

A Strategic Path for Chinese Enterprises to Achieve High-Quality Development within the ESG Framework Driven by Digital Technology

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ABSTRACT

The digital era requires enterprises to pay attention to technological innovation and optimise ESG performance in the development process, so as to achieve high-quality development. Based on this, this paper proposes the hypotheses related to enterprise ESG, technological innovation and enterprise high-quality development. And construct the regression model of enterprise ESG performance and high-quality development. Basic statistics and correlation analysis are used to provide a preliminary description of enterprise ESG performance and high-quality development. Through the total effect test, the role of enterprise ESG performance on high-quality development is clarified. Through the mediation effect test, the role played by technological innovation between corporate ESG and high-quality development is clarified, and the proposed hypotheses are verified, and the property rights, geographic and industry differences in the impact of corporate ESG performance on high-quality development are further explored by using robustness test and heterogeneity analysis. Finally, corresponding recommendations are made. Most of the enterprises selected in this paper have low levels of high-quality development, unsatisfactory ESG performance, and large overall gaps in technological innovation. The correlation coefficients of ESG performance (ESG) with corporate high-quality development (LnTFP) and technological innovation are 0.402 and 0.335, respectively, and all of them are significantly and positively correlated at the 1 per cent level. Hypotheses H1, H2, and H3 are all valid. ESG performance and technological innovation have more significant effects on the high-quality development of state-owned enterprises, eastern regions, and high-pollution enterprises.

Keywords: esg performance, regression model, mediation effect, heterogeneity analysis

1. Introduction

Corporate ESG development strategy framework refers to the development strategies and plans of corporations in terms of environmental, social and governance (ESG). ESG is an acronym for

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environmental, social and governance, and is an important part of corporate sustainable development. For investors, ESG factors are important indicators for investment decisions and can help investors manage risks and obtain long-term returns [1-4]. For corporations, active attention to ESG issues will help enhance corporate value, manage risk and win consumer recognition. Therefore, the understanding and application of ESG has become a key topic in today's business world [5-6]. As society's attention to CSR continues to grow, more and more companies are beginning to incorporate ESG factors into their strategic planning in order to achieve sustainable business models and long-term value creation [7-9].

Within the ESG framework, the path for Chinese enterprises to achieve high-quality development should be multifaceted, focusing not only on the growth of their economic profits, but also on their performance in environmental, social and corporate governance aspects. Only in this way can Chinese enterprises achieve the goal of sustainable development and create greater value for society, themselves and the environment [10-13]. Since ESG is a corporate development concept centred on environmental, social and corporate governance, building an ESG path of high-quality corporate development can not only help enterprises reduce business risks and increase long-term corporate value, but also promote the whole society towards the goal of sustainable development. Comprehensively improving the development level of enterprises from environmental, social and corporate governance aspects is a key path for Chinese enterprises to achieve high-quality development [14-17].

Literature [18] takes A-share main board listed companies in Shanghai and Shenzhen as the research object and verifies the effect of ESG on corporate value. The heterogeneity of corporate ESG on corporate value is discussed from both corporate and regional levels, and the results show that corporate ESG can promote corporate value and innovation level. Literature [19] describes the effects and mechanisms of ESG performance on the high quality development of firms. Empirical evidence shows that good ESG performance can promote high-quality development of enterprises. And the innovation investment of enterprises plays a moderating role in ESG and enterprise development. Literature [20] examined the impact of the configuration of ESG corresponding to corporate background factors on the high-quality development of SOEs. Analyses using a multi-stage qualitative comparative analysis method concluded that models such as resource capability-eminent and sustainability-driven with different combinations of ESG and corporate conditions have a facilitating effect on the high-quality development of SOEs. Literature [21] created a model framework for ESG evaluation of energy enterprises and examined the evaluation of enterprise high-quality development performance from two perspectives: theoretical enrichment and empirical analysis. The results of the study show that any of ESG is of great significance to enterprises. Its findings provide sustainable development policy recommendations for relevant sectors to promote high-quality development of enterprises. Literature [22] constructs an analytical framework of ESG to understand the relationship between ESG and high quality development of enterprises. The empirical test of corporate ESG performance points out that relevant companies that publish ESG-related information according to regulatory requirements will receive more attention from investors. Literature [23] shows the operation and development of Chinese SMEs in the context of globalisation from a new perspective, especially in the face of the growing ESG, and its research work provides suggestions for SMEs to adapt to and take advantage of this trend.

