

Does ESG Rating Affect Corporate Innovation?

Shiying Chen*, Tingru Shen

School of Economics, Hua Zhong University of Science and Technology, Wuhan 430074, China

Abstract: Promoting the development of innovation is the core requirement for achieving economic growth in the new era. The performance of Environmental, Social responsibility and Governance (ESG) is an important indicator to measure the sustainable development ability of enterprises. How the ESG rating affects the corporate innovation is still a hot issue that needs to be answered urgently. Based on the quasi-natural experiment of SynTao Green Finance's announcement of ESG rating in 2015, we use Chinese listed companies in Shanghai and Shenzhen from 2011 to 2019 as samples to test the impact of ESG rating on corporate innovation and its transmission mechanism. The research results show that there is a significant positive relationship between ESG rating and corporate innovation, and ESG rating mainly promotes corporate innovation by reducing agency costs and easing financing constraints. This research helps to clarify the relationship between ESG rating and corporate innovation, and can provide an important reference for the Chinese government to formulate relevant policies to improve the ESG rating system, promote corporate innovation and sustainable economic development.

Keywords: ESG rating, Corporate innovation, Agency costs, Financing constraints.

1. Introduction

In recent years, China has paid more and more attention to the important driving role of innovation in economic development. As an efficient subject of innovation, enterprises play an extremely important role in economic growth, but now they are often faced with double dilemmas in the process of innovation. On the one hand, innovation as an activity with a high risk of failure and a long return period, may lead to large fluctuations in the business performance of the company. Enterprise management with conflict of interest with shareholders may be reluctant to engage in innovative activities due to career or personal interests, resulting in a lack of willingness to innovate. On the other hand, innovation activities have the characteristics of high investment and long cycle, which makes corporate innovation need sufficient and stable financial resources to escort it. However, the proportion of innovative tangible assets is relatively low, and the value and risk are difficult to measure, which will also make enterprises face the dilemma of external financing difficulties, which will lead to the lack of innovation ability of enterprises. Under the influence of these two types of problems, corporate innovation is often restricted, thereby limiting the improvement of corporate competitiveness and the sustainable growth of the economy. How to help enterprises alleviate the plight of innovation, improve the level of innovation, and then drive high-quality economic development with technological progress is undoubtedly the key point of current development.

At the same time, ESG concepts centered on Environment, Social Responsibility and Governance are receiving more and more attention as a framework for assessing corporate sustainability. Statistics from the Global Sustainable Investment Alliance for some parts of the world show that the asset management scale of ESG investment has grown rapidly from 13.2 trillion dollars in 2012 to 35.3 trillion dollars in 2020, with a compound annual growth rate of about 13.02%. The overall growth rate of the asset management industry was only 6.01%. Especially in the past two years, the development of ESG has been particularly rapid. From companies under regulatory pressure to participate in ESG activities and

disclose ESG data, to now companies have begun to actively disclose more detailed ESG indicators, third-party rating agencies have begun to increase, and all parties have begun to actively implement the concept of ESG. What is the driving force behind the rapid development of the ESG rating industry? In fact, from data disclosure by companies to third-party agencies conducting ratings based on data, this complete set of ESG rating publication process not only helps companies optimize their own internal governance structures and meet regulatory requirements, but also enables companies and the outside world to improve the efficiency of information transmission, which plays a pivotal role in coordinating internal conflict of interests and alleviating external financing constraints, thus having a huge influence on enterprises.

Given that corporate innovation plays such an important role in economic growth, the implementation of ESG concepts by companies is the general trend of the times. Under the background that the international economic situation is becoming more complex and the Chinese economy is facing transformation, exploring the relationship between ESG rating and corporate innovation will help China formulate a more complete ESG industry development policy and explore corporate innovation.

Based on the quasi-natural experiment of SynTao Green Finance's announcement of corporate ESG rating in 2015, we use Chinese listed companies in Shanghai and Shenzhen from 2011 to 2019 as samples to test the impact of corporate ESG rating on corporate innovation and its transmission mechanism. The research results show that there is a significant positive relationship between ESG rating and corporate innovation, and ESG rating mainly promotes corporate innovation by reducing agency costs and easing financing constraints. In addition, we provide suggestions for the development of ESG rating and corporate innovation based on multiple perspectives such as regulators, third-party rating agencies, and enterprises.

