

# *A Study on the Impact of ESG Ratings on the Innovation Capability of Chinese-Listed Companies*

Chen Chang<sup>1,a,\*</sup>

<sup>1</sup>*Department of Global Studies, Sophia University, Tokyo, Japan*  
*a. changchen0201@163.com*

*\*corresponding author*

**Abstract:** According to the report "Global Innovation Index 2023" released by the World Intellectual Property Organization (WIPO), China's global innovation index (GII) ranks 12th, indicating that the government must speed up the construction of the technological innovation system. Enterprises also need to increase investment in innovation. At the same time, enterprises inevitably face the issue of sustainable development. ESG rating is an indicator to measure the ability of sustainable development and the potential of enterprises. In recent years, the Chinese government has advocated a new concept of high-quality development, which is positively aligned with the ESG concept. However, some companies also believe that the ESG concept is a policy requirement and rule limitation and cannot improve the competitiveness of the enterprise. At the same time, domestic scholars lack research on ESG, mainly on the relationship between ESG and financial indicators. This article selects listed companies from 2013 to 2022 as research samples to study the relationship between ESG ratings and patent applications, conduct regression analysis, and clarify the positive effect of ESG indicators on the innovation ability of enterprises. At the same time, heterogeneity testing is conducted for different market sizes, and this promoting effect is more significant for large-scale enterprises. The conclusion provides direction for further promoting the implementation of ESG concepts in enterprises. The government, society, and enterprises should all play their roles to jointly promote the high-quality development of enterprises.

**Keywords:** ESG rating, innovation, patent, high-quality development

## **1. Introduction**

Looking back at 2023, the world situation was characterized fiercely by complexity and competition, and the global economic recovered slowly with insufficient momentum. The global industry chain was seriously threatened and trade frictions were increasing. At the same time, the global technological revolution, industry transformation, and upgrading provided new opportunities for the development of the world. Among them, China has made many innovative achievements in artificial intelligence, the digital economy, new energy, and other aspects that have received the attention and recognition of many countries worldwide. However, according to the report, "Global Innovation Index 2023" released by the World Intellectual Property Organization (WIPO), China's global innovation index (GII) ranks 12th, down one place from last year, indicating that the government must speed up the construction of technological innovation system. Enterprises also need to increase

investment in innovation and promote the transformation of innovation achievements into productive forces.

There is no doubt that with rapid development, enterprises inevitably face the issue of sustainable development. In 2004, the United Nations Global Compact released a report "WHO CARES WINS", which formally put forward the concept of "ESG" (Environment, Social, and Governance) and recommended that enterprises should focus on not only financial indicators but also long-term sustainable development from various aspects of environmental, social impact and corporate governance. Since then, international organizations, investment institutions, and other market players have continued to deepen their thinking on ESG and gradually formed a complete set of ESG concepts. As a specific and quantifiable indicator to measure the ability of sustainable development and potential of enterprises, ESG rating has received worldwide attention and recognition. International authoritative rating agencies such as KLD, MSCI, and S&P Dow Jones have put forward their ESG evaluation indicators to assess whether enterprises meet sustainable development goals.

In China, the ESG concept is still in the exploratory stage. The Chinese government has advocated a new concept of high-quality development and promoted emission reduction measures actively in recent years. A series of laws and regulations have also been formulated to encourage enterprises to pay more attention to social responsibility and require enterprises to establish a reasonable governance structure that is positively consistent with the concept of ESG. China pledged to strive to peak carbon emissions before 2030 and achieve carbon neutrality before 2060 at the General Debate of the seventy-fifth session of the United Nations General Assembly. However, enterprises have not yet unified their understanding of the ESG concept. Some enterprises believe that good performance of ESG factors can improve corporate image and competitive power as an intangible asset. Some enterprises hold a pessimistic view of ESG. They believe that ESG affects the development of enterprises, and they have to accept the concept passively because of the disclosure requirements of policies and regulations.

In addition, the research on ESG in China is insufficient, domestic scholars mainly focus on the relationship between ESG and financial indicators, while few studies have explored the impact of ESG indicators on enterprises' innovation ability from an empirical perspective. This paper explores the analysis of ESG rating on the output of innovation capability and distinguishes the impact of different sizes of enterprises, based on the real situation of enterprises.