Literature [24] delves into the relationship between corporate ESG performance and technological innovation, presenting evidence of a positive correlation between ESG performance and HQD to enrich the landscape of sustainable business practices. It reveals the complex mechanisms of corporate HQD under ESG practices and expands the theoretical framework of sustainability and innovation management. Based on panel data of Chinese listed companies, literature [25] discusses the impact of ESG responsibility in fulfilling corporate high-quality development with the help of principal-agent theory and signalling theory. By adopting the entropy-weighted TOPSis method to measure the

enterprise development level of enterprises, the results specified that ESG has a positive impact on the high-quality development of enterprises. Literature [26] attempts to verify the impact of corporate ESG performance on green innovation through empirical analysis. Taking 933 Chinese A-share listed companies from 2015-2019 as the research object, the analysis results point out that ESG performance can enhance the green technology innovation ability of enterprises to a certain extent. Literature [27] explored the impact of ESG on corporate development. Taking the data of A-share listed enterprises as a sample, the results of the study illustrate that the development of high-tech enterprises is significantly more affected by ESG than that of non-technology enterprises. Literature [28] examined the impact of ESG performance on firms' sustainable green innovation based on the perspective of sustainable innovation. Analysing the data of many listed enterprises in China, it was obtained that enterprises with ESG advantages can promote the development of their sustainable green innovation. Literature [29] used data from listed companies in China from 2010 to 2020 in order to discuss the relationship between ESG and high-quality development. It is indicated that there are some limitations in the impact of ESG on firm performance in Chinese firms, and firms' innovation is negatively correlated with performance, while ESG plays a mediating role between innovation and performance.

The article initially explores the relationship between corporate ESG, technological innovation and corporate high-quality development under the digitalisation drive, and accordingly puts forward relevant hypotheses. A-share manufacturing enterprises from 2012 to 2020 are selected as the research object, and after determining the research variables, the regression model of enterprise ESG performance and high-quality development is constructed. Then, empirical research is carried out to confirm whether the hypotheses of this paper are valid or not through the total effect test and mediation effect test. The robustness test confirms that the research findings are not affected by the LnTFP measure and the technological innovation measure. Heterogeneity analyses are conducted to examine the effects of ESG performance and technological innovation on firms with different property rights, geographies and industries. Based on the results of the empirical analyses, corresponding strategies are proposed for the high-quality development of enterprises.

2. Theoretical analysis and research hypotheses

2.1. Digitally Driven Corporate ESG Practices and High Quality Development

1) Digital Embedding Support for Technological Transformation and Upgrading of Enterprises. With the expansion and intensification of the scope of data elements and digital technology tools embedded in production and life, enterprises' production and operation modes and even development concepts have undergone significant changes, which will also affect their ESG practices. The rapid expansion of the strength and scope of digital embedded production and life not only directly brings about the transformation and upgrading of enterprise production technology, but also effectively enhances the responsible social image of enterprises through the significant increase in resource utilisation and the reduction of the use of energy-intensive resources, not only through the use of digital tools to bring about significant optimisation and improvement in organisational structure, governance processes and resource consumption, but also through the enhancement of social reputation, goodwill of customers and product quality, effectively compensating for the previous ESG practices. The improvement of social reputation, customer goodwill and product quality can effectively make up for the cost payment in the previous ESG practice.

2) Digital embeddedness helps the quality of enterprise development. The direct consequence of the extensive use of data elements and digital technology in enterprise production and operation is a radical change in the traditional model. Both the allocation of resources and the acquisition of economic profits will be continuously upgraded and optimised due to the embedding of high-tech elements, and enterprises will pay more attention to their own R&D and innovation capabilities and the construction of modern structural systems.

3) Optimisation of the scope of corporate information disclosure by digital embedding. The essence of corporate ESG practices is to proactively fulfil their social responsibilities, change the traditional 'profit-only' orientation, pay attention to ecological environment protection and the interests of social groups, and actively promote the green and intelligent transformation of production and operation with high-quality development, so as to make their products and services more in line with social needs.

4) Mechanism of corporate ESG practices for high-quality development. In today's society, which places more emphasis on synergistic green development, the extensive use of digital technology tools and data elements in production and life makes the traditional mode of accelerating economic development at the expense of the environment increasingly denied and replaced, and the survival and development of enterprises in the modern society must be adapted to the new social needs and characteristics of the trend. The transformation and upgrading of enterprise production and operation with the primary purpose of adapting to the development trend of the times will prompt all economic entities to converge on governance concepts and methods, and society's concern for the environment and respect for and attention to human values will prompt enterprises to increase ESG practices. From the point of view of enterprises' own interests, the increasingly advanced use of factors of production and the construction of production modes will also enable enterprises to enjoy the dividends of scientific and technological progress and improve the unit production efficiency, and the reduction of simple human capital expenditures and the enhancement of the ability of resource innovation and allocation will enable them to get rid of the inefficient production methods of high input and high energy consumption, and replace them with technological and intelligent high-quality development. In other words, out of self-interest, enterprises will also strive for and enjoy greater technological and digital dividends to capture more favourable markets and promote their ESG practices.