Compared with previous studies, the main innovations of this paper are as follows: First, based on the quasi-natural experiment of SynTao Green Finance's announcement of corporate ESG rating in 2015, it enriches the relevant research

on the influencing factors of corporate innovation. Innovation is the core driving force for enterprise growth in the new era. Existing research has explored the influencing factors of innovation from multiple dimensions such as enterprise internal characteristics and external environment. However, as an important indicator to measure the sustainable development capability of enterprises, few studies link it with corporate innovation. The empirical research of this paper finds that there is a significant positive relationship between the publication of ESG rating and patent licensing, which indicates that publication of ESG rating can effectively improve the corporate innovation. This paper contributes to enriching research in the field of enterprise innovation.

Second, this paper clarifies the impact mechanism of ESG rating on corporate innovation. This paper finds that the publication of ESG rating improves corporate innovation by reducing agency costs and easing financing constraints. On the one hand, ESG rating has strengthened the external supervision pressure faced by enterprises, forcing them to improve their internal governance and reduce agency costs, thus prompting them to increase resource support and energy investment in innovation activities. On the other hand, ESG rating can alleviate the degree of information asymmetry with investors, reduces the financing cost of enterprises and provides more abundant funds for innovative projects by easing financing constraints. Based on empirical research, this paper examines two impact mechanisms through which ESG rating reduces agency costs and eases financing constraints, providing a reasonable explanation for the relationship between ESG rating and innovation.

The structure of the rest of the paper is arranged as follows: the second part is hypotheses development, the third part is methodology, the fourth part is analysis, and the last part is conclusion.

2. Hypotheses Development

Corporate innovation has the characteristics of high risk, high investment, long cycle and high professionalism. The resulting information asymmetry and principal-agent problems make corporate innovation often limited by internal governance problems and external funding problems. The stakeholder theory holds that outsiders such as consumers, investors, and regulators will continue to pay attention to corporate business information out of their own interests, which enables information disclosure to alleviate the difficulties faced by corporate innovation to a certain extent. Therefore, we believe that the publication of ESG rating can improve the innovation level of enterprises in the following two aspects.

On the one hand, we believe ESG rating may boost corporate innovation by reducing agency costs. First, ESG rating increases oversight pressure from external stakeholders and reduces management's opportunistic behavior. For personal interests or career considerations, enterprise managers often implement opportunistic behaviors in the absence of internal supervision, such as rent-seeking and corruption activities for personal gain. The opportunistic behaviors caused by these principal-agent problems will have a crowding-out effect on corporate innovation, leading to a decrease in the willingness of companies to innovate. By releasing signals, the ESG rating releases alleviates the information asymmetry between corporate insiders and interested external parties such as consumers, media, and regulators, enabling companies to gain more attention and

receive stronger external supervision. To a certain extent, this increases the chance of the negative information of the company being exposed, thereby constraining the management to carry out opportunistic behavior and improving the company's willingness to innovate.

Second, ESG rating increases the motivation of corporate shareholders to optimize the governance structure and reduces the opportunistic behavior of management. The principal-agent problem of enterprises mainly comes from the lack of internal supervision, and ESG rating in the eyes of consumers, investors and other outsiders amplifies the performance of enterprises in ESG activities, which in turn directly affects enterprises. For example, when investors expect a company to have a higher ESG rating and this does not materialize, the company suffers reputational damage and loses funding opportunities. Therefore, in order to improve ESG rating and protect their own interests, such external supervision will force corporate shareholders to take the initiative to increase ESG investment. With the improvement of corporate governance ability and the strengthening of internal supervision of enterprises, the agency problem between shareholders and management can be alleviated, thereby restraining the opportunistic behavior of management.

On the other hand, ESG rating may promote corporate innovation by easing financing constraints. First, the publication of ESG rating alleviates the information asymmetry between companies and stakeholders, making it easier to obtain external financing. When there is information asymmetry, investors and creditors lack the understanding of the internal situation of the enterprise, and often demand a higher risk premium, resulting in financing difficulties for the enterprise. ESG rating conveys more non-financial performance of the company to investors and creditors, which not only reflects the company's sustainable development concept and good operating conditions, but also reduces the company's financing costs through the transmission of more effective information.

