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A Study on the Impact of ESG Performance on Green Innovation Performance of Listed Manufacturing Enterprises in China

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Abstract: In the context of the global economy, environmental issues have garnered significant attention, and the green innovation performance of the manufacturing industry, as a pivotal component of economic development, has emerged as a pivotal concern in achieving sustainable growth.The concept of Environmental, Social and Corporate Governance (ESG) has garnered considerable global attention, prompting an increasing number of manufacturing enterprises to integrate ESG factors into their strategic planning to enhance competitiveness and social responsibility. However, manufacturing industries often encounter challenges such as technological limitations, financial constraints, and market competition when pursuing green innovation pathways.Therefore, exploring the impact of ESG performance on green innovation performance can provide enterprises with strategic references. Such references can facilitate the analysis of the correlation mechanism between ESG and green innovation performance. This, in turn, can assist enterprises in acquiring financial support, optimizing resource allocation, and reducing innovation costs. Concurrently, enterprises can enhance their corporate image, garner social recognition, and cultivate a more conducive external environment for green innovation by fortifying their ESG management.In consideration of the aforementioned background, this study utilizes the ESG performance of the manufacturing industry as its point of departure for research. The study's objective is to examine the impact of ESG performance on the green innovation performance of manufacturing industry enterprises. To this end, it employs a two-way fixed effect model to investigate the impact of ESG performance on green innovation performance. The findings of the study demonstrate that commendable ESG performance exerts a discernible stimulatory influence on the green innovation performance of enterprises. Consequently, manufacturing enterprises are required to proactively adopt the concept of ESG development, explicitly acknowledge the beneficial impact of ESG performance on green innovation performance, and consequently prioritize ESG management.

Keywords: ESG performance, green innovation performance, R&D investment, financing constraints.

1. Introduction

Manufacturing is the foundation and lifeblood of the real economy, and its high-quality development plays a decisive role in promoting China's economy as a whole to the high-quality development stage. The implementation of green innovation by enterprises constitutes a positive response to environmental challenges, thereby reducing natural resource consumption and environmental damage, and thus promoting sustainable development [1]. Concurrently, green innovation is also a pivotal means to promote the development of the green economy, enterprise transformation, and sound development [2]. On the other hand, corporate ESG performance is a comprehensive evaluation system, which covers the aspects of environment, social responsibility and corporate governance, and is able to effectively assess the status of enterprises' environmental and social responsibility as well as their own management and governance capabilities. In this paper, we analyze ESG performance of manufacturing companies, which is the mainstream corporate performance measurement standard today, coincides with the current green development strategy and high-quality development goals, and is gradually attracting the attention of Chinese companies, investors, and the government.

In light of the aforementioned context, this study commences with an examination of the ESG performance of manufacturing enterprises, investigating the potential of fulfilling ESG responsibilities to genuinely enhance their green innovation performance. It offers novel research perspectives on overcoming the challenges faced by manufacturing enterprises in green innovation, including the scarcity of R&D investment and the paucity of substantial green innovation outcomes. The study fosters enterprises' enthusiasm for green innovation, thereby augmenting their performance in this domain. Concurrently, it mitigates information asymmetries in the investment process, fosters scientific investment practices, and enhances investment efficiency and return. Moreover, for the government and regulatory authorities, it assists in formulating targeted policies to establish a conducive external environment for enterprises, and promote the government to enhance the strength of R&D support for enterprises, in order to alleviate the difficulties of enterprise financing and ensure the effective allocation of funds. In the context of China's active promotion of sustainable and green development, enhancing the green development level of Chinese manufacturing enterprises is of great practical significance, as is addressing the scarcity of high-quality green innovation outcomes. This paper employs an ESG framework to comprehensively investigate the impact of ESG performance on corporate green innovation performance. The findings of this study contribute to a more profound understanding within the practical community of the role of corporate ESG performance in promoting green innovation performance. Moreover, the study offers empirical evidence to support listed companies in enhancing their corporate ESG performance, encouraging proactive environmental, social, and internal corporate governance, and fostering their green innovation capability.

2. Empirical Research Design

2.1. Mechanism Analysis and Research Hypothesis

From the environmental perspective of ESG performance, companies with good ESG performance are more likely to recognize the opportunities and challenges posed by green development, integrate ecological issues with the current state of development of the company, and incorporate environmental actions such as green innovation into the company's corporate strategy in order to create and develop an emerging competitive advantage for the company [3].