2.2. Research hypotheses

2.2.1. ESG performance and high-quality corporate development. Corporate ESG performance covers three aspects: environmental, social and governance [30]. Among them, the environmental aspect mainly examines the enterprise's impact on the environment, such as the enterprise's treatment of various types of pollutant emissions in the production process and resource utilisation. In terms of social responsibility, ESG mainly focuses on the impact of the enterprise on society, such as employee welfare and safety, product safety, and the relationship between upstream and downstream. Corporate governance reflects the management of a company's internal structure, considering aspects such as the company's internal organisational structure, the relationship between stakeholders and the transparency of information disclosure. Therefore, it can be said that ESG influences the comprehensive development level of enterprises from three aspects: environment, society and corporate governance. Based on this, the following research hypotheses are proposed:

H1: Good ESG performance can promote high-quality corporate development.

2.2.2. ESG Performance and Technological Innovation. The ESG concept requires enterprises to assume corresponding social responsibility in their production activities and fulfil their obligations to society and the environment. Under the ESG concept, it is inevitable for enterprises to carry out technological innovation. Technological innovation is a requirement for enterprises to adjust their business models, organisational structures and management methods in the context of social and technological progress, with the aim of improving production efficiency and competitive advantages. Actively promoting enterprise technological innovation can help promote the development of enterprise transformation audit, improve the efficiency of resource utilisation, and is in line with the ESG concept. Accordingly, the following hypotheses are proposed:

H2: Good ESG performance can promote corporate technological innovation.

2.2.3. ESG performance, technological innovation and high-quality corporate development. Technological innovation driven by digital technology is of great significance to the transformation and development of enterprises to obtain long-term sustainable development. Innovation and improvement in production technology are indispensable to achieve the improvement of enterprise ESG. The enterprise's innovative production technology takes social responsibility while obtaining economic benefits for the enterprise itself, therefore, the following hypothesis is proposed:

H3: Good ESG performance can promote high-quality development of enterprises through technological innovation.

3. Study design

3.1. Sample selection and data sources

Referring to the classification standard of the 2012 edition of 'Classification and Codes of Listed Companies' of the Securities and Futures Commission (SFC), this paper selects A-share manufacturing enterprises from 2012 to 2020 as the research object, the explanatory variable of this study is the ESG performance of the enterprises, and the data comes from the rating data of CSI, the calculation data of the explanatory variable of Total Factor Productivity (TFP) comes from the database of Cathay Pacific (CSMAR), and the data of the enterprise financial related indexes are mainly from China Research Data Service Platform (CNRDS) and WND database (WIND). Next, the obtained data are processed as follows: enterprises with special status are excluded, and samples with incomplete and missing data are deleted. Finally, 15,584 empirical samples were obtained, and the empirical research was completed by applying Stata 15.0 software.

3.2. Definition of variables

The explanatory variable of this paper is the high quality development of manufacturing enterprises (LnTFP). In this paper, from the perspective of the times, we believe that the fundamental source and driving force to achieve the high-quality development of manufacturing enterprises at this stage is to improve total factor productivity, and it is more meaningful to consider the development quality of enterprises from the perspective of total factor productivity, so we use total factor productivity (TFP) as a proxy variable to measure the level of high-quality development of manufacturing enterprises [31].

Common estimation methods for calculating enterprise total factor productivity can be divided into parametric and non-parametric estimation methods, and the index method and data envelopment analysis (DEA) belong to non-parametric estimation methods. Stochastic frontier analysis, OLS method, OP method, LP method and instrumental variable method (system generalised moment estimation) belong to parametric estimation methods [32]. LP method is superior to OP and OLS methods, which can effectively alleviate the problem of endogeneity of the independent variable and avoid the situation of negative investment in OP method. Meanwhile, in the research of previous scholars, the LP method is more widely used to calculate the total factor productivity of enterprises, so the LP method is also used to measure the total factor productivity of enterprises to carry out the empirical test, the specific calculation is based on the production function of enterprises as shown below:

$$Y_{it} = A_{it} L_{it}^{\alpha} K_{it}^{\beta} \quad (1)$$

$$\ln Y_{it} = \ln A_{it} + \alpha \ln L_{it} + \beta \ln K_{it} + \mu_{it} \quad (2)$$

In the above formula, Y is the output of the enterprise, specifically calculated by substituting the logarithm of the total business revenue of the enterprise. A is the intermediate proxy variable, specifically calculated by substituting the logarithm of the actual cash paid for the purchase of goods,

services and other materials. L is the labour input, specifically calculated by substituting the logarithm of the number of employees of the enterprise. K is the capital input of the enterprise, specifically calculated by substituting the logarithm of the cash paid for the fixed assets and intangible assets.

