Study on the Path of Corporate ESG Performance to Drive Green Innovation--Based on Data of Listed Companies in Sichuan Province

Qiqi Zheng[1st*], Dongchuan Lin[2nd], Hongyi Li[3rd], Yanling Wang[4th]
zqqzhengqiqi@163.com[1*], Lindongchuan@163.com[2], 1517784446@qq.com[3], 1652127220@qq.com[4]

College of Business and Tourism, Sichuan Agricultural University, Chengdu, Sichuan, China[1,2,3,4]

Abstract： Enhancing the green innovation capability of enterprises is a crucial way to help Sichuan Province's green transformation. ESG is necessary as a more comprehensive and systematic social responsibility indicator to examine the path of impact on corporate green innovation. This paper constructs a multiple linear regression model of ESG performance and green innovation of enterprises in Sichuan province by taking listed companies in Sichuan province from 2016 to 2020 as the research object, and conducts descriptive analysis, correlation analysis and multiple regression analysis by stata software to study the relationship between ESG performance and green innovation of enterprises. It is found that enterprises with better ESG performance will have a higher level of green innovation capability, and government subsidies are the specific path of ESG performance on green innovation capability enhancement.

Keywords: corporate ESG performance; green innovation; government grants;

1 Introduction

In 2021, the "Outline of the Construction Plan for the Twin-City Economic Circle in Chengdu-Chongqing Region" indicated that it is necessary to build a new development pattern for the twin-city economic circle, accelerate the green low-carbon technology revolution and explore a new path of green transformation. Green development has become an inevitable choice for the Chengdu-Chongqing region to achieve the goal of "two carbon" as an essential part of the market; how to transform and upgrade to green and low-carbon has become a real dilemma for enterprises in Chengdu-Chongqing.

Existing research shows that corporate social responsibility can significantly contribute to green innovation capabilities. Compared with the traditional social responsibility indicators, the Environmental, Social and Governance (ESG) social responsibility indicator system is more robust. It is an essential non-financial report to measure the degree of corporate environmental protection and social responsibility. Therefore, ESG is necessary as a more comprehensive and systematic social responsibility indicator to examine the path of impact on corporate green innovation. Scholars have mainly studied the economic consequences of ESG at both macro and micro levels, such as ESG investment helping to achieve the "double carbon" goal; companies with good ESG performance have better corporate management quality, sustainable profitability and cash flow [1]. Existing scholarly research on the factors influencing green innovation has focused on both internal and external dimensions. From the

perspective of internal factors of firms, green innovation is influenced by organizational green learning [2], entrepreneurial human capital [3], and internal resources firms; from the perspective of external factors of firms, green innovation is associated with external financing constraints [4], environmental regulations [2], and green market pressure [5]. However, the existing literature rarely explores whether corporate ESG performance changes the business decision-making behaviour of firms, and it is of great theoretical and practical significance to study the impact of corporate performance in environmental, social responsibility and corporate governance on corporate green technology innovation in the context of the widespread implementation of the green development concept.

2 Theoretical analysis and research hypothesis

Green technology innovation, with green development as its core pursuit, can inject intrinsic power into the sustainable development of China's economy and society. On the one hand, better environmental, social, and governance (ESG) performance of enterprises will gain higher market evaluation and thus attract more institutional investors, which will facilitate enterprises' sustainable access to resources required for green technology innovation to carry out technological innovation activities to enhance their competitive advantage[6]. On the other hand, better ESG performance will give investors more investment measures and reduce the risk of adverse selection, which can better alleviate the financing constraints of enterprises and thus increase R&D investment for green innovation; at the same time, the better the ESG rating of enterprises, the more effectively they can play the role of reputation insurance and motivate listed enterprises to continue their green reform and innovation. Based on this, this paper proposes research hypothesis 1.

H1: Better ESG performance can promote corporate green technology innovation.