The concept of "good environmental performance" of an enterprise encompasses a range of factors. Firstly, it signifies the capacity to adopt and implement effective environmental management measures. Secondly, it denotes a proactive response to relevant policies. Thirdly, it involves the efficient utilization of resources. Finally, it entails the proactive implementation of environmental preventive management, encompassing the realization of technological innovation, the cultivation of corporate environmental protection culture, and the establishment of a green brand, among other factors. In the context of the current challenges to sustainable development of resources and environment, such initiatives can help enterprises maintain and enhance their competitive advantages and realize the harmonious coexistence of environmental protection and economic development.

From the social perspective of ESG performance, good CSR performance refers to a balanced and coordinated relationship between a company and its stakeholders, and according to stakeholder theory and signaling theory, the attention of corporate investors can effectively promote corporate green innovation [4]. By optimizing employee benefits and actively fulfilling social responsibilities, companies send reliable and trustworthy signals to investors. Stakeholders tend to believe that companies that perform well in environmental, social, and governance (ESG) have a stronger contractual spirit and the ability to fulfill their commitments, and therefore will give such companies more trust and resource support to meet the needs of sustainable development.

From the perspective of corporate governance of ESG performance, excellent governance capability can effectively alleviate the principal-agent problem by building effective incentive and constraint mechanisms. It has been shown that the core objective of corporate governance is to promote the long-term development of enterprises, and the realization of this objective needs to follow the basic principles of innovation and value creation, and under the supervision of the board of directors, corporate managers will consciously adopt green scientific decisions conducive to the development of enterprises [5].

From the comprehensive perspective of ESG performance, ESG, as a strategic investment approach, can optimize the allocation structure of resources and effectively reduce the risks in the innovation process. In comparison with conventional innovation endeavors, green innovation exhibits distinctive characteristics with regard to input costs, risks, and anticipated returns, among other factors. In the process of promoting green technological innovation, enterprises must engage in a series of pivotal phases, including R&D and production, necessitating substantial long-term investment in capital, human resources, and other factors, thereby amplifying the uncertainty surrounding innovation risks. Conversely, enterprises demonstrating commendable ESG performance are incentivized to augment their investment in green innovation and R&D, a strategic move that is expected to enhance their green innovation capabilities [6].

Based on the above analysis, the following hypotheses are proposed in this paper:

H1: Good ESG performance of manufacturing firms can effectively improve green innovation performance;

H2: Good environmental performance of manufacturing firms can effectively improve green innovation performance;

H3: Good Social Responsibility Performance of Manufacturing Firms Can Effectively Improve Green Innovation Performance;

H4: Good corporate governance performance of manufacturing firms can effectively improve green innovation performance.

2.2. Sample Selection and Data Sources

This paper utilizes a sample of A-share listed companies in China's manufacturing industry from 2014 to 2023 as the research object. The selected companies encompass 31 sub-directions in the manufacturing sector (C) of the National Economic Industry Classification (GB/T 4754-2017). The ESG scores of the companies, the number of listed companies' green patent applications, and the data of the companies were matched. To ensure the robustness of the research results, the samples were processed in accordance with the unified practices in the academic world. Specifically, the following steps were taken: (1) the data of enterprises in financial industries, as well as ST and ST*, were excluded; (2) the data of enterprises with residual data were excluded; and (3) to reduce the impact of extreme values on the results, the continuous variables were subjected to shrinking on the 1st and 99th percentile. The final sample of 2,843 firms and 17,935 observations was obtained. The data on corporate ESG performance are obtained from Wind databases, the data on green innovation are obtained from the China Research Data Service Platform (CNRDS), and the data on the remaining variables are obtained from the database of Cathay Pacific (CSMAR). The data analysis was conducted using Stata 16.0 software.

2.3. Design and Description of Variables

(1) Explained variable: green innovation performance(GI). The number of green invention patent applications is used as a proxy variable for the explained variables. In order to facilitate the measurement, the number of green invention patent applications of enterprises is added one to take the logarithm.

(2) Explanatory variables: corporate ESG performance. In this paper, the ESG rating of CSI is selected as an explanatory variable. The evaluation results are categorized into nine grades of “AAA-C”, and assigned the value of “1-9” for the convenience of calculation.

(3) Control variables: The control variables employed in this study encompass a range of metrics, including firm size (Size), gearing ratio (Lev), return on equity (ROE), growth rate of operating income (Growth), cashflow ratio (Cashflow), shareholding ratio of the top ten shareholders (Top10), Tobin's Q (TobinQ), and year of establishment of the company (FirmAge). Furthermore, time characteristics and individuals are incorporated into the analysis, as they have the potential to influence the study's outcomes. This additional control serves to refine the study's findings by considering the

influence of individuals and years.