Second, ESG rating reduces the risk of corporate debt defaults, making it easier to obtain external financing. When a company's ESG performance is not transparent enough, in order to reduce costs, companies may violate regulatory requirements in terms of environmental and social responsibility. Once discovered, they will need to pay reputation damage, administrative fines and rectification costs, thereby increasing the possibility of corporate debt default. ESG rating forces companies to increase their investment in ESG activities, which reduces the policy risk and default probability of companies. Better performance in the financial dimension can increase the possibility of long-term borrowing by creditors.

Third, ESG rating satisfies policy requirements, making it easier to obtain government subsidies. In recent years, the deepening of Chinese ecological construction and the increasing social burden have prompted the Chinese government to begin to provide certain subsidies to enterprises for environmental protection and fulfillment of social responsibilities. As China pays more and more attention to the ESG industry, it may provide more policy support and resource preference for companies to carry out ESG activities and disclose detailed ESG information. ESG rating forces companies to increase their investment in ESG activities, obey government guidance, and make it easier to obtain financial support from policies and other aspects, thereby easing financing constraints (Zeng and Crowther,

2019). Therefore, based on the above analysis, we propose the following hypothesis:

Hypothesis 1: ESG rating can promote corporate innovation.

3. Methodology

3.1. Sample and Data

We select Chinese listed companies in Shanghai and Shenzhen from 2011 to 2019 as a sample, and the required data comes from the Wind and CSMAR databases. At the same time, referring to the existing literature (Atan et al., 2018; Gong et al., 2021), this paper processes the research samples as follows: (1) Eliminate ST companies and financial industry companies; (2) Eliminate sample companies with missing key variables in this paper ; (3) Winsorize the upper and lower 1% quantiles for all continuous observation variables in the model, and regress the standard deviation, and conduct cluster adjustment at the enterprise level to reduce the influence of sample aggregation characteristics. Finally, 12,696 enterprise sample observations were obtained.

3.2. Variables

(1) ESG rating

We mainly use the SynTao Green Finance rating data released in 2015. SynTao Green Finance is a rating agency with environmental protection economy and responsible investment as its main direction, and has a high reputation in related fields. Its ESG rating includes indicators in three dimensions: environment, society and corporate governance, which are further subdivided into 13 secondary indicators and more than 200 tertiary indicators, including environmental management, negative disclosure and environmental goals. The evaluation system scores according to the information disclosure of each indicator, comprehensively calculates the score of the listed company according to the weight, and conducts the rating according to the four levels of ABC. This paper takes SynTao Green Finance's announcement of listed company rating in 2015 as a quasi-natural experiment to further examine the impact of this exogenous shock on corporate innovation. The indicator is specifically expressed as follows: after the listed company announces the ESG rating, the ESG rating of the current year and subsequent years takes the value of 1, otherwise it takes the value of 0.

(2) Corporate innovation

There are two main ways to measure corporate innovation in the existing literature: one is to use the R&D investment of the enterprise as a proxy variable of innovation; the other is to use the number of patents granted by the enterprise to measure the innovation level of the enterprise. This paper uses two indicators, the total amount of enterprise patent authorization and the amount of invention patent authorization, to measure the innovation level of enterprises. This is because, as a legally recognized right, granted patents can intuitively represent the level of innovation output of an enterprise. The authorized patents include three categories: invention patents, utility model patents and design patents. Among them, invention patents are the one with the strictest review and the highest quality, and can better reflect the quality of innovation output of enterprises.