Corporate green innovation, as a long-term investment, precisely cannot be achieved without investors' capital investment. First, companies with good ESG performance will pay more attention to environmental protection and actively fulfil their social responsibilities, which will leave a good impression on the government and make them more likely to receive financial help from the government, thus increasing the willingness of companies to carry out green innovation. Second, ESG assessment information can be used as a reliable signal of good corporate performance, which alleviates the information asymmetry between the government and enterprises and enhances the government's willingness to invest funds in enterprises [7]. Finally, government funding for enterprises can create a certification effect in society, and external investors see it as a wind vane for their investment. Enterprises will have a greater willingness to innovate with financial support from the government as well as external investors. Based on this, this paper proposes the following hypotheses:

H2: Other things being equal, government subsidies play a mediating role in ESG performance and firm innovation.

3 Empirical Analysis

3.1 Data sources and sample selection

In this paper, listed companies in Sichuan Province from 2016-2020 are studied and all continuous variables are subjected to 1% top and bottom tailing by stata software. Corporate ESG rating data were selected from the Huazheng ESG database, and green innovation data were obtained from the CSMAR database.

3.2 Model design and variable definition

3.2.1 Model design

$$GI_{i,t} = \alpha + \beta_1 ESG_{i,t} + \beta_2 X_{i,t} + \varepsilon_{i,t} \ (1)$$

$$Sub_{i,t} = \alpha + \beta_1 ESG_{i,t} + \beta_2 X_{i,t} + \varepsilon_{i,t} \ (2)$$

$$GI_{i,t} = \alpha + \beta_1 ESG_{i,t} + \beta_2 Sub_{i,t} + \beta_3 X_{i,t} + \varepsilon_{i,t} \ (3)$$

Where GI denotes the level of green innovation of the firm, i represents the firm, t represents the year, ESG denotes the firm's ESG rating performance, and Sub denotes government subsidy. $X_{i,t}$ denotes a set of control variables.

3.2.2 Variable definition

(1) Explained variable: green innovation (GI). This paper draws on the approach of Pan Ye[8]and uses the total number of current green-type patent applications by firms to measure green innovation.

(2) Explanatory variable: corporate ESG performance (ESG). This paper draws on the methods of Changjiang Zhang et al.[9] and Guanghua Xu[10]using the Huazheng ESG data rating database. Furthermore, according to the research method of Ma Xili[11], this paper assigns ESG rating levels of listed companies in order; the specific assignment method is 9 points for AAA, 8 points for AA, 7 points for A, and so on.

(3) Mediating variable: government subsidies (Sub). In this paper, direct government subsidies to firms are used as a measure of government subsidies and are logarithmized.

(4) Control variables: Lev: ratio of total liabilities to total assets; ATO: ratio of operating income to average total assets; Cashflow: ratio of net cash flow from operating activities to total assets; Board size: the number of board members is taken as the natural logarithm; Dual: CEO and chairman Dual (Dual): CEO and Chairman take the value of 1, otherwise 0; TobinQ (TobinQ): ratio of market capitalization to total assets; year and industry are selected as dummy variables.

3.3 Regression analysis

3.3.1 Descriptive statistical analysis

In this paper, descriptive statistics of the sample were performed using stata software, and the results of descriptive statistics of the variables are presented in Table 1. The mean value of GI is 6.956, with the minimum and maximum values of 0 and 222, respectively, indicating that

the green innovation capability of listed companies in Sichuan Province is low and varies widely among companies. The mean value of ESG is 6.395, indicating that the average ESG score of listed companies in Sichuan Province is high and the ESG performance is good. The mean value of Sub is 14.198, with the maximum value of 20.175, indicating that most sample companies receive government subsidies. The mean value of Lev is 0.401, indicating that the average gearing ratio of listed companies in Sichuan Province is 40.1%. The overall level is stable, but from the minimum and maximum values, the minimum value of the gearing ratio of sample companies is 5.5%, and the maximum value is 90.6%, indicating significant differences among companies and the gearing ratio. The mean value of Dual is 0.221, which indicates that only 22.1% of the companies have dual positions, and the degree of dual positions is low.

