



The Impact of Environmental Information Disclosure on Green Innovation: the Moderating Role of R&D Investment

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Abstract. In today's rapid economic development, China's environmental regulation has gradually changed to voluntary disclosure. So what role does environmental information disclosure play in the green innovation of enterprises? What is the mechanism of influence between them? This paper selects the data of Shanghai and Shenzhen A-share listed companies from 2008 to 2021 for empirical analysis, discusses the affect and mechanism of environmental information disclosure on corporate green innovation, and draws conclusions and puts forward corresponding suggestions.

Keywords: Environmental Information Disclosure; R& D investment; Green Innovation.

1 Introduction

Today, with the rapid development of economy and science and technology, environmental issues have been related to people's lives, enterprise development and national development, and many other aspects. Good environmental governance meets the needs of all stakeholders. In this context, green innovation has gradually become an effective way of environmental management. However, in the process of carrying out green innovation, enterprises often have to pay extra costs, which leads to the general lack of enthusiasm of enterprises. In this context, it has become a common phenomenon to rely on measures such as government subsidies, pollutant discharge charges and information disclosure to promote enterprises' green innovation. However, The "greenwashing" theory, developed by Lyon and Maxwell¹, suggests that the lower a company is, the more likely it is to distract investors and consumers by disclosing more information about the environment. Cho² et al. studied the top 500 companies in the United States and found that companies with high levels of disclosure did not improve their environmental performance.

But in real life, enterprises tend to adopt a series of low-cost strategies without taking real actions to seek policy support, which leads to "too much talk and too little action"³.

To sum up, this paper selects the data of Shanghai and Shenzhen A-share listed companies from 2008 to 2021 for empirical analysis, and discusses the impact and mechanism of environmental information disclosure on corporate green innovation.

2 Theoretical Analysis and Research Hypothesis

Existing studies have found that environmental information disclosure can promote technological innovation of enterprises, but can it promote green innovation of enterprises? According to the principle of signal transmission, environmental information disclosure by enterprises can reflect the company's obligation to reduce emissions, and pass positive information to the society, it can help enterprises to establish a good reputation and image, so as to obtain a good social reputation, so as to increase the company's commercial credit financing, so as to promote the company's green technology innovation⁴.

Based on this, this paper proposes hypothesis H1a: environmental information disclosure has a positive impact on enterprises' green innovation level.

The legitimacy theory points out that the disclosure of environmental information is driven by the legitimate pressure exerted by the government and public opinion. From the perspective of government regulation, the government regulation system is mandatory and can play a deterrent role. In order to reduce the risk of being legally punished, companies have to take some measures⁵. At the same time, there are also some literature points out that there are "opportunistic" behaviors in enterprises to cater to the government and operators, that is to say, when enterprises disclose environmental information, it is not solely for the purpose of improving their environmental performance, but for the purpose of speculation. In practice, in order to obtain government subsidies, enterprises increase the disclosure of environmental protection information, but do not apply it to other aspects, resulting in "compensation fraud"⁶.

Based on this, this paper proposes hypothesis H1b: Environmental information disclosure has a negative impact on enterprises' green innovation level.

As the source and driving force of enterprise technological innovation activities, R&D investment plays an important role in enterprise green innovation. In the context of the national "dual carbon" strategy, in order to reduce pollutant emissions and improve production efficiency, enterprises may increase R&D investment after obtaining government subsidies, so as to achieve the purpose of reducing carbon emissions and improving production efficiency, and thus improve the green innovation performance of enterprises. However, from the perspective of legitimacy theory, enterprises may not invest subsidies in green innovation after they have fulfilled their environmental requirements and have reached their goals. Based on the above analysis, this paper proposes hypothesis H2: R&D investment plays a moderating role in the impact of environmental information disclosure on green innovation.

3 Empirical Design and Index Measurement

3.1 Sample Selection and Data Source

Table 1. Description of variables

Types of variables	Variable name	Variable description
Explained variable	GI	Take logarithm of the number of corporate green patent applications plus one
Explanatory variables	Eid	A scoring method is used to measure the level of environmental information disclosure of listed companies.
Adjusting variables	RD	R&d intensity: The ratio of R&D expenditure to operating income in the current period

In order to explore the impact of environmental information disclosure on enterprise innovation, this paper takes China's A-share listed companies as the research object, and excludes the enterprises with special treatment and delisting expectation. According to the data of Guotai'an database, the sample years with incomplete key indicators are excluded, and the listed companies from 2008 to 2021 are finally selected as samples, with a total of 5905 observed values, to empirically test the impact of environmental information disclosure on enterprise innovation. The main variables are described in Table 1.