3.3. Estimation Method

Based on the quasi-natural experiment of SynTao Green Finance's announcement of ESG rating of Chinese listed companies in 2015, we explore the impact of ESG rating on corporate innovation by constructing a multi-period double-difference model. This paper adopts the following model for research:

$$\text{Inpatent}_{i,t+1} = \beta_0 + \beta_1 \text{ESG}_{i,t} + \beta_2 \text{Contr}_{i,t} + \text{Year}_t + \text{Firm}_{i,t} + \varepsilon_{i,t} \quad (1)$$

In model (1), the explained variables are measured by two indicators: the total number of patents granted (Inpatent) and the number of invention patents granted (Inpatent_I). The explanatory variable (ESG) is expressed as whether the ESG rating has been announced in the current period. This paper constructs a dummy variable of multi-period DID based on the time node of the ESG rating announcement of listed companies. The subscripts i and t represent the company and year, respectively, Year_t is the fixed effect of the year, $\text{Firm}_{i,t}$ is the fixed effect of the individual company, and ε represents the residual term. This paper controls the following influencing factors: (1) Enterprise characteristics and financial status variables: enterprise size (Size), enterprise age (Age), property rights (Soe), Tobin's Q (Tobin), asset-liability ratio (Lev). (2) Director characteristic variables: ownership concentration (Share), board size (Dir), proportion of independent directors (Indep), and mean age of management (Mgage). In order to alleviate the endogeneity problem, this paper lags both the explanatory variables and the control variables by one period.

At the same time, in order to test the impact mechanism of ESG rating on corporate innovation, this paper constructs model (2) and model (3) to test the two mechanisms respectively. Among them, the variable Agen is the agency cost of the company, which is measured by the company's free cash flow. The larger the company's free cash flow, the greater the agency cost of the company. The variable Finan represents the financing constraints of the enterprise, which is measured by the KZ index (Kaplan and Zingales, 1997). The larger the KZ index, the greater the degree of financing constraints faced by the enterprise. The detailed description of all variables is shown in Table 1.

$$\text{Agen}_{i,t}(\text{Finan}_{i,t}) = \beta_0 + \beta_1 \text{ESG}_{i,t} + \beta_2 \text{Contr}_{i,t} + \text{Year}_t + \text{Firm}_{i,t} + \varepsilon_{i,t} \quad (2)$$

$$\text{Inpatent}_{i,t+1} = \beta_0 + \beta_1 \text{ESG}_{i,t} + \beta_2 \text{Agen}_{i,t}(\text{Finan}_{i,t}) + \beta_3 \text{Contr}_{i,t} + \text{Year}_t + \text{Firm}_{i,t} + \varepsilon_{i,t} \quad (3)$$

4. Analysis

4.1. Descriptive Statistics

Table 2 shows the descriptive statistics of the main variables. It can be seen from the table that the mean of the total patents is 10.434, the sample mean of the invention patents is 2.5941, and the mean of ESG rating is 0.0638. The main control variable data such as enterprise size (mean 22.0722), property rights (mean 0.3543), Tobin's Q (mean 1.9805), and asset-liability ratio (mean 0.4235) are all within a reasonable range.

Table 1. Main empirical variable definitions.

Variable	Description
Inpatent	The total number of annual patents (invention, utility model, design) authorized by the enterprise.
Inpatent_I	The total amount of annual invention patent authorization of the enterprise.
ESG	The company publishes the ESG rating, which is 1 for the current year and subsequent years, otherwise it is 0.
Agen	Corporate free cash flow.
Finan	KZ index.
Size	The logarithm of the total assets of the company.
Age	The logarithm of the listing years of the company.
Soe	Take 1 if the enterprise is a state-owned enterprise, otherwise take 0.
Tobin	Market value of total assets/Value of total assets.
Lev	Total Liabilities/Total Assets.
Share	The proportion of shares held by the largest shareholder in the total share capital.
Dir	Number of directors.
Indep	Proportion of independent directors to the total number of board members.
Mgage	The mean age of non-independent directors and executives is the natural logarithm.

Table 2. Descriptive statistics for primary variables.

