indicates that the impact of ESG performance on green employment varies significantly across different types of companies. SOEs exhibit a more pronounced impact of ESG on green employment, which may be attributed to their typically greater access to resources for implementing ESG strategies. Additionally, ESG advantages have a significant positive impact on green employment levels in both capital-intensive and technology-intensive enterprises, with the effect being particularly pronounced in technology-intensive enterprises. Furthermore, ESG advantages significantly enhance green employment levels in both high-tech and non-high-tech enterprises, though the promotional effect is more pronounced in high-tech enterprises.

6.2. Policy implications

Based on the findings of the above research, the following specific policy implications are drawn:

1) Establish and improve ESG standards and frameworks. In the context of globalization, countries should strengthen international cooperation in the ESG field, share experiences, and jointly promote the achievement of global sustainable development goals. Although there are mature ESG standards and frameworks internationally, each country should establish an ESG standard system tailored to its national conditions and stage of development, while maintaining compatibility with international standards to facilitate ESG reporting and investment by multinational companies. Governments should strengthen requirements for the disclosure of corporate ESG information to encourage companies to place greater emphasis on environmental protection and social responsibility. Specifically, unified ESG information disclosure standards can be established and incorporated into corporate annual reports to ensure transparency and accuracy of information.
2) Strengthen government guidance. Research has found that ESG performance can promote green employment by increasing corporate R&D investment and technological upgrade mechanisms. The government should introduce more incentive measures to encourage enterprises to increase investment in research and development, especially in the development of green technologies and products. For instance, providing policy support such as R&D subsidies, tax incentives, and loan interest subsidies can help enterprises reduce their financial burden and enhance their enthusiasm for R&D. Research shows that the formal institutional framework of government-led green finance policies has a positive impact on the ESG performance of enterprises. Therefore, it is necessary to encourage the further promotion of green finance policies. Given the significant influence of Chinese SOEs in ESG practices, the government should provide more technical support and financial subsidies to SOEs to help them better play the role of ESG. At the same time, attention should be paid to and support provided for the green development of non-SOEs, especially small and medium-sized ones. Through services such as training and consultation, they should be helped to enhance their ESG management capabilities. For capital-intensive and technology-intensive enterprises, the government

should guide these enterprises to accelerate industrial upgrading, especially high-tech enterprises, and encourage them to adopt more environmentally friendly technologies and processes to achieve green growth. This includes providing financial support and technical guidance for industrial upgrading, as well as creating a policy environment conducive to the development of high-tech industries.

3) Strengthening corporate management and social responsibility. Enterprises should establish and improve their own ESG management systems, integrating ESG principles into their daily operations. By regularly assessing and improving ESG performance, enterprises can enhance their sustainable development capabilities. Enterprises should increase R&D investments in green technologies to continuously enhance their green innovation capabilities. Through technological innovation, enterprises can not only reduce environmental pollution during production processes but also create more green job opportunities. Enterprises should actively participate in social cooperation projects, collaborating with governments, non-governmental organizations, academic institutions, and others to jointly promote the development of green employment. Through collaboration, companies can access more resources and support while better fulfilling their social responsibilities. In summary, advancing ESG system construction at both the policy and corporate levels not only facilitates the effective utilization of corporate ESG advantages but also further promotes the development of green employment, contributing to the achievement of comprehensive sustainable development in economic and social spheres. These measures help establish a healthier, more sustainable economic development model while also contributing to the realization of an environmentally friendly society.

6.3. Research limitations and future prospects

6.3.1. Research limitations

Although this study has revealed the impact of ESG performance on green employment at both theoretical and empirical levels, it still has certain limitations:

Limitations in indicator measurement: The definition of green employment is primarily based on the alignment between a company's core business and the "Green Industry Guidance Catalog," without further distinguishing the green attributes of specific job positions, which may lead to certain biases in the measurement of green employment levels. Although ESG ratings were assessed using Huazheng Ratings supplemented by Bloomberg Ratings for robustness testing, differences in indicator weights and evaluation systems among rating agencies may have potential implications for the results.

Further mechanism analysis: The intermediary effect of production-scale expansion and technological innovation has only validated the overall pathway, without further distinguishing the heterogeneous roles of ESG sub-dimensions (E, S, G) in different mechanisms. For example, the environmental dimension (E) may have a more significant impact on green employment through technological innovation, while the governance dimension (G) may exert its influence primarily through production-scale expansion.

6.3.2. Future research directions

Refining indicators and mechanisms: In the future, it is possible to combine microlevel corporate data to develop more precise green employment measurement indicators, conduct in-depth analyses of the differentiated impacts of ESG sub-dimensions across different mechanisms, and explore the roles of moderating variables.

Expanding dynamic and heterogeneity research: Employing methods such as panel vector autoregression to capture the dynamic interaction between ESG and green employment, focusing on stage-specific differences driven by factors like the corporate lifecycle and transformation phases, as well as the impact of extreme events on ESG employment effects.

Cross-country comparison of ESG impacts: Significant variations may exist across countries in how ESG affects green employment due to differences in institutional environments, market maturity, and cultural contexts. For example, such variations can be observed in policy-driven differences and divergences in technological innovation foundations.

Policy-driven differences: In emerging economies like China, ESG practices rely more on government-led policy incentives (such as green finance pilots and environmental subsidies), while Western countries rely more on market mechanisms (such as investor ESG preferences and consumer demand for green products). This difference may result in distinct pathways for ESG to drive production-scale expansion—emerging economies may more easily expand capacity through policy support, while Western companies may more easily stimulate employment through market demand.

Differences in technological innovation foundations: Developed countries hold a first-mover advantage in green technology R&D, and the promotion of green innovation through ESG performance may be more prominently reflected in the creation of high-end technical positions. In contrast, developing countries may more frequently drive green employment in mid-to-low-end sectors through technology introduction and scaled production.

Differences in corporate attributes: Non-SOEs account for a higher proportion in Europe and the United States, and the impact of ESG on green employment may rely more on companies' voluntary social responsibility awareness, whereas SOEs in China, which bear more public functions, may exhibit a stronger positive correlation between ESG and green employment. In the future, cross-country panel data could be used to compare the intensity, pathways, and boundary conditions of ESG employment effects under different institutional frameworks, providing empirical references for global ESG collaboration and development.

6.4. Summary

In summary, promoting the construction of ESG systems at the policy and enterprise levels can not only facilitate the effective utilization of enterprises' ESG advantages but also further drive the development of green employment, thereby contributing to the achievement of comprehensive sustainable development in both economic and social spheres. These measures help establish a healthier, more sustainable economic development model while also contributing to the realization of an environmentally friendly society. Recognizing the limitations of this study and exploring cross-national comparisons will provide direction for future research, driving the continuous deepening of theory and practice in the fields of ESG and green employment.

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Ethical Statement

This study does not contain any studies with human or animal subjects performed by any of the authors.

Conflicts of Interest

The authors declare that they have no conflicts of interest to this work.

Data Availability Statement

Data available on request from the corresponding author upon reasonable request.

Author Contribution Statement

Chunyi Han: Formal analysis, Investigation, Data curation, Writing – original draft, Visualization, Investigation; **Pengfei Zhou:** Conceptualization, Methodology, Resources, Writing – review & editing, Supervision, Project administration, Funding acquisition; **Yang Shen:** Software, Validation.

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