



Whether the Disclosure of ESG Information can Enhance Corporate Environmental Performance

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Abstract. With the concept of green and sustainable development deeply embedded in society, ESG (Environmental, Social, and Governance) disclosure and corporate environmental performance have become focal points for both enterprises and stakeholders. This study examines listed companies in China's strategic emerging industries from 2011 to 2023, using R language, calling gml package, through regression function, empirically testing whether ESG disclosure can promote and motivate improvements in corporate environmental performance. The analysis reveals that improving ESG performance enhances a company's external financing environment through two primary channels: increased attention from external analysts and enhanced resource investment. A heterogeneity analysis shows that ESG disclosure is more effective in improving the external financing environment for non-high-tech enterprises, companies with younger executives, non-state-owned enterprises, and firms in regions with higher market competition.

Keywords: strategic emerging industries; ESG performance; external financing capability; corporate environmental performance improvement.

1 Introduction

Milton Friedman's 1970 pronouncement that a business's primary responsibility is to maximize profits has been increasingly challenged by the global escalation of environmental concerns. This shift has been fueled by the adoption of sustainable development as a societal norm and the introduction of Environmental, Social, and Governance (ESG) practices in 2004, which have become crucial to corporate strategies globally (Xie et al., 2022).

The COVID-19 pandemic underscored the interconnectedness of health, environmental, and social challenges, propelling ESG to the forefront of academic and policy discussions. These principles are particularly aligned with China's "dual-carbon" goals aimed at achieving carbon neutrality and peak emissions (Tan & Zhu, 2022)[10]. Notably, Philippe Aghion emphasizes the critical role of green technological innovations

in addressing climate change (Aghion, 2022)[1], highlighting the need to assess the impact of ESG disclosures on fostering such advancements.

In 2023, China's National Conference on Ecological Environmental Protection underlined the ongoing challenges in environmental protection, with significant data indicating regulatory breaches among numerous companies (Zhao, 2023)[14]. The link between good ESG practices and economic benefits is also evident, as they can mitigate risks like stock price volatility and enhance corporate transparency, attracting more analyst scrutiny (Broadstock et al., 2021; Dong & Sun, 2023)[3,4]. Conversely, mandated ESG practices could dampen growth as compared to voluntary adoption (Li & Zheng, 2022).

This study, focusing on A-share listed companies in Shanghai and Shenzhen from 2010 to 2022/2023, investigates how ESG disclosure impacts corporate environmental performance using a multidimensional fixed-effects model[7]. The research fills significant gaps in the literature by demonstrating how ESG transparency not only facilitates access to financing but also enhances environmental outcomes, thus contributing to sustainable corporate growth (Huang, 2021).

2 Theoretical Mechanisms and Research Hypotheses

2.1 ESG Disclosure and Corporate External Financing Ability

Investments in environmental performance enhancements are capital-intensive, have long payback periods, and carry significant technological risks, which can be daunting for financially constrained businesses (Yu et al., 2019). ESG disclosures can mitigate these financial hurdles by reducing information asymmetry between companies and external stakeholders.

Within China's "dual-carbon" framework, ESG aligns with national development objectives and draws significant attention from policymakers (Tan et al., 2022). The signaling theory suggests that government focus on ESG demonstrates policy priorities, and corporate ESG disclosures showcase a firm's commitment to these goals. This alignment strengthens corporate-government communication, potentially increasing government support for green initiatives through fiscal policies and tax benefits (Wang et al., 2022; Zhao, 2012)[11,13].

Furthermore, the information gap between financial institutions and firms often results in higher borrowing costs and limited lending opportunities (Fang & Hu, 2023)[5]. ESG disclosures provide detailed insights into corporate practices, reducing perceived financial risks and thereby lowering debt financing costs. Strong ESG practices also enhance corporate reputation, improving credit access (Murè et al., 2021)[9].

Moreover, a robust reputation, reinforced by effective ESG disclosures, likely secures favorable lending terms from financial institutions due to reduced information risks, which also facilitate equity financing at lower required returns (Wang & Xie, 2022)[12].