The explanatory variable of this paper is firms' ESG performance. The mediating variable is technological innovation (TI). The mediating variables are firm size (Size), equity concentration (LHR), board size (IDR), return on assets (ROA), gearing (LEV), firm growth (GRT), and nature of equity (OP). The variables are shown in Table 1.

Table 1. Variable introduction

Variable type	Variable name	Variable symbol
Explained variable	Enterprise high quality development	LnTFP
Explanatory variable	ESG performance	ESG
Mediating variable	Technology innovation	TI
Control variable	Enterprise size	Size
	Equity concentration	LHR
	Board size	IDR
	Return on assets	ROA
	Leverage ratio	LEV
	Enterprise growth	GRT
	Ownership property	OP
	Industry	Ind
	Year	Year

3.3. Modelling

This paper uses panel data for regression analysis, controlling for individual firms and time. According to the existing literature at home and abroad, the following panel data regression model is established:

1) In order to test hypothesis 1, this paper constructs the model as listed in equation (3) to verify the impact of ESG performance on the high-quality development of enterprises, and hypothesis 1 is valid if the coefficient is $\alpha_1 > 0$ and statistically significant at the level of less than 10%.

$$TFP_{it} = \alpha_0 + \alpha_1 ESG_{it} + \alpha_2 \sum Control_{it} + \varepsilon_{it} \quad (3)$$

2) In order to test hypothesis 2, this paper constructs a model as listed in equation (4) to verify the impact of ESG performance on technological innovation, and hypothesis 2 is valid if the coefficient $\beta_1 > 0$ and is statistically significant at the level of less than 10 per cent:

$$TI_{it} = \beta_0 + \beta_1 ESG_{it} + \beta_2 \sum Control_{it} + \varepsilon_{it} \quad (4)$$

3) In order to test hypothesis 3, this paper constructs the models listed in equations (5) and (6) to verify whether the path of technological innovation exists, i.e., whether the ESG performance of enterprises can be promoted through technological innovation to achieve high-quality development. Mainly through the observation of coefficients γ_1 , μ_1 and μ_2 to judge whether there is a mediating effect of enterprise technological innovation:

$$TI_{it} = \gamma_0 + \gamma_1 ESG_{it} + \gamma_2 \sum Control_{it} + \varepsilon_{it} \quad (5)$$

$$TFP_{it} = \mu_0 + \mu_1 ESG_{it} + \mu_2 FC_{it} + \mu_3 \sum Control_{it} + \varepsilon_{it} \quad (6)$$

4. Empirical findings and analyses

4.1. Descriptive statistics

According to the research model above, this chapter mainly uses Stata15.0 software to do descriptive statistical analysis of the three main variables and all control variables, and the results of the research are shown in Table 2. According to Table 2, it can be seen that the maximum value of the sample enterprises' high-quality development (LnTFP) during the period of 2012-2020 is 12.063, the minimum value is 6.823, the mean value is 9.215, and the standard deviation is 1.065, and the level of high-quality development of the majority of the enterprises has a large space for improvement, and the indicator gap between the sample enterprises is large, which is conducive to the follow-up study and can better reflect the relationship between the changes in the sample variables. The maximum value of ESG performance (ESG) is 57.632, the minimum value is 12.654, with a difference of 44.978, and the mean value is 30.152. In the ESG scoring system of the Bloomberg database, the ESG score ranges from 0 to 100, which shows that the overall level of the fulfilment of the ESG responsibility of listed companies in China is relatively low, and the awareness of the listed companies' social responsibility is still to be further improved. Has to be further improved. Meanwhile, the standard deviation is 9.012, indicating that the ESG performance of listed companies varies among different industry subjects. The maximum value of technological innovation (TI) is 7.012, the minimum value is 0, and the standard deviation is 2.014, indicating that there is a large gap between listed companies as a whole, while the mean value is 3.274, which means that the listed companies in the whole sample are generally insufficient in technological innovation, and have not yet attached importance to technological innovation activities.