2.4. Model Building

Based on the above analysis, in order to test hypotheses H1-H4, the influence of corporate ESG performance on green innovation performance, the following fixed effect model is constructed:

$$GI_{it} = \alpha_0 + \alpha_1 ESG_{it} + \gamma Controls_{it} + Symbol_c + Year_t + \varepsilon_{it}$$

Where the explanatory variable is firms' green innovation performance (GI_{it}), the explanatory variable is firms' ESG performance (ESG_{it}), α_0 is the intercept term, ε_{it} is the random error term, subscript i denotes the ith firm, t denotes the period, $Controls_{it}$ is a series of control variables, $Symbol_c$ denotes individual fixed effects, and $Year_t$ denotes year fixed effects. The coefficients α_1 indicate the effect of corporate ESG performance on corporate green innovation performance, and if significantly positive, hypotheses 1-4 hold.

3. Empirical Tests and Analysis of Results

3.1. ESG Performance and Green Innovation Performance

Table 3-1. Results of regression analysis of ESG performance on green innovation performance of manufacturing enterprises

	(1)	(2)
Variant	GI	GI
ESG	0.030***	0.019***
	(5.050)	(3.196)
Size		0.312***
		(16.807)
Lev		-0.086
		(-1.498)
Growth		-0.034**
		(-2.051)
ROE		-0.030
		(-0.529)
TobinQ		0.024***
		(4.464)
Cashflow		0.079
		(0.903)
Top10		0.184**
		(2.100)
FirmAge		-0.289**
		(-2.029)
Symbol	YES	YES
Year	YES	YES
N	17935	17935
Adj. R2	0.691	0.700

Note: The values in parentheses are t-values, *, * *, and * * * respectively indicating significant values at the 10%, 5%, and 1% levels.

In order to examine the impact of ESG performance of manufacturing enterprises on green innovation performance, in the first step of the benchmark regression without adding control variables only consider the impact of the explanatory variable ESG performance of manufacturing enterprises on the green innovation performance of the explanatory variables, and in the second step add control variables to examine the impact of ESG performance of manufacturing enterprises on green innovation performance. The regression results are shown in Table 3-1. The regression result column 1 shows the impact of ESG performance of manufacturing enterprises on green innovation performance when no control variables are added, and the coefficient between ESG performance of manufacturing enterprises and green innovation performance is 0.030, which is significant at the 1% level, indicating that every one unit of improvement in ESG performance of manufacturing enterprises can make the green innovation performance of enterprises rise by 0.030 on average; from the regression result of column 2, it can be seen that after adding the From the regression results in column 2, after adding control variables, the coefficient between the two is 0.019, and it is significant at the 1% level, indicating that the ESG performance of manufacturing enterprises plays a positive incentive role in green innovation performance, the more enterprises pay attention to ESG performance, the better the ESG performance is, the more it helps to improve the green innovation performance, and the hypothesis H1 is verified.

3.2. ESG Sub Performance and Green Innovation Performance

The results for hypothesis H2-H4 are shown in Table 3-2. As shown in the table below, the coefficient between the environmental performance of manufacturing enterprises and their green innovation performance is 0.020, which is significant at the 1% level. This indicates that for every 1 unit improvement in the environmental performance of manufacturing enterprises, their green innovation performance can increase by an average of 0.020; According to the regression results in column 2, after adding control variables, the coefficient between the two is 0.012, which is significant at the 5% level, indicating that the environmental performance of manufacturing enterprises has a positive incentive effect on green innovation performance. The more companies focus on environmental performance, the better their ESG performance, which is more conducive to improving green innovation performance. Hypothesis H2 is verified. The social performance of manufacturing enterprises is 0.032 without control variables and 0.022 with control variables, both significant at the 1% level, indicating that the social performance of enterprises will significantly affect green innovation performance. According to column 5, the coefficient between corporate governance performance and green innovation performance is 0.013, which is significant at the 1% level and 0.008 after controlling for variables, indicating a positive correlation between corporate governance performance and green innovation performance at the 10% level. Assuming that H2-H4 have been validated.

Table 3-2. Results of regression analysis of ESG sub-performance on green innovation performance of manufacturing enterprises

	(1)	(2)	(3)	(4)	(5)	(6)
Variant	GI	GI	GI	GI	GI	GI
E	0.020***	0.012**				
	(3.450)	(2.012)				
S			0.032***	0.022***		
			(5.444)	(3.760)		
G					0.013***	0.008*
					(2.853)	(1.769)
Size		0.314***		0.312***		0.315***
		(16.923)		(16.783)		(16.972)
Lev		-0.098*		-0.086		-0.086
		(-1.714)		(-1.499)		(-1.491)
Growth		-0.034**		-0.034**		-0.035**
		(-2.068)		(-2.053)		(-2.105)
ROE		-0.020		-0.031		-0.026
		(-0.356)		(-0.555)		(-0.462)
TobinQ		0.024***		0.024***		0.024***
		(4.440)		(4.440)		(4.430)
Cashflow		0.074		0.078		0.077
		(0.844)		(0.899)		(0.877)
Top10		0.190**		0.183**		0.187**
		(2.178)		(2.098)		(2.140)
FirmAge		-0.304**		-0.285**		-0.296**
		(-2.129)		(-2.002)		(-2.072)
Symbol	YES	YES	YES	YES	YES	YES
Year	YES	YES	YES	YES	YES	YES
N	17935	17935	17935	17935	17935	17935
Adj. R2	0.690	0.700	0.691	0.700	0.690	0.700

Note: The values in parentheses are t-values, *, * *, and * * * respectively indicating significant values at the 10%, 5%, and 1% levels.