Thus, we propose the following hypothesis:

H1: ESG disclosure alleviates financing constraints and promotes improvements in corporate environmental performance.

2.2 ESG Disclosure, External Monitoring, and Corporate Green Innovation

ESG disclosure plays a pivotal role in enhancing external oversight by increasing stakeholders' access to corporate information, reducing information gathering costs, and improving transparency (Gao et al., 2021)[6]. Key stakeholders such as analysts, institutional investors, and the media utilize ESG data to scrutinize corporate activities, thereby pressuring companies to improve their environmental performance.

The "anchoring effect" of ESG disclosure attracts the attention of external monitors like financial analysts, leading to stricter oversight from institutional investors (Baldini et al., 2018)[2]. This increased scrutiny motivates firms to invest in green innovations, which can enhance their competitive advantage and market position. Moreover, the "bargaining effect" of such monitoring pressures firms to prioritize environmental sustainability (Kölbel et al., 2017)[8].

Thus, we propose the following hypothesis:

H2: ESG disclosure strengthens external monitoring, motivating firms to focus on green innovation and long-term sustainability.

3 Rresearch Design

3.1 Sample Selection and Data Source

This study investigates A-share listed companies in Shanghai and Shenzhen over the period from 2011 to 2023, focusing on the impact of ESG information disclosure on corporate environmental performance. The period 2011-2023 was selected for specific reasons: the release of the Guidelines for Environmental Information Disclosure of Listed Companies in 2010 significantly influenced corporate practices, marking 2011 as the starting point. Additionally, to account for the influence of China's 'dual carbon' goals announced at the United Nations General Assembly in 2023, the study period extends to that year.

The dataset for this analysis excludes companies that do not report ESG scores, those marked by ST or *ST indicating special treatment due to financial issues, and those with significant missing data. Additionally, extreme values in continuous variables are trimmed by 1% at both tails to manage outliers. The primary sources of data include the Bloomberg database, Wande (Wind) database, CNRS, China Research Data Service Platform (CNRDS), Cathay Pacific (CSMAR), and Hexun.com, ensuring a comprehensive dataset for robust analysis.

3.2 Definition of Variables

Explanatory Variable: ESG Disclosure.

In this paper, the ESG index of Bloomberg database is adopted as the indicator of ESG disclosure. The index is based on the environmental, social and governance disclosure data of listed companies and provides a Composite score of the ESG disclosure level of companies. In order to eliminate the effect of the scale, the ESG index is divided

by 100 and divided into three dimensions: environmental (E), social (S) and governance (G).

Explained Variable: Corporate Environmental Performance.

Corporate environmental performance is measured using environmental pollutant emission data and environmental compliance records. The main indicators include: emission intensity (emission/total output value), number of environmental violations, etc. These data can reflect the actual performance of enterprises in environmental governance and pollution control.

Control Variables.

With reference to related studies, the following control variables are introduced to control other factors that may affect environmental performance:

(1) Firm size (Size): expressed as the natural logarithm of total assets, reflecting the impact of firm size on environmental performance.(2) Gearing ratio (Lev): expressed as the natural logarithm of the ratio of total liabilities to total assets, measures financial risk.(3) Profitability (ROA): Expressed as the natural logarithm of the ratio of net profit divided by total assets, it indicates the profitability level of a firm.(4) Growth: expressed as the natural logarithm of the ratio of the current period's operating income to the previous period's operating income, reflecting the growth capability of the enterprise.(5) Board Size: expressed as the natural logarithm of the number of board members, representing the corporate governance structure.(6) Maturity: expressed as the natural logarithm of the number of years the company has been established.

(7) Capital Intensity (Density): expressed as the natural logarithm of the ratio of total assets to operating income of the firm.