As for the control variables, the standard deviation of enterprise size (Size) is 1.274, the maximum value is 11.533, the minimum value is 4.963, and the allometric distance is 6.57, which indicates that there is a large gap in enterprise size among A-share listed companies in general. The standard deviation of the gearing ratio (LEV) is 0.237, the maximum and minimum values are 0.911 and 0.074 respectively, and the full distance is 0.837, indicating that the gap in solvency between different enterprises is obvious. The standard deviation of return on total assets (ROA) is 0.054, the maximum and minimum values are 0.287 and -0.274 respectively, and the full distance is 0.561, which indicates that the profitability of enterprises in different industries does not have a large gap, but it may affect the effect of technological innovation activities. The maximum and minimum values of corporate growth (GRT) reach 2.548 and -0.586 respectively, and the standard deviation reaches 0.354, with a large standard deviation, indicating that there is a significant difference in the growth capacity among the sample companies. Board size (IDR) reaches a maximum of 2.862 and a minimum of 1.726, with a standard deviation of 0.265, indicating that there is a significant difference in business risk among the sample companies. The largest and smallest shareholding concentration (LHR) are 0.792 and 0.092 respectively, with a standard deviation of 0.193, and the sample mean is 0.421, which means that the proportion of shares held by the first largest shareholder is 42.1%, indicating that the sample firms have a low degree of shareholding concentration. The mean value of the nature of ownership (OP) is 0.513, indicating that 51.3% of the sample enterprises are owned. The mean and standard deviation of the control variables selected in this paper do not differ significantly from those in the existing literature, and it is initially judged that the empirical research data in this paper are reasonable.

Table 2. Full sample descriptive statistics

Variable	N	Mean	SD	Min	Max
LnTFP	15584	9.215	1.065	6.823	12.063
ESG	15584	30.152	9.012	12.654	57.632
TI	15584	3.274	2.014	0.000	7.012

Size	15584	9.674	1.274	4.963	11.533
ROA	15584	0.085	0.054	-0.274	0.287
GRT	15584	0.201	0.354	-0.586	2.548
IDR	15584	2.316	0.265	1.726	2.862
LHR	15584	0.421	0.193	0.092	0.792
LEV	15584	0.552	0.237	0.074	0.911
OP	15584	0.513	0.528	0.000	1.000

4.2. Correlation analysis and covariance test

The correlation test is used to measure the degree of correlation of different indicators to prevent the regression results from being biased due to over-correlation of indicators. In this paper, Pearson correlation analysis is used to carry out preliminary tests on the explanatory variable of high-quality development of enterprises (LnTFP), the explanatory variable of ESG performance (ESG), the mediator variable of technological innovation (TI), and all the control variables, including the growth of enterprises (GRT), the proportion of independent directors (IDR), and the nature of the shareholding (OP), etc., and the results are shown in Table 3.

According to the Pearson test results in Table 3, ESG performance (ESG) is significantly and positively correlated with corporate high quality development (LnTFP) at the 1% level (correlation coefficient of 0.402), which suggests that active ESG performance can promote corporate high quality development, and preliminarily verifies Hypothesis I. ESG performance (ESG) is significantly and positively correlated with technological innovation (TI) at the 1% level (correlation coefficient of 0.333), and all control variables including corporate growth (GRT), independent director ratio (IDR), and nature of equity (OP). Correlation (correlation coefficient of 0.335), which is a positive relationship between the two. In addition, high quality development of firms (LnTFP) is significantly and positively correlated with firm size (SIZE), gearing ratio (LEV), return on total assets (ROA), growth of firms (GRT), proportion of independent directors (IDR), shareholding structure (LHR), and nature of shareholding (OP), with correlation coefficients of 0.634, 0.495, 0.065, 0.145, 0.098, 0.196, 0.185. The above study is in line with the economic laws.

Table 3. Pearson correlation analysis of main variables

	LnTFP	ESG	TI	Size	ROA	GRT	IDR	LHR	LEV	OP
LnTFP	1									
ESG	0.402***	1								
TI	0.325***	0.335***	1							
Size	0.634***	0.374***	0.485***	1						
ROA	0.065***	0.046***	0.056***	-0.008	1					
GRT	0.145***	0.032***	0.032**	-0.028**	0.274***	1				
IDR	0.098***	0.007	0.007	0.021***	- 0.068***	- 0.051***	1			
LHR	0.196***	0.022*	0.001	0.026***	0.075***	-0.031**	0.033**	1		
LEV	0.495***	0.082***	0.078***	0.364***	- 0.492***	-0.001	0.167***	0.092***	1	
OP	0.185***	0.055***	-0.018	0.186***	- 0.213***	- 0.152***	0.264***	0.324***	0.245***	1