Variable	Num	Mean	Std	Median	Max	Min
Inpatent	12695	10.4340	17.6921	3.0000	110.0000	0.0000
Inpatent_I	12695	2.5941	5.6959	0.0000	98.0000	0.0000
ESG	12695	0.0638	0.2444	0.0000	1.0000	0.0000
Size	12695	22.0722	1.1942	21.9309	26.7233	16.7022
Age	12695	2.4012	0.4626	2.3026	3.3673	1.6094
Soe	12695	0.3543	0.4783	0.0000	1.0000	0.0000
Tobin	12695	1.9805	1.1832	1.3677	8.6790	0.1921
Lev	12695	0.4235	0.2043	0.4140	0.9981	0.0071
Share	12695	33.8480	14.4955	31.8008	89.0930	2.1969
Dir	12695	8.6017	1.6939	9.0000	18.0000	3.0000
Indep	12695	0.3740	0.0554	0.3333	0.8000	0.0000
Mgage	12695	3.8954	0.0629	3.8992	4.1109	3.6254

4.2. Regression Analysis

Based on the regression model (1), we use the OLS estimation method to examine the impact of ESG rating on the total patents and invention patents. All model estimates control the fixed effects of year and individual companies. Table 3 lists the corresponding regression results. Columns (1)-(2) report the impact of ESG rating on the total patents by companies. In the absence of other control variables, the estimated coefficient for ESG is 2.4260, which is significant at the 1% level. After adding control variables, the estimated coefficient of ESG is 2.2849, which is significant at the 5% level, indicating that ESG rating can significantly increase the total patents by enterprises. Columns (3)-(4) report the impact of ESG rating on the invention patents by companies. In the absence of other control variables, the estimated coefficient for ESG is 0.6972, which is significant at the 5% level. After adding control variables, the estimated coefficient of ESG is 0.6269, which is significant at the 5% level, indicating that ESG rating is positively correlated with the invention patents by companies. The above conclusions prove that ESG rating can significantly improve the innovation level of enterprises. Therefore, the hypothesis 1 is verified.

4.3. Mechanism Analysis

As mentioned earlier, ESG rating can increase innovation of companies by reducing agency costs and easing financing constraints. Next, we will empirically test the two mechanisms of reducing agency costs and easing financing

constraints by promoting corporate innovation through ESG rating.

Based on the mechanism of reducing agency cost, the regression results are listed in (1)-(3) of Table 4. Column (1) examines the relationship between ESG rating and firm agency costs. Among them, the estimated coefficient of ESG is -1.8218, which is significant at the 1% level, which indicates that ESG rating can significantly reduce the agency cost of companies. In columns (2)-(3), the explained variables are the total patents and invention patents. The estimated coefficients of agency cost Agen are -0.3177 and -0.0478, and are significant at the level of 1% and 5%, which proves that the higher the agency cost, the lower the innovation level of the enterprise. The estimated coefficients of ESG are 1.9615 and 0.5782, both of which are significant at the level of 5%, which indicates that agency costs play a partial intermediary role. ESG rating has effectively improved the level of corporate innovation by reducing agency costs.

Based on the mechanism of easing financing constraints, the regression results are listed in (4)-(6) of Table 4. Column (4) examines the correlation between ESG rating and corporate financing constraints. Among them, the estimated coefficient of ESG is -1.4420, and it is significant at the level of 1%, which indicates that ESG rating can significantly reduce the financing constraints of enterprises. In columns (5)-(6), the estimated coefficients of Finan's financing constraints are -0.1341 and -0.0342 respectively, both of which are significant at the 10% level, indicating that higher external financing constraints will significantly reduce the

innovation level of enterprises. The estimated coefficients of ESG are 2.0931 and 0.5780 respectively, both of which are significant at the level of 5%, which indicates that financing

constraints have played an intermediary role, and ESG rating can improve the innovation level of enterprises by easing financing constraints.

Table 3. ESG rating and corporate innovation

VARIABLES	Inpatent		Inpatent_I	
	(1)	(2)	(3)	(4)
ESG	2.4260*** (2.6173)	2.2849** (2.4941)	0.6972** (2.4137)	0.6269** (2.1918)
Size		0.5371 (1.0666)		0.3046** (1.9622)
Age		0.2381 (0.2938)		-0.1321 (-0.4896)
Soe		1.8094 (1.2965)		0.1582 (0.3382)
Tobin		-0.6887 (-0.8927)		-0.1729 (-0.6733)
Lev		0.7058 (0.5374)		0.2479 (0.5943)
Share		-0.0039 (-0.1455)		-0.0010 (-0.0954)
Dir		0.0852 (0.4003)		0.0858 (1.4045)
Indep		1.9825 (0.4029)		2.7317** (2.2196)
Mgage		2.6066 (0.4417)		0.6160 (0.3739)
Constant	7.9024*** (19.7603)	-16.2447 (-0.6779)	2.0592*** (15.9276)	-8.4332 (-1.2892)
Year	Yes	Yes	Yes	Yes
Firm	Yes	Yes	Yes	Yes
N	9652	9652	9652	9652
Adj-R2	0.0094	0.0096	0.0153	0.0165