Table1 Descriptive Statistics

Variable	Statistical variable				
	Obs	Mean	SD	Min	Max
GI	798	6.956	21.394	0	222
ESG	798	6.395	1.182	2	9
Sub	798	14.198	4.776	0	20.175
Lev	798	.401	.215	.055	.906
ATO	798	. 55	. 32	0.058	2.639
Cashflow	798	.05	.063	-.169	.246
Board	798	2.113	.199	1.609	2.565
Dual	798	.221	.415	0	1
TobinQ	798	2.155	1.482	.85	11.461

3.3.2 Correlation analysis

The results of the pearson correlation analysis by using Stata software are shown in Table 2. Corporate ESG performance is significantly and positively correlated with green innovation capability (GI), indicating that the better the corporate ESG performance, the higher the corporate green innovation capability, which initially verifies hypothesis 1. GI also shows a significant positive correlation with Sub, indicating that the more government subsidies a company receives, the stronger the corporate green innovation capability. The asset-liability ratio shows a significant positive correlation with the level of green innovation of enterprises, indicating that the higher the level of debt and the higher the market value, the higher the green innovation ability of enterprises; dual-occupancy shows a significant negative correlation with the green innovation ability of enterprises, indicating that the dual-occupancy situation reduces the green innovation level of enterprises. To further test whether there is multicollinearity among the variables, the variance inflation factor (VIF) of the variables is calculated to be 1.08, which is far below the alert value of 10, so there is no multicollinearity problem in this paper.

Table 2 Pairwise Correlations

	GI	ESG	Sub	Lev	ATO	Cashflow	Board	Dual	TobinQ
GI	1								
ESG	0.177***	1							
Sub	0.084**	0.094***	1						

Lev	0.231***	-0.082**	0.0390	1					
ATO	0.163***	-0.001	-0.031	0.125***	1				
Cashflow	-0.060*	0.156***	-0.0360	-0.204***	0.143***	1			
Board	-0.091**	0.159***	0.0570	-0.0330	-0.036	0.068*	1		
Dual	-0.088**	-0.201***	-0.0330	-0.065*	0.099***	-0.143***	-0.183***	1	
TobinQ	-0.177***	-0.128***	-0.0240	-0.087**	-0.007	0.069*	-0.098***	0.0200	1

3.3.3 Analysis of regression results

Table 3 Regression Results

VARIABLES	GI
ESG	4.684***(7.02)
Lev	26.474***(7.11)
ATO	12.114***(4.80)
Cashflow	-5.697(-0.47)
Board	-12.958***(-3.35)
Dual	-3.125*(-1.81)
TobinQ	-2.960***(-5.78)
Industry	Yes
Year	Yes
Constant	--5.446(-0.33)
Observations	798
R-squared	0.247

In this paper, a panel regression analysis of listed enterprises in Sichuan Province was conducted using stata software, and the regression results are shown in Table 3. The results show that the ESG regression coefficient is significantly positive at the 1% level, indicating that when the ESG performance of enterprises is good, the higher the level of green innovation capability of enterprises. Since ESG performance will give investors more investment measures and reduce the risk of adverse selection, it can better alleviate the financing constraints of enterprises and thus increase R&D investment for green innovation; meanwhile, the better the ESG rating of an enterprise, the more effectively it can play the role of reputation insurance and motivate listed enterprises to continue green reform and innovation. The regression coefficient of Lev is significant at the 1% level. The regression coefficient of Lev is positive at the 1% level, which is due to the increase of debt service risk caused by the high gearing ratio, and enterprises have a higher risk-taking spirit and are willing to improve their green innovation capability. This result verifies hypothesis 1 of this paper.

3.3.4 Further analysis

Table 4 Regression Results

	(1)	(2)	(3)
VARIABLES	Sub	GI	GI
ESG	0.537***(3.26)	4.536***(6.76)	4.684***(7.02)
Sub		0.275*(1.88)	

Lev	0.908(0.99)	26.225***(7.05)	26.474***(7.11)
ROA	-0.762(-1.22)	12.323***(4.88)	12.114***(4.80)
Cashflow	-2.985(-0.99)	-4.877(-0.40)	-5.697(-0.47)
Board	0.739 (0.77)	-13.161***(-3.41)	-12.958***(-3.35)
Dual	-0.169(-0.39)	-3.169*(-1.78)	-3.215*(-1.81)
TobinQ	-0.199(-1.57)	-2.905***(-5.67)	-2.960***(-5.78)
Industry	Yes	Yes	Yes
Year	Yes	Yes	Yes
Constant	4.864(1.19)	-6.783(-0.41)	-5.446(-0.33)
Observations	798	798	798
R-squared	0.081	0.250	0.247