## 2. Literature Review

### 2.1. The value of ESG

In 2006, the United Nations Principles for Socially Responsible Investment (UNPRI) put forward the "Principles for Responsible Investment (PRI)", which makes environmental, social, and governance factors essential indicators to measure the ability of sustainable development and ESG investment became an important investment strategy. External investors can evaluate the investment risk, and sustainable development level and measure the contribution of enterprises to social development through ESG indicators [1].

Generally speaking, E of ESG means rational use of resources, degradation, and treatment of pollutants, concern about climate change, and protection of biodiversity. S emphasizes social responsibility, such as paying attention to vulnerable groups, poverty alleviation, charity activities, employee welfare and health, and community public interest input. G is from the perspective of corporate governance, including business ethics, information transparency, ownership structure, and other factors. A series of high standards should be set to promote the unity of the three [2]. ESG investments mostly focus on the European market and use a negative screening approach, where portfolio companies must meet certain criteria [3]. ESG helps companies achieve competitive

advantage, improve operational efficiency, and enhance reputation, which is the consensus of most companies [4]. According to the stakeholder theory, ESG improves reputation and can attract more investors, such as institutional investors in the stock market, can be recognized by stakeholders, and can bring new business directions and investment opportunities for enterprises [5]. ESG concept can also improve the efficiency of rational allocation of resources. An enterprise's performance of ESG can alleviate financing constraints by obtaining support from relevant stakeholders, restrain resource mismatch, and provide enterprises with enough space and favorable conditions for R&D activities [6].

## **2.2. ESG and financial indicators**

Through the research of scholars, it is found that the role of ESG is not only reputation but also closely related to financial indicators. In terms of enterprise value, the improvement of the ESG index can reduce the financing pressure and capital cost so that the improvement effect of Tobin's Q is obvious [7]. Good ESG performance is conducive to easing corporate financial risks and thus enhancing corporate value [8]. By examining the research results of about 2,200 previous researchers on ESG and corporate value, about 90% of studies have concluded that there is a positive relationship between those two and that this facilitation relationship is stable enough to be tested over time [9].

However, some scholars also have different views. According to the relevant data of European enterprises from 2002 to 2014, the three dimensions of ESG indicators are significantly negatively correlated with enterprise value [10]. There is no significant correlation between ESG ratings and portfolio returns [11]. The data during the COVID-19 could not prove that the ESG performance of Japanese companies is related to stock returns [12]. Moreover, this effect of ESG has a threshold effect that does not apply to all enterprises, only when ESG performance reaches a certain level can have a positive impact [13]. Compared with the positive promotion effect, negative ESG events have a more significant impact on the company, causing the company's market value to fall, while the effect of positive events on earnings is almost negligible [14]. When companies announced their participation in greenhouse gas emission reduction plans, the market reaction was mostly pessimistic and the market return rate also had an inverse effect [15]. In China, the financial performance of companies that received green company awards lagged behind those that did not [16].

## **2.3. ESG and innovation**

There is no doubt about the importance of innovation to improve competitive advantage [17]. Innovation helps to discover new business opportunities and, like brainstorming, inspires more technological solutions [18]. According to the stakeholder theory, the practice of ESG can stimulate the innovation ability of enterprises through the guidance of policies, institutions, and legal provisions [19]. Employees in the new era have high requirements for a corporate atmosphere and corporate governance environment, and attracting talent is also the key to innovation [20], the spillover effect of knowledge improves the innovation ability of enterprises [21]. ESG performance can increase the company's investment in innovation activities, thereby improving the company's profitability [22]. The importance of ESG is to promote the formation of enterprise innovation mechanisms [23], which is reflected in the technological change of enterprises. ESG rating can reflect the level of enterprises to green development and promote green technology innovation [24]. Continuous innovation can gain a leading edge in the complex and changing market environment to achieve long-term development. However, other effects of ESG cannot be ignored. For example, according to the value of cash holding, enterprises must reserve enough cash to cope with the main business in the future aiming to help enterprises increase R&D investment and improve technological innovation level, but the

improvement of ESG will inevitably lead to cash shortage [25]. The relationship between ESG and innovation ability has not been unified.

### 3. Methodology

#### 3.1. Research hypotheses

The number of patent applications is a quantitative index used to measure the innovation capability of an enterprise, reflecting the output efficiency of the enterprise's R&D investment. More patent applications represent that the product is non-duplicated and irreplaceable, indicating that the comprehensive strength and potential of the enterprise are beyond that of other competitors. Enterprises with good ESG performance can gain the attention and recognition of stakeholders such as governments and organizations, find new business opportunities and partners and obtain special financial support and advanced technology guidance more easily, promote product innovation and transformation. Given the above analysis, this paper posits the following hypotheses to identify the impact of ESG rating.