Meanwhile, according to the results of Pearson correlation analysis in Table 3, it can be seen that the correlation coefficients between the variables are low, and the maximum value of all correlation coefficients is 0.634, which preliminarily determines that the multivariate regression in this study does not have serious multiple covariance. It can be seen that the model constructed in the paper is relatively stable and the regression model results are credible. However, the correlation between single variables cannot cover other factors that affect the high quality development of enterprises (LnTFP), and the results of Pearson analysis may have some deviation from the actual situation, so in order to improve the credibility of the conclusions of the article and reduce the bias of the results of the article due to the existence of multiple covariance in the model, this paper carries out the VIF test on the variables in the samples, and the results are shown in Table 4, with the maximum value of VIF of 1.65% and the maximum value of VIF of 1.65% for the control variables. The maximum VIF value is 1.65, the minimum value is 1.16, and the average VIF value is 1.36, which is much smaller than 10 (generally the VIF value is higher than ten indicating that the problem of covariance is significant), indicating that this paper's screening index is more objective and scientific, and there will be no multicollinear phenomenon that will cause interference with the article's conclusions, and it can continue to carry out the subsequent empirical analysis work.

Table 4. Common linear test results

Variable	VIF	1/VIF
Size	1.650	0.621
LEV	1.540	0.642
ROA	1.530	0.688
TI	1.410	0.731
OP	1.270	0.835
ESG	1.250	0.882
LHR	1.210	0.883
GRT	1.190	0.902
IDR	1.160	0.912
Mean VIF	1.360	-

4.3. Analysis of baseline results

4.3.1. Total effects test. In order to explore the impact of ESG performance on the high-quality development of enterprises, OLS estimation method is used to carry out regression, and after Hausman test, the results show that the original hypothesis of adopting the random effect model is rejected, and this paper chooses to use the panel fixed effect model to analyse the results of regression as shown in Table 5.

Column (1) in the table is the regression of just ESG performance on corporate high-quality development without considering control variables, and the results show that the estimated coefficient of ESG performance on corporate high-quality development is positive and passes the test of significance at the 1% level. Column (2), on the other hand, shows the regression results after adding control variables, and from the results, it can be seen that the estimated coefficient of ESG performance on firms' high-quality development is still positive and significant at the 1 per cent level. From the results of the benchmark regression, there is a positive correlation between corporate ESG performance and corporate high-quality development, indicating that corporate ESG performance can significantly promote corporate high-quality development. And the coefficient of enterprise ESG level is 0.000714, from the economic point of view is that, on average, for every 1 unit increase in the level of enterprise ESG performance, enterprise high-quality development will be increased by 0.000714 units, according to which hypothesis H1 can be proved.

Table 5. Regression results of ESG performance on high-quality development of enterprises

Variable	(1)	(2)
	LnTFP	LnTFP
ESG	0.00125***	0.000714***
	(0.0000685)	(0.0000523)
Size		0.00165***
		(0.000105)
ROA		-0.00916***
		(0.000516)
GRT		0.00000255
		(0.0000227)
IDR		0.000405
		(0.000482)
LHR		-0.0000162***
		(0.00000523)
LEV		-0.000802
		(0.00128)
OP		0.000421***
		(0.0000624)
_cons	0.00725***	-0.00174
	(0.000256)	(0.00122)
N	15584	15584
Year	YES	YES
Industry	YES	YES
R2	0.078	0.152

4.3.2. Mediated effects test. According to the previous mediation effect test steps, the first test of the impact effect of ESG performance and technological innovation on the high-quality development of

enterprises, the regression results are shown in Table 6. From column (2), it can be seen that the impact coefficient of enterprise ESG performance on technological innovation is 0.000805, and it is significant at the level of 1%, indicating that enterprise ESG performance has an upgrading effect on the level of technological innovation, and the hypothesis H2 is verified. Column (3) examines the effect of ESG performance and technological innovation on the high quality of enterprises, and the regression results show that after adding the mediating variable of technological innovation, the coefficients of ESG performance and technological innovation are 0.000608 and 0.0000754, which are all positive at 1% significance level, indicating that the level of technological innovation plays an intermediary role in the process of ESG performance to promote the development of high quality of enterprises. That is to say, improving the ESG performance of enterprises can enhance their technological innovation level, which in turn promotes the high-quality development of enterprises. Hypothesis H3 is verified.