4. Research Recommendations

4.1. Clarify the New Demands for Fulfilling ESG Responsibilities in The New Era, And Innovate the Paths and Methods for Fulfilling the Responsibilities of The Three Parties

At present, the world is paying more and more attention to sustainable development and environmental protection, and the ESG concept has become an international consensus, and actively improving ESG performance is a necessary way for enterprises to develop soundly and improve green innovation performance. The results of empirical analysis show that the overall ESG performance of China's manufacturing enterprises still needs to be improved, and the ESG awareness of many enterprises is relatively weak. Based on the new development stage, manufacturing enterprises, as the main body of social wealth creation, should actively take the lead in telling the story of Chinese enterprises' fulfillment of their ESG responsibilities in the process of moving towards common wealth. Firstly, manufacturing enterprises should deeply integrate resources, knowledge, technology and ESG principles, embed ESG concepts into daily strategic management, cultivate an internal ESG culture, enhance employees' ESG awareness and sense of responsibility, and create a positive environment for social responsibility and corporate governance; secondly, enterprises should take the initiative to communicate effectively with stakeholders, take into account the interests of all parties, strive for understanding and support, and build a communication mechanism and cooperation mechanism based on win-win cooperation. Thirdly, in the context of the manufacturing industry entering into the era of micro-profit, the competition among enterprises is not only limited to products, technologies and talents, but also involves the level of reputation. Manufacturing enterprises need to deeply recognize the positive correlation between ESG responsibility and business value, enhance corporate image and reputation by actively fulfilling ESG responsibility, shape high-quality brands and brand value, and build a new ecosystem of enterprise development in new goals, new starting points and new environments; Finally, manufacturing enterprises should be committed to improving resource efficiency and economic performance, adopting environmental protection measures such as energy saving, emission reduction and recycling, reducing production costs, improving resource efficiency and product quality, enhancing market competitiveness, and realizing better economic benefits.

4.2. Promoting Investment In R&D And Enhancing R&D Capabilities

R&D investment is a key factor driving green innovation. Manufacturing enterprises need to increase their R&D investment, develop more environmentally friendly and efficient production processes and products, adopt clean production technology and circular economy models, effectively improve their green innovation performance, avoid false innovation behaviors such as "greenwashing", ensure the necessary capital investment for enterprises to

improve the quality of green innovation, promote the green and low-carbon development of enterprises, and open up new market opportunities and competitive advantages for enterprises. With the continuous increase in consumer attention to environmental protection and sustainable development issues, the demand for green products in the market is also increasing. By strengthening R&D investment, enterprises can more quickly capture changes in market demand, build a sounder R&D system, attract and cultivate more R&D talents, and then develop green products that meet market demand, enhancing the market response speed and competitiveness of enterprises.

References

[1] Ming tian, Shaoqi shen, Jiarui yan. Research on the impact mechanism of climate change risk on corporate sustainability performance [J/OL]. Resources and Industry, 1-27 [2024-10-30]. (In Chinese).

[2] Zhao En-Torch, Sen yang. Impact of new quality productivity development on green innovation in China's high-end manufacturing industry [J]. Finance and Economics Monthly, 2024, 45 (20): 123-129. (In Chinese).

[3] Rohit, Sharma, and, et al. Production, purification, characterization, and applications of lipases [J]. Biotechnology Advances, 2001.

[4] K.W. Korea, Y.T. Gan. Can investor attention promote corporate green innovation performance - the mediating effect of financing constraints and the moderating role of environmental regulations [J]. Science and Technology Progress and Countermeasures, 2023, 40(8):89-98. (In Chinese).

[5] Tong lu, Yin dang. Investor protection, innovation investment and firm value [J]. Financial Review, 2012, 4(5):15-33, 122. (In Chinese).

[6] Yuanyuan sun, Xinzhu zhang, Meiyan zhang, et al. ESG performance, R&D investment and firms' green dual innovation-the moderating effect based on media monitoring [J/OL]. Operation and Management, 1-21 [2024-10-18]. (In Chinese).