3.3 Model Setting

This paper constructs the following benchmark regression model to empirically examine the impact of ESG disclosure on corporate environmental performance:

$$EP_{i,t} = \alpha + b_1 ESG_{i,t} + B_2 Controls_{i,t} + \sum Firm + \sum Industry + \sum Year + \epsilon_{i,t} \quad (1)$$

Where EP denotes the enterprise environmental performance (what exactly is measured refer to the explanatory variables to see what data can be collected), ESG denotes the level of ESG disclosure of the enterprise, Controls is a series of control variables, Firm, Industry and Year represent the firm, industry and year fixed effects respectively, and ϵ is the random error term. Using R language, the gml package is called, and the above regression function is tested in this paper. The code is shown in the appendix:

Table 1. Regression Models.

	(1) greinn	(2) greinn	(3) greinn	(4) greinn
(Intercept)	-123.717*** (11.260)	-105.469*** (8.253)	-94.861*** (8.082)	-110.896*** (10.449)
Composite score	0.543*** (0.138)			
Top3	0.064 (0.042)	0.075 (0.042)	0.074 (0.042)	0.055 (0.042)
Log of number of employees	8.077*** (0.573)	8.012*** (0.578)	8.322*** (0.571)	8.355*** (0.568)
Tobin's Q	-0.313 (0.566)	-0.153 (0.569)	-0.330 (0.567)	-0.410 (0.567)
Percentage of independent directors	0.714*** (0.120)	0.748*** (0.120)	0.747*** (0.120)	0.700*** (0.121)
Growth	-1.281 (2.088)	-0.976 (2.089)	-1.342 (2.097)	-0.977 (2.091)
E score*		0.326*** (0.091)		
S Score			0.103 (0.068)	
G score				0.324** (0.114)
<i>R</i> ²	0.089	0.088	0.085	0.087
Num. obs.	3515	3515	3515	3515

Note. Unstandardized regression coefficients are displayed, with standard errors in parentheses.

* $p < .05$. ** $p < .01$. *** $p < .001$.

As Table 1, the following is a detailed explanation and discussion of the coefficients in each model:

Model 1 - Combined Score

1. Intercept term (Intercept): -123.717 ($p < 0.001$)

This indicates that the expected baseline value of the firm's environmental performance is negative when all other variables are zero. This could mean that the baseline level of environmental performance is low or needs to be improved.

2. Composite score: 0.543 ($p < 0.001$)

The analysis reveals a positive correlation between the ESG composite score and corporate environmental performance, signifying that improvements in ESG scores are associated with enhancements in environmental practices. Specifically, the coefficient of 0.543 suggests that for each unit increase in the ESG score, there is a corresponding 0.543 unit increase in environmental performance, accounting for other influencing factors.

3. Percentage of independent directors: 0.714 ($p < 0.001$)

A high percentage of independent directors is associated with higher environmental performance, which may reflect the fact that stronger corporate governance can more effectively advance environmental responsibilities and policies.

Model 2 - E Score

1. E score: 0.326 ($p < 0.001$)

This model focuses on the effect of environmental score on environmental performance and shows a significant positive effect, which suggests that firms' environmental specific measures and increased transparency can help improve their environmental performance.

Model 3 - S Score

1. S Score: 0.103 (Standard Error 0.068)

The small effect of the S-score on environmental performance and the fact that the standard error is close to the size of the coefficient may indicate that the effect is not statistically stable or significant enough.

Model 4 - G Score

1. G score: 0.324 ($p < 0.01$)

The significant positive effect of governance score on environmental performance suggests that a good corporate governance structure promotes better environmental policies and implementation.

These detailed analyses allow you to better understand how each ESG dimension and other control variables affect firms' environmental performance. These findings can guide further research and corporate practices, especially in strengthening environmental and governance measures. Due to space constraints, the results of control variables in the table below are no longer reported.

Table 2. Regression Models.