3.2 Model Construction

In order to study the impact of environmental information disclosure on enterprises' green innovation, this paper constructs the following baseline regression model:

$$GI_{it} = \alpha_1 + \beta_1 EID_{it} + \beta_2 X_{it} + \epsilon \quad (1)$$

In order to study the relationship between corporate environmental information disclosure, R&D investment and green innovation, with green innovation as the explained variable, environmental information disclosure as the explanatory variable, and R&D investment as the regulating variable, a multiple linear regression model was constructed as follows:

$$GI_{it} = \alpha_1 + \beta_1 EID_{it} + \beta_2 RD_{it} + \beta_3 EID \times RD + \beta_4 X_{it} + \epsilon \quad (2)$$

4 Empirical Analysis

4.1 Descriptive Statistics

The following Table 2 shows the analysis results of descriptive statistics. The mean value of GI is 0.711, the minimum value is 0, and the maximum value is 3.067, indicating that the overall green innovation level of listed companies is low, and the difference between individuals is large.

The maximum value of the total level of Eid is 3.892, the minimum value is 0, and the average value is 2.17, indicating that the company's environmental information disclosure is still at a relatively low level on the whole.

The maximum value of RD is 0.572, the minimum value is 0, and the average value is 0.0569, indicating that there are great differences in R&D input of enterprises.

Table 2. Descriptive statistics

VARIABLE	(1) N	(2) mean	(3) sd	(4) min	(5) max
Eid	5905	2.170	0.988	0	3.892
GI	5905	0.711	0.546	0	3.067
RD	5905	0.0569	0.0590	0	0.572

4.2 Empirical Test

Regression Analysis.

Results in column 2 of Table 3 show a significant negative correlation between EID and GI at the 1% confidence level. The results show that environmental information disclosure has an inhibitory effect on enterprises' green innovation, which verifies and supports hypothesis H1b. The environmental information disclosure of enterprises is only to meet the legal requirements, but the pressure of environmental regulation inhibits the green innovation of enterprises. Column 3 shows that the interaction coefficient between EID and RD is significantly negative, which verifies hypothesis 2. R&D investment plays a moderating role in the process of environmental information disclosure's impact on green innovation

Table 3. Empirical test result

	(1) Main regression GI	(2) Regulating effect GI
Eid	0.019 (0.009)	0.023 (0.009)
RD		1.019*** (0.228)
interact		1.430 (0.386)
Size	0.140*** (0.017)	0.140*** (0.017)
Indep	0.001 (0.002)	0.001 (0.002)

Board	0.061 (0.059)	0.053 (0.058)
INST	0.000 (0.001)	0.000 (0.001)
Mshare	0.000 (0.001)	0.000 (0.001)
ListAge	0.042** (0.017)	0.033* (0.017)
cons	2.577 (0.418)	2.614 (0.417)
N	5905	5905
r ²	0.646	0.649

Standard errors in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

4.3 Robustness Test

In this paper, the robustness of the regression results is tested by the instrumental variable method, and the results are shown in the Table 4.

Table 4. Robustness test result

VARIABLES	firstEid Eid	second GI
L.Eid	0.372 * * * (28.06)	
interact	1.136 * (1.93)	1.763 * * * (4.39)
Size	0.235 * * * (10.31)	0.200 * * * (11.54)
Indep	0.003 (1.22)	0.001 (0.55)
Board	0.185 * * (2.42)	0.008 (0.15)
INST	0.000 (0.27)	0.001 * (1.74)
Mshare	0.001 (0.80)	0.001 (1.27)
ListAge	0.164 * * * (6.20)	0.010 (0.53)
Eid		0.051 * * (2.09)
Observations	5220	5220
R-squared		0.069

t-statistics in parentheses

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

The empirical results show that after endogenous mitigation, the data of environmental information disclosure is still significant, which is consistent with the above results, indicating that the analysis results in this paper are robust.

5 Conclusions

According to the empirical results, the following conclusions are drawn: (1) Environmental information disclosure has a negative impact on the green innovation level of enterprises. (2) It is found that R& D investment has a moderating effect on the relationship between corporate environmental information disclosure and corporate green innovation.

According to the above conclusions, the following countermeasures and suggestions are put forward: Government supervision departments should improve the current environmental information disclosure system, optimize the current environmental information management system, and strengthen the supervision of disclosure standards and disclosure quality.

At the same time, under the background of the in-depth implementation of the "double carbon" strategy and China's vigorous promotion of green economy, enterprises should recognize the potential of green innovation, actively carry out green technological innovation, and build an appropriate innovation system, strengthen green innovation research and development, improve the use of resources and production efficiency, and improve the quality of economic development.

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