Table 6. Regression results of ESG and TI on LnTFP

Variable	(1)	(2)	(3)
	Step 1	Step 2	Step 3
	LnTFP	TI	LnTFP
ESG	0.000714***	0.000805***	0.000608***
	(0.0000523)	(0.0000556)	(0.0000596)
TI			0.0000754***
			(0.0000187)
Size	0.00165***	0.00158***	0.000889***
	(0.000105)	(0.000112)	(0.000128)
ROA/Cashflow	-0.00916***	-0.00905***	0.000556***
	(0.000516)	(0.000508)	(0.00112)
GRT/Indep	0.00000255	0.00000274	0.000463***
	(0.0000227)	(0.0000232)	(0.0000668)
IDR/Board	0.000405	0.000415	0.000814*
	(0.000482)	(0.000474)	(0.000447)
LHR/TOP1	-0.0000162***	-0.0000145***	-0.0000182***
	(0.00000523)	(0.00000556)	(0.00000552)
LEV/FIXED	-0.000802	-0.000811	-0.00784***
	(0.00128)	(0.00132)	(0.000533)
OP/INST	0.000421***	0.000474***	0.000000986
	(0.0000624)	(0.0000665)	(0.00000255)
_cons	-0.00174	-0.00159	0.00174
	(0.00122)	(0.00155)	(0.00155)
N	15584	15584	15584
Year	YES	YES	YES
Industry	YES	YES	YES
R2	0.152	0.148	0.223

4.4. Robustness Tests

The findings were further robustly tested and the results are shown in Table 7. The regression coefficients of ESG and TI remain significantly positive when re-regressed with the generalised least squares OLS method for estimating TFP (TFP_OLS) and the fixed effects FE method for estimating TFP (TFP_FE) and the study conclusions are not disturbed by the selection of the LnTFP measure.

In previous literature, there are two main measures of technological innovation: research and development expenditures and patents. Among them, R&D expenditures measure firms' innovation

inputs, while patents measure innovation outputs. In this paper, we re-test the natural logarithm of R&D expenditures as a share of revenues (R&D) and the number of patents on inventions plus one (LnTI) as proxy variables for R&D innovation. The table shows that ESG has a significant positive effect on LnTFP, which is not disturbed by the selection of technological innovation measures.

Considering that there is a certain time lag in the ESG performance of enterprises on enterprise development, this study adopts the treatment of lagging the explanatory variables by one period. The regression coefficient of ESG lagged by one period (1.ESG) is significantly positive at the 5% level, and the regression coefficient of Patent lagged by one period (1.Patent) is significantly positive at the 1% level, which is basically consistent with the original results.

Table 7. Robustness test results

	Replace the measurement of LnTFP		Replace the measurement of TI		Lag by 1 period
	LnTFP_OLS	LNTFP_FE	LnTFP_LT	LNTFP_LT	LNTFP_LT
ESG	0.056***	0.067***	0.025***	0.082***	
	-5.74	-6.75	-2.95	-9.24	
TI	0.336***	0.385***			
	-38.45	-38.86			
LnTI			0.294***		
			-35.15		
R&D				0.052***	
				-0.31	
1.ESG					0.028**
					-2.45
1.TI					0.326***
					-30.79
Control variable	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES
Industry FE	YES	YES	YES	YES	YES
Adj.R2	0.652	0.651	0.642	0.573	0.605
N	15584	15584	15584	15584	15584

4.5. Heterogeneity analysis

ESG performance may show differences in different property rights, geographies and industries, and companies need to tailor their ESG management and high-quality development strategies to their specific circumstances in practice. The results of the heterogeneity analysis are shown in Table 8. From Table 8, it can be seen that:

1) Compared with other types of enterprises, ESG performance and technological innovation have a more significant impact on the high-quality development of state-owned enterprises. In terms of the size of the coefficients, the ESG coefficient (0.125) and TI coefficient (0.203) of state-owned enterprises are larger, and the positive promotion of high-quality development as larger. Compared with non-SOEs, SOEs are usually guided by government policies and have a stronger sense of social responsibility, and SOEs are more inclined to carry out ESG practices in order to respond to government requirements while demonstrating social responsibility commitment. Good ESG performance may be closely related to R&D and innovation, and SOEs achieve high-quality development by investing more resources in R&D and upgrading their technology.

2) Compared to the central and western regions, ESG performance has a more significant impact on the high-quality development of firms in the eastern region. ESG performance, technological

innovation and high-quality development of enterprises in the geographically heterogeneous enterprise group are all positively correlated, but the coefficient of ESG in the central and western regions is not significant. In terms of coefficient size, the ESG coefficient of firms in the eastern region is larger (0.074) and significant at the 1% level, with a greater positive contribution to high-quality development. The eastern region is usually at the forefront of China's economic development and has a more developed industrial structure and economic base. Firms are more likely to have access to financial, technological, and talent support, and thus are more capable of achieving significant results in ESG performance and R&D innovation, thus promoting high-quality development. While the TI coefficients are all positive to promote high-quality development of enterprises, significant at the 1% level, the coefficients as a whole do not differ much, and the central and western regions (0.199) are slightly higher than the eastern regions (0.187), which indicates that R&D and innovation have a significant positive effect on the high-quality development of enterprises in both the eastern regions and the central and western regions, and that investment in R&D does not discriminate between regions.