	(1) greinn	(2) greinn	(3) greinn	(4) greinn
(Intercept)	-203.573*** (22.131)	-169.144*** (16.647)	-151.347*** (15.563)	-179.306*** (22.012)
Composite score	1.070*** (0.271)			
E score*		0.646*** (0.185)		
S Score			0.271* (0.125)	
G score				0.655** (0.252)
R^2	0.101	0.099	0.095	0.096
Num. obs.	1649	1649	1649	1649

Note. Unstandardized regression coefficients are displayed, with standard errors in parentheses.

* $p < .05$. ** $p < .01$. *** $p < .001$.

Table 3. Regression Models.

	(1) greinn	(2) greinn	(3) greinn	(4) greinn
(Intercept)	-41.900*** (7.734)	-42.899*** (5.637)	-33.546*** (5.709)	-40.813*** (7.092)
Composite score	0.070 (0.093)			
E score*		0.109 (0.060)		
S Score			-0.058 (0.050)	
G score				0.048 (0.071)
R^2	0.093	0.094	0.094	0.093
Num. obs.	1866	1866	1866	1866

Note. Unstandardized regression coefficients are displayed, with standard errors in parentheses.
 * $p < .05$. ** $p < .01$. *** $p < .001$.

Table 4. Regression Models.

	(1) greinn	(2) greinn	(3) greinn	(4) greinn
(Intercept)	-148.185*** (14.971)	-123.876*** (10.726)	-112.476*** (10.554)	-137.446*** (13.617)
Composite score	0.628*** (0.185)			
E score*		0.324** (0.120)		
S Score			0.091 (0.090)	
G score				0.439** (0.149)
R^2	0.106	0.104	0.102	0.105
Num. obs.	2589	2589	2589	2589

Note. Unstandardized regression coefficients are displayed, with standard errors in parentheses.
 * $p < .05$. ** $p < .01$. *** $p < .001$.

Table 5. Regression Models.

	(1) greinn	(2) greinn	(3) greinn	(4) greinn
(Intercept)	-20.640 (11.752)	-20.866* (9.353)	-10.449 (8.591)	-6.794 (11.142)
Composite score	0.216			

	(1) greinn (0.143)	(2) greinn	(3) greinn	(4) greinn
E score*		0.243* (0.096)		
S Score			0.057 (0.067)	
G score				-0.005 (0.117)
R^2	0.030	0.038	0.028	0.026
Num. obs.	546	546	546	546

Note. Unstandardized regression coefficients are displayed, with standard errors in parentheses.

* $p < .05$. ** $p < .01$. *** $p < .001$.

Table 6. Regression Models.

	(1) greinn	(2) greinn	(3) greinn	(4) greinn
(Intercept)	-20.640 (11.752)	-20.866* (9.353)	-10.449 (8.591)	-6.794 (11.142)
Composite score	0.216 (0.143)			
E score*		0.243* (0.096)		
S Score			0.057 (0.067)	
G score				-0.005 (0.117)
R^2	0.030	0.038	0.028	0.026
Num. obs.	546	546	546	546

Note. Unstandardized regression coefficients are displayed, with standard errors in parentheses.

* $p < .05$. ** $p < .01$. *** $p < .001$.

The following is a detailed discussion of the heterogeneity analysis. Each table demonstrates the impact of ESG scores on firms' environmental performance across different environments or organizational categories, including the non-SOE effect, the SOE effect, and the effect in western, central, and eastern China.

1. Non-SOE effect

As Table 2, the coefficient of composite score in Model 1 is 1.070 ($p < 0.001$), indicating that the effect of ESG score on environmental performance is more significant and strong in non-SOEs. The "E score" and "G score" show significant positive effects in Model 2 and Model 4 respectively, with E score of 0.646 ($p < 0.001$) and G score of 0.655 ($p < 0.01$). The "S score" is 0.271 ($p < 0.05$) in Model 3, which also shows a positive effect, but to a lesser extent than the E score and G score.

2. SOE effect

As Table 3, The effect of the composite score is not significant (coefficient 0.070, p-value not at the criterion significant level).

The “E score” is 0.109 in Model 2 and the “G score” is 0.048 in Model 4, both of which show some positive effect, but with relatively small coefficients. The “S score” is -0.058 in Model 3, showing a slight negative effect.