H1: The improvement of ESG rating has a positive impact on the increase in the number of patent applications.

If hypothesis 1 is true, it indicates that the improvement of ESG indicators has a promoting effect on innovation ability. However, whether is there the same impact on all the companies considering the different circumstances of each enterprise, such as the scale, economic growth cycle, and nature. Large-scale enterprises enjoy more capital advantages, a higher level of staff, and a mature management system. The difficulty of improving ESG indicators should be less and the output capacity of innovation should be better than that of small and medium-sized enterprises. High-quality innovation results will bring higher returns to enterprises, forming a virtuous circle. So here is the second hypothesis.

H2: The ESG index increases the number of patent applications of large enterprises more significantly than that of small enterprises.

#### 3.2. Data source

At present, only listed companies are required to disclose ESG information, so this paper selects listed companies from 2013 to 2022 as research samples, and carries out the following screening: exclude ST and ST\* companies; exclude real estate and financial companies; eliminate data anomalies and missing samples of major indicators. To eliminate the effect of extreme values, 1% and 99% horizontal indentation were performed for continuous variables. Finally, 29,920 sample observations were obtained. The ESG rating comes from the Huazheng database (It constructs the industry weight matrix according to the industry characteristics of listed companies to realize the use of different index systems for different industries); enterprise innovation patent data from Chinese Research Data Services Platform; other explanatory variables and control variables were obtained from the CSMAR enterprise database. Data processing and model estimation were performed using Stata17.0 software.

#### 3.3. Explanatory variables, explained variables, control variables, fixed variables

(1) The explained variable is the number of patent applications annually (PATENT). Considering that many patent applications are 0 and the number distribution presents a thick tail. To increase the accuracy of the result, the natural logarithm of the number of patent applications is taken after adding 1.

(2) Explanatory variables: The ESG rating of Huazheng not only considers the actual situation of China's capital market but also combines the evaluation framework of mainstream ESG abroad. It is

the most authoritative ESG rating agency in China at present. The ratings are C, CC, CCC, B, BB, BBB, A, AA, and AAA from low to high, respectively. C rating means ESG equals 1; B rating means ESG equals 4; A rating means ESG equals 7.

(3) Control variables: Referring to relevant literature and considering research needs, asset-liability ratio, return on assets, ownership concentration, the company's size, and Tobin's Q value are taken as control variables.

Asset-liability ratio (LEV): This indicator is used to measure the ability of enterprises to repay debts. Generally speaking, 40%-60% is more appropriate, but there are differences due to the nature and regions of the enterprise.

Return on assets (ROA): also known as return on assets, is used to measure how much net profit per unit of assets created, is used to measure the profitability of enterprises. It is generally believed that between 10% and 20% is more appropriate.

Ownership concentration (FHOLD): It can be used to measure the distribution of the company's ownership and the strength of the company's stability. Generally, the first shareholder accounts shares for more than 30%, which is considered concentrated. The excessive concentration of equity leads to the formation of an unreasonable equity structure, which makes the conflict between the major shareholders and the minority shareholders more obvious.

Company size (SIZE): Considering the large difference in asset size between different enterprises, to make this empirical analysis more targeted, the logarithm of the total assets of the enterprise is taken.

Tobin's Q value (TQ): This index is the ratio of the market value of the company to the replacement cost of its assets, which is used to measure whether the market value of the asset is overvalued or undervalued. It is one of the important indicators used to measure the value of the enterprise. If Tobin's Q value is greater than 1, indicating that the market is optimistic about the future development prospects of this enterprise.

(4) Fixed effect: Year, Industry as fixed effects.

### 3.4. Model

$$Patent_{i,t} = \alpha_0 + \alpha_1 ESG_{i,t} + \sum controls_{i,t} + \sum ind + \sum year + \varepsilon$$

### 3.5. Heterogeneity study

If hypothesis 1 can be turned out, then the firm size should be classified. If the firm size is greater or equal to the average size of the sample, the firm is a large firm, regarding others as small firms. To compare the influence of ESG performance on the quantity of innovation output in enterprises of different sizes, heterogeneity research is conducted according to this classification.