Robust standard errors in parentheses
*** p < 0.01, ** p < 0.05, * p < 0.1

Table 4. Influence Mechanism Test

VARIABLES	Agen (1)	Inpatent (2)	Inpatent_I (3)	Finan (4)	Inpatent (5)	Inpatent_I (6)
ESG	-1.8218*** (-8.1538)	1.9615** (2.1097)	0.5782** (2.0016)	-1.4420*** (-14.4356)	2.0931** (2.3010)	0.5780** (2.0458)
Agen		-0.3177*** (-4.7524)	-0.0478** (-2.2227)			
Finan					-0.1341* (-1.8104)	-0.0342* (-1.7624)
Constant	-0.5724 (-0.1507)	-16.2129 (-0.6851)	-8.4284 (-1.2954)	-5.0115 (-1.6407)	-17.1682 (-0.7173)	-8.6687 (-1.3255)
Year	Yes	Yes	Yes	Yes	Yes	Yes
Firm	Yes	Yes	Yes	Yes	Yes	Yes
N	12695	9652	9652	12695	9652	9652
Adj-R2	0.0494	0.0150	0.0175	0.0522	0.0100	0.0167

Robust standard errors in parentheses
*** p < 0.01, ** p < 0.05, * p < 0.1

5. Conclusion

Based on a sample of Chinese listed companies in Shanghai and Shenzhen from 2011 to 2019, this paper examines the impact of the quasi-natural experiment of ESG rating publication on corporate innovation and its transmission mechanism. The main research results show that ESG rating

promotes corporate innovation by reducing agency costs and easing financing constraints. As companies are included in the ESG rating report, agency costs and financing constraints are significantly reduced, and both of these reductions have a significant role in promoting the total patents and invention patents. This demonstrates our hypothesis that ESG rating promotes corporate innovation through signaling and

enhanced oversight.

Based on the previous research results, we put forward several suggestions for regulatory, third-party rating agencies and enterprises. For regulators, the promotion of corporate innovation by third-party rating agencies' release of corporate ESG information should be fully affirmed. Regulatory agencies at all levels should continue to promote the implementation of ESG policies, continuously guide listed companies to disclose ESG data, and promote relevant research institutions to carry out ESG research and publication. On the one hand, it is necessary to urge or compel listed companies to disclose ESG information and indicators to ensure that rating agencies have sufficient and authentic raw ESG data and expand the coverage of ESG rating. On the other hand, it is necessary to increase the guidance and support for local third-party ESG rating agencies, and build standardized industry norms and a diversified rating system as soon as possible.

For third-party rating agencies, they should be aware that the ESG rating market is still in its infancy, and continue to iterate ESG rating standards, tools and methodologies to meet the needs of different investors. On the one hand, third-party rating agencies should closely follow policy guidance, draw on mature international systems to continuously iterate industry methodology, and improve the reliability and authority of output to form a competitive advantage. On the other hand, on the basis of fully absorbing international experience, the localization and diversification of ESG rating standards should be done well, and a rating system that meets the different needs of investors should be produced, so as to form more sufficient barriers to competition and help companies achieve sustainable development.

For enterprises, they should recognize the positive effects of ESG rating and continuously disclose more detailed quantitative data to improve the efficiency of information transmission. The positive signals sent by enterprises to the outside world through ESG information disclosure effectively alleviate the financing constraints and agency costs faced by enterprises. However, more attention to enterprises also means that negative information about enterprises is more likely to be mined. Therefore, enterprises need to continue to

standardize their own business methods and improve the quality of information disclosure in order to achieve the growth of enterprise performance.

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