To further analyze the results of the mediating role of government subsidies in the impact of ESG performance on green innovation capacity of listed enterprises in Sichuan Province, this paper used stata software to test the mediating utility, and the results are shown in Table 4.This paper refers to the intermediary effect test proposed by Zhonglin Wen et al., so that model (3) adds government subsidies as an intermediary variable based on model (1) to test the intermediary role of government subsidies between corporate ESG performance and green innovation. As seen in column (1) of Table 5, the regression coefficient between corporate ESG performance and government subsidies is 0.537 and significant at the 1% level, indicating that corporate ESG performance can have a significant positive effect on government subsidies. As shown in column (3) of Table 5, the regression coefficient between corporate ESG performance and green innovation is 4.684 and is significant at the 1% level; the regression coefficient between government subsidies and green innovation is 0.275 and is significant at the 10% level. After adding government subsidies, the regression coefficient between corporate ESG performance and green innovation decreases, indicating that government subsidies play a partial mediating role between corporate ESG performance and green innovation, and H2 passes the test.

4 Conclusion and Insight

This paper empirically examines the impact of corporate ESG performance on green innovation capacity by using listed companies in Sichuan Province from 2016 to 2020. It is found that firms with better ESG performance will have higher levels of green innovation capacity. Second, the mechanism of action test shows that government subsidies are the specific path of action for ESG performance on green innovation capacity enhancement. The implications of this paper are mainly in the following two aspects: first, we should improve the capital market system, optimize the ESG rating system, alleviate the degree of internal and external information asymmetry, solve the enterprise financing problems, and fundamentally promote enterprises to carry out green technology innovation. Secondly, Sichuan enterprises should improve each index of ESG performance, enhance their corporate reputation, obtain more political resources, enhance their green innovation capability, and help Sichuan province realize the transformation of the green technology revolution.

References

[1] Moran. Active practice of ESG investment in sustainable development model[J]. Financial Market Research,2022(02):66-69.

[2] Cao, Hongjun, Sun, Jihui. Environmental regulation, organizational green learning and corporate green innovation[J]. Industrial Technology Economics,2021,40(03):152-160.

[3] Jiang Shiying. A study on the influence of entrepreneurs' human capital on the green innovation capability of enterprises[J]. Technology Economics and Management Research,2021(03):40-44.

[4] Zhai, Huayun, Lewis. Study on the relationship between digital finance development, financing constraints and corporate green innovation[J]. Science and Technology Progress and Countermeasures,2021,38(17):116-124.

[5] Hou Yanhui, Li Shuoshuo, Hao Min, Rao Weizhen. The influence of green market pressure on green innovation behaviour of knowledge-based firms[J]. China Population-Resources and Environment, 2021, 31(01):100-110.

[6] Yang, Yang, Yu, Feng. A Mechanistic Study on the Impact of Political Affiliation on Corporate Innovation[J]. Nankai Economic Research,2014(06): 32-43. DOI:10.14116/j.nkes.2014.06.003.

[7] Wang G, Xie FJ, Jia Y. A re-examination of R&D subsidy policy incentive mechanism--based on external financing incentives[J]. China Industrial Economics, 2017(02): 60-78. DOI:10.19581/j.cnki.ciejournal.2017.02.005.

[8] Pan Ye. Research on the impact of corporate social responsibility on green innovation[D]. Guizhou University of Finance and Economics, 2021. DOI:10.27731/d.cnki.ggzcj.2021.000420.

[9] Zhang CJ, Zhang YY, Chen YC.ESG performance, investor confidence and performance of listed companies[J]. Environmental Economics Research, 2021, 6(04): 22-39. DOI:10.19511/j.cnki.jee.2021.04.003.

[10] Xu G., Zhuo Y., Zhang Y. M., Zhang J. Y. Does ESG disclosure increase firm value? [J]. Finance and Accounting Newsletter,2022(04): 33-37. DOI:10.16144/j.cnki.issn1002-8072.2022.04.029.

[11] Ma Xili. Do ESG investment strategies have a mine clearance function? -- An empirical study based on the Chinese A-share market[J]. Northern Finance, 2019(05): 14-19. DOI:10.16459/j.cnki.15-1370/f.2019.05.004.