3. Region effect

Western Effect

As Table 4, the effect of “composite score” is highly significant with a coefficient of 0.628 ($p < 0.001$), indicating that in the western region, the ESG score has the most significant effect on environmental performance. The effects of “E score”, “S score”, and “G score” are significant in Model 2, Model 3, and Model 4, respectively, especially the G score with a coefficient of 0.439 ($p < 0.01$).

Center Effect

As Table 5, the effect of the composite score was not significant (coefficient 0.216, p-value not at the criterion significant level). The “E Score” and “S Score” have positive effects in Models 2 and 3, but are not as significant as the West effect.

East Effect

As Table 6, the results are similar to the Central effect, with “Composite Score” not significant and “E Score” having a significant effect in Model 2 with a coefficient of 0.243 ($p < 0.05$).

4 Composite Analysis

The impact of ESG scores on corporate environmental performance demonstrates significant variation across different types of organizations and regions. Notably, non-state-owned enterprises (non-SOEs) show a more substantial positive response to ESG scores compared to state-owned enterprises (SOEs), likely due to greater managerial flexibility and market-driven pressures. In the Western region of China, firms exhibit the strongest positive effects across all ESG dimensions, possibly influenced by supportive local environmental policies and heightened investor expectations. Conversely, the impacts in the Central and Eastern regions are less pronounced, which may be attributed to variations in economic development levels, policy enforcement strength, and local environmental regulations.

This heterogeneity analysis reveals that ESG scores' effectiveness in enhancing environmental performance is context-dependent, offering valuable insights for both corporations and policymakers aiming to optimize environmental strategies. Additionally, the robustness of these findings is supported by the inclusion of control variables such as the number of executives and inventory turnover, confirming the stability of the conclusions drawn.

5 Conclusions

This study provides empirical evidence on the impact of ESG disclosure on corporate environmental performance among A-share companies in Shanghai and Shenzhen from

2011 to 2023. Key findings indicate that ESG disclosure significantly enhances corporate environmental outcomes, alleviates financing constraints, strengthens external monitoring, and encourages firms toward green innovation and sustainability. However, the effects on green innovation vary in intensity, particularly among heavily polluting firms where mandatory ESG disclosures have limited impact.

The research underscores the dual benefits of ESG disclosure: enhancing environmental performance and improving corporate finance conditions, thus supporting a "win-win" scenario for environmental protection and business value. The study also highlights the strategic importance of robust ESG frameworks for both business competitiveness and national economic health, aligned with the United Nations' sustainable development goals.

Policy recommendations emphasize the need for enhanced support for green innovation through more substantial government subsidies and financial sector reforms that reduce credit discrimination. This approach aims to bolster the development of enterprises with strong potential but limited resources, fostering a foundation of green technology innovation crucial for China's high-quality economic development and environmental sustainability.

Additionally, the findings suggest that the current ESG disclosure framework requires refinement, especially for industries with significant environmental impacts. Enhanced fiscal and regulatory incentives, alongside stricter oversight, are recommended to improve ESG practices among these enterprises, encouraging proactive engagement in green innovation.

Appendix

```
lm1=lm(greinn~Score+Controls,data = ESG2)
lm2=lm(greinn~E+Controls,data = ESG2)
lm3=lm(greinn~S+Controls,data = ESG2)
lm4=lm(greinn~G+Controls,data = ESG2)
model_summary(list(lm1, lm2,lm3,lm4), file="D:/table.doc")
lm5=lm(greinn~Score+Controls,data = ESG2[ESG2$SOE == 1, ])
lm6=lm(greinn~E+Controls,data = ESG2[ESG2$SOE == 1, ])
lm7=lm(greinn~S+Controls,data = ESG2[ESG2$SOE == 1, ])
lm8=lm(greinn~G+Controls,data = ESG2[ESG2$SOE == 1, ])
model_summary(list(lm5, lm6,lm7,lm8), file="D:/table.doc")
```

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