## 4. Results

### 4.1. Descriptive statistics

Through the analysis of 29,920 samples, it can be seen that there are great differences in the number of patent applications and ESG rating of Chinese listed enterprises from Table 1. Specifically, the minimum value of the number of patent applications is 0, the maximum value is 5.333, the standard deviation is 1.296, the average value is 0.833, and the median is 0, indicating that a large part of enterprises did not apply for any patent in some years, and also shown that less than half of enterprises reached the industry average level. As for the ESG score results, the median is 4 and the average is 4.108, indicating that most enterprises' ESG ratings are concentrated in B or BB, and the two-level

differentiation is significant because the minimum value is 1, the maximum value is 6, and the standard deviation equals to 1.081.

As for asset-liability ratio, most firms' debt-to-asset ratios were within a reasonable range (mean is 0.406, median is 0.397), although some firms' debt-servicing capabilities varied widely (minimum and maximum is 0.0546 and 0.898, respectively, with a standard deviation of 0.2).

A profitability indicator—ROA ranges from -0.266 to 0.203, the average and median are 0.0373 and 0.0387, respectively, with little difference, and the standard deviation is 0.0654. The majority of enterprises have a low ability to use assets to obtain profits and there is a lot of room for improvement.

In terms of corporate structure, the shareholding ratio of the largest shareholder in most enterprises is concentrated at 30%-35%, with little difference between the average and the median, and the maximum value is 0.736, which exceeds the minimum value by 65%, indicating that the largest shareholder has a larger right to control and the difference in the shareholding concentration is obvious.

The minimum value of enterprise size is 19.94, the maximum is 26.15, the median and average are around 22, and the standard deviation is 1.267, reflecting that the sample enterprises' asset size is relatively large, although companies experience different life cycles.

Tobin's Q value is an important index to measure the market value of assets. The minimum value is less than 1, the maximum value is nearly 9, the median value is 1.658, the average value is 2.096, and the standard deviation is 1.37. To some extent, it means that most enterprises have good market competitiveness and future development potential. The data shows that the investors hold an optimistic attitude towards the development of those companies.

Table 1: Sample statistics.

Variable	N	Mean	Min	p50	Max	SD
PATENT	29920	0.833	0	0	5.333	1.296
ESG	29920	4.108	1	4	6	1.081
LEV	29920	0.406	0.0546	0.397	0.898	0.200
ROA	29920	0.0373	-0.266	0.0387	0.203	0.0654
FHOLD	29920	0.336	0.0848	0.313	0.736	0.147
SIZE	29920	22.20	19.94	22.02	26.15	1.267
TQ	29920	2.096	0.850	1.658	8.929	1.370

## 4.2. Correlation analysis

Table 2 shows that there is a positive correlation between the number of patent applications and the ESG rating of the sample (correlation coefficient is 0.162 with a 1% level of significance) indicating that hypothesis 1 is likely to be supported and that further regression analysis is needed. The correlation coefficients of other control variables, such as asset-liability ratio, ROA, equity concentration, company size, and patent applications statistically significant at a 1% level. However, Tobin's Q has a negative correlation with the number of patent applications and the coefficient is -0.119. For all variables, the correlation coefficient is less than 0.5, indicating that the relationship is weak and will not cause significant interference to the regression results. The result meets the requirement.

Table 2: The correlation among all variables.

	PATENT	ESG	LEV	ROA	FHOLD	SIZE	TQ
PATENT	1						
ESG	0.162***	1					
LEV	0.184***	-0.131***	1				
ROA	0.032***	0.236***	-0.359***	1			
FHOLD	0.070***	0.102***	0.022***	0.147***	1		
SIZE	0.470***	0.167***	0.472***	0.016***	0.181***	1	
TQ	-0.119***	-0.102***	-0.216***	0.131***	-0.109***	-0.362***	1

*t statistics in parentheses*

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

### 4.3. Multicollinearity analysis

To prevent collinearity effect between variables which makes regression coefficients unreliable, introduced multicollinearity analysis. As can be seen from Table 3, the VIF values between explanatory variables and control variables are all less than 10, the tolerance is greater than 0.1. Thus, it can be seen that the variables in this study do not have multicollinearity problems and will not affect the accuracy of the main empirical results.

Table 3: Multicollinearity affects results.

Variable	VIF	1/VIF
ESG	1.20	0.834214
LEV	1.80	0.555043
ROA	1.34	0.747944
FHOLD	1.17	0.857920
SIZE	1.91	0.523875
TQ	1.38	0.724979
Mean VIF	3.29	

### 4.4. Regression analysis

The Table 4 result is obtained through regression analysis. According to the basic result analysis, the regression coefficient between ESG and R&D output of enterprises is 0.0803 at the significance level of 1%. It represents that the upgrade of ESG rating has a positive promoting effect on the number of patent applications, indicating that ESG significantly promotes the innovation ability of enterprises. Hypothesis 1 is true.

Table 4: Basic regression results.

	(1)
	PATENT
ESG	0.0803***
	(12.74)
LEV	-0.2176***
	(-5.21)
ROA	-0.4533***
	(-4.12)

Table 4: (continued).

FHOLD	0.1460***
	(3.19)
SIZE	0.5613***
	(82.77)
TQ	0.0685***
	(12.84)
_cons	-12.2803***
	(-73.56)
Industry	YES
Year	YES
N	29920
r <sup>2</sup> _a	0.3105
F	150.6702
p	0.0000

*t* statistics in parentheses

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

#### 4.5. Robustness test

A robustness test is used to check whether the results obtained from the model are accurate and reliable. There is a large number of 0 in patent application data, which has the characteristics of truncated data, so the Tobit model is used for further testing. As can be seen from Table 5, at the significance level of 1%, the ESG index still has a positive promoting effect on patent applications, so more accurate model fitting results are obtained, proving that such a promoting effect still exists.

Table 5: Robustness test results (Tobit model).

	(1)
	PATENT
ESG	0.0737***
	(13.33)
LEV	-0.2293***
	(-6.26)
ROA	-0.5025***
	(-5.21)
FHOLD	0.1514***
	(3.77)
SIZE	0.4934***
	(82.86)
TQ	0.0682***
	(14.56)
_cons	-10.7992***
	(-73.68)
Industry	YES
Year	YES
N	29920

Table 5: (continued).

r <sup>2</sup> a	0.3076
F	148.6547
p	0.0000

*t* statistics in parentheses

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

#### 4.6. Heterogeneity analysis

The above studies have demonstrated the positive impact of ESG on innovation output capacity. However, it is still doubtful whether improving the ESG index has the same promoting effect on different sizes of firms. Therefore, heterogeneity analysis is conducted. According to the statistical results, less than 50% of the enterprises in the sample are large-scale enterprises. As can be seen from Table 6, at the significance level of 1%, the correlation coefficient of large-scale enterprises is 0.1105, which is higher than that of small-scale enterprises (0.0376), indicating that the positive effect of the ESG index on patent applications is certain regardless of the scale. However, the promotion effect on the patent output of large-scale enterprises is more prominent, meaning that the improvement of the ESG index has a more significant impact on the innovation output capacity of large-scale enterprises than that of small-scale enterprises.

Table 6: Heterogeneity results.

	(1)	(2)
	BIG	SMALL
	PATENT	PATENT
ESG	0.1105***	0.0376***
	(10.30)	(5.51)
LEV	-0.4194***	-0.0513
	(-5.33)	(-1.21)
ROA	-0.2282	-0.0002
	(-1.01)	(-0.00)
FHOLD	0.3462***	-0.2676***
	(4.57)	(-5.20)
SIZE	0.7499***	0.3415***
	(54.93)	(25.59)
TQ	0.0034	0.0292***
	(0.28)	(5.51)
_cons	-16.9400***	-7.1384***
	(-48.99)	(-23.95)
Industry	YES	YES
Year	YES	YES
N	13600	16320
r <sup>2</sup> a	0.3474	0.0789
F	85.1941	16.8811
p	0.0000	0.0000

*t* statistics in parentheses

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

## 5. Discussion

### 5.1. Data interpretation

Through the analysis, the following two conclusions can be drawn:

- (1) The improvement of the ESG index has a significant improvement on the innovation ability of enterprises. The higher the ESG, the more patent output.
- (2) This promotion effect is more significant for large-scale enterprises.

### 5.2. Reason analysis

Based on empirical research, enterprises enhance their reputation by practicing ESG behavior and disclosing ESG information to the public and society. The ESG concept provides enterprises with new ideas and methods for sustainable development, which helps enterprises enhance competitiveness and industrial transformation.

(1) Effect of talent aggregation: A high ESG rating indicates that enterprises pay more attention to employee well-being and career development, it is easier to obtain the value recognition of outstanding talents, forming the talent aggregation effect, promoting the flow, sharing, and transformation of knowledge within enterprises, forming a virtuous circle. The growth of high-quality talent teams helps enterprises break technical barriers, improving enterprise innovation efficiency and scientific research output.

(2) Long-term investment value: According to the 2020 Rate the Raters report, more than 65% of investors use ESG scores as a reference to evaluate business performance. Following the trend of world development, investors prefer to invest in companies with long-term value, companies with better ESG performance, development potential, and little financial pressure. It can attract financial support from banks and the public, reduce financing costs and time constraints, and make it easier to obtain patent output and innovation results.

(3) Reduce risks: Enterprises with good ESG performance show that the standard of behavior and decision-making mechanism are more standardized, they will try their best to avoid R&D projects with high risk and uncertainty, reduce R&D costs and unnecessary waste of resources that improve innovation efficiency.

However, it is also worth noting that the effect of this positive promotion effect is different among different enterprises. It is easier for large-scale enterprises to obtain patent output if they improve the ESG index, because the improvement of ESG requires capital investment, and technical support, while most small-scale companies are in the growth stage with limited resources, technology, experience, and so on, almost they have no say and influence. There is no way to form a scale economics effect, especially since it is difficult to balance the limited resource allocation problem, and can only pay more attention to the main business and corporate profits. Besides, a patent application usually has a hysteresis effect; it takes several years of research to get the output results, while most small enterprises are in the growth process. There are too many uncertain factors that fluctuate greatly, to some extent, the promotion impact of ESG for small-scale enterprises is limited. In addition to this, compared with small enterprises, large enterprises practicing ESG concepts are easier to get attention from the outside society, can attract high-quality partners, establish stable cooperative relations, and obtain more patent output.

### 5.3. Case analysis

ESG ratings have been attached to importance by more and more Chinese enterprises, among which Jingdong Logistics Co., LTD performs best.

In terms of environment, Jingdong Logistics was the first firm to build a "green supply chain" and strive to drive the low-carbon transformation of the supply chain. In 2017, the "Green Flow Plan" was launched, aiming to focus on green sustainable development in collaboration with the three aspects of "Planet", "People" and "Profits" by industry and social forces. Jd Logistics took the lead in promoting renewable energy and environmentally friendly materials packaging; systematically used green transportation modes such as new energy vehicles and driverless vehicles; constructed the first "zero-carbon" logistics park in China; the first to issue the "Carbon neutral Guide for logistics Parks" successfully.

Concerning social responsibility, Jingdong Logistics actively fulfilled its social responsibility: engages in public welfare undertakings, pays attention to vulnerable groups, participates in rural revitalization and people's livelihood construction, promotes community and industrial development, builds rural logistics system, strengthens infrastructure and forms a virtuous cycle of urban and rural consumption and resource circulation. At present, Jingdong Logistics has served more than 1,000 industrial belts in the country.

As regards corporate governance, JD Logistics signed standardized labor contracts with all front-line employees, providing stable income, so that employees can enjoy a better life and career development space. In November 2022, JD Logistics upgraded its structure and established an ESG Management Committee formally to improve the accountability mechanism of the board of directors and senior executives for ESG matters.

In 2022, JD Logistics participated in the S&P CSA score for the first time (the Corporate Sustainability Assessment initiated by S&P Global, which mainly measures the performance of enterprises in ESG), ranking among the best global logistics enterprises with 47 points. It also received full marks in 17 subcategories of the rating. In 2023, JD Logistics' S&P CSA rating rose to 52 points, leading 87% of the world's transportation companies.

## **6. Conclusion**

### **6.1. Summary of research methods and conclusions**

Through empirical research, this paper confirms the positive effect of the ESG index on the innovation ability of enterprises, and this effect is more significant in large-scale enterprises.

### **6.2. Suggestions**

Through research, the improvement of enterprise ESG helps to improve the innovation ability of enterprises, promote industrial upgrading, and enhance overall competitiveness. Therefore, we should vigorously develop ESG construction.

(1) The government should speed up the construction of a complete ESG system, establish a unified ESG standard, strive to combine the implementation of ESG with national goals and policies, and publicize the positive impact of ESG. At the same time, the state should advocate for society and enterprises to look at the problem from the perspective of long-term development; in the meantime, the government should also accelerate the construction of scientific and technological innovation systems and continue to improve our country's national innovation ability.

(2) China should encourage financial institutions, research departments, and regulatory agencies to play a role together to create a good environment and favorable conditions for the development of ESG and innovation ability. Given the inconveniences of SMEs in the practice of ESG, the government should provide appropriate support and help; financial institutions should strengthen financial support. Accordingly, more tax relief policies, more relaxed and long-term loan support; universities and research institutions should share advanced experience and technology, and train key talents.

Enterprises should also realize the importance and necessity of ESG, and disclosure ESG information proactively. To be specific, large enterprises should continue to promote the construction of ESG actively in a leading role. Large enterprises should participate in public welfare and charity projects, pay attention to vulnerable groups, protect the rights and interests of employees, and improve the corporate governance structure. At the same time, they should unite small enterprises to build an enterprise development ecology in which large and small enterprises are interdependent and mutually promoting, enhance the resilience and competitiveness of the industrial chain and supply chain, create more cooperation opportunities, invest more in research and development program and increase innovation output.

Small enterprises can also unite to form a cluster effect and jointly explore the ESG development mode, which is suitable for small and medium-sized enterprises. Small enterprises should be encouraged to update product production mode, enhance process innovation ability, and improve corporate governance and technological innovation efficiency. Industrial cooperation between enterprises works together to improve the efficiency of industrial organization and drive overall high-quality development.

### 6.3. Contribution

"Drawing on current trends and international standards, and supported by 10 years of data and empirical evidence, this paper demonstrates the positive impact that Environmental, Social, and Governance (ESG) practices can have on enterprise innovation and competitiveness. Specifically, the paper provides evidence that ESG practices can enhance enterprise innovation output, as measured by patent production, and contribute to improved competitiveness in the global market. This research offers valuable insights for enterprises seeking to embrace ESG practices as a means of improving their innovation capabilities, corporate image, and overall performance. The implications of these findings are significant for enterprises, as well as for government and societal stakeholders, as they highlight the crucial role of ESG practices in driving sustainable and high-quality development.

### 6.4. Limitation

Firstly, the sample selection of this paper excludes financial and real estate enterprises, which cannot completely represent all enterprises. Secondly, the overall rating of ESG is adopted in this paper, in the future, I will try to use E, S, and G ratings respectively for specific analysis. Finally, future studies should carry out more heterogeneity analysis, such as according to the nature of the industry, to obtain more specific and accurate results.

### References

- [1] Naeem M A, Yousaf, I., Karim S, et al. (2023). *Comparing Asymmetric Price Efficiency in Regional ESG Markets before and during COVID-19. Economic Modelling.* 106095, 118.
- [2] Ferrell A, Liang H, L R. Ferrell A, Liang H, Renneboog L. (2016). *Socially responsible firms. Journal of financial economics.* 122(3), 585-606.
- [3] A.Dyck, K.V. Lins, L. Roth, H.F. Wagner. (2019). *Do institutional investors drive corporate social responsibility? International evidence. Financ. Econ.* 131, 693-714.
- [4] Aouadi A, Marsat S. (2018). *Do ESG Controversies Matter for Firm Value? Evidence from International Data. Journal of Business Ethics.* 151(4), 1027-1047.
- [5] Qureshi M A, Kirkerud S, Theresa K, et al. (2020). *The impact of sustainability (environmental, social, and governance) disclosure and board diversity on firm value: The moderating role of industry sensitivity. Business Strategy and the Environment.* 29(3), 1199-1214.
- [6] Binghong Lin, Bingxiang Li. (2023). *The impact of ESG responsibility Fulfillment on Enterprise R&D investment: from the perspective of Resource Acquisition and resource allocation. Soft Science.* 04, 1-12.

- [7] WONG W C, BATTEN J A, AHMAD A H, et al. (2020). Does ESG certification add firm value? *Finance Research Letters*. 39, 101593.
- [8] Linlin Wang, Yonghui Lian, Jie Dong. (2022). Research on the mechanism of ESG Performance. *Securities Market Review*. 5, 23-24.
- [9] Friede G, Busch T, Bassen A. (2015). ESG and financial performance: aggregated evidence from more than 2000 empirical studies. *Journal of Sustainable Finance & Investment*. 5(4), 210-233.
- [10] Sassen R, Hinze A K, Hardeck I. (2016). Impact of ESG factors on firm risk in Europe. *Journal of business economics*. 86, 867-904.
- [11] G.Halbritter, G. Dorfleitner. (2