3) Compared with non-polluting enterprises, ESG performance and technological innovation have more significant effects on the high-quality development of high-polluting enterprises. However, in terms of the size of the coefficients, the ESG coefficient (0.456) and TI coefficient (0.213) of high-polluting enterprises are larger, and have a greater positive contribution to high-quality development. Highly polluting enterprises face stricter environmental regulation and public concern, and these enterprises may pay more attention to improving ESG performance to cope with environmental protection pressure, reduce environmental risks, and alleviate public opinion pressure. Highly polluting firms face the need to transform in order to meet environmental regulations and social expectations. As a result, these companies may be more willing to engage in R&D and innovation to find more environmentally friendly and green production technologies and business practices to enhance their competitiveness and sustainability.

Table 8. Heterogeneity analysis results

LnTFP_LT	Property heterogeneity		Region heterogeneity		Industry heterogeneity	
	State-owned	Nonstate-owned	Eastern	Central-western	Polluting	Nonpolluting
ESG	0.125***	0.026***	0.074***	0.023	0.456***	0.062***
	-6.85	-3.58	-7.11	-1.75	-2.82	-6.57
TI	0.203***	0.163***	0.187***	0.199***	0.213***	0.172***
	-14.26	-21.16	-22.28	-14.32	-13.87	-22.79
Control variable	YES	YES	YES	YES	YES	YES
Adj.R2	0.685	0.502	0.523	0.634	0.602	0.544
N	7995	7589	11810	3774	3287	12297

4.6. Strategic Recommendations

Based on the previous analysis, enterprises should pay attention to the following aspects when formulating development strategies.

First, it is necessary to enhance the awareness of ESG information disclosure and optimise the enterprise's own ESG performance. Construct and improve ESG management mechanism from corporate strategy and company system, actively introduce ESG professionals, and at the same time accelerate internal ESG professional training to optimise the talent structure.

Secondly, ESG should be implemented and applied to every aspect of the company's operation and management, to promote green technological innovation, to improve the transparency of corporate governance, and to enhance the decision-making and management efficiency of the company's green

transformation and sustainable development.

Third, it is necessary for state-owned enterprises, capital-intensive enterprises and enterprises in regions with high environmental regulatory intensity to be more proactive in corporate ESG practices on the basis of active technological innovation in order to realise their sustainable development goals.

5. Conclusion

Taking digital technology as the main driving force, the article explores the relationship between corporate ESG practices and corporate high-quality development through theory and puts forward corresponding hypotheses. After selecting samples and defining variables, a regression analysis model is constructed to deeply explore the mechanism by which corporate ESG performance affects corporate high-quality development.

1) The maximum value of the sample enterprises selected in this paper in terms of high-quality development (LnTFP) is 12.063, the minimum value is 6.823, the mean is 9.215, and the standard deviation is 1.065, and the level of high-quality development of the majority of the enterprises has a large room for improvement. The mean value of ESG performance (ESG) of Chinese listed companies is 30.152, and the overall level of ESG responsibility fulfilment is low. The mean value of technological innovation (TI) is 3.274, with a standard deviation of 2.014, indicating that listed companies have a large gap in technological innovation as a whole, and generally have insufficient technological innovation and do not pay enough attention to technological innovation activities.

2) The correlation coefficient between ESG performance (ESG) and corporate high quality development (LnTFP) is 0.402, and the correlation coefficient with technological innovation (TI) is 0.335, and both of them are significantly and positively correlated at the 1% level.

3) The coefficient of enterprise ESG level is 0.000714, the coefficient of enterprise ESG performance on technological innovation is 0.000805, and the coefficients of ESG performance and technological innovation are 0.000608 and 0.0000754, and all of them are positive at 1% level of significance, and the hypotheses H1, H2, and H3 are all verified.

4) In terms of property rights heterogeneity, ESG performance and technological innovation have a more significant impact on the high-quality development of state-owned enterprises. From the perspective of geographical heterogeneity, ESG performance has a more significant impact on the high-quality development of enterprises in the eastern region. From the perspective of industry heterogeneity, ESG performance and technological innovation have a more significant impact on the high-quality development of high-pollution enterprises.

5) By constructing and improving the ESG management mechanism, implementing ESG in management operations, and actively fulfilling ESG responsibilities while carrying out technological innovation, enterprises get the help to achieve high-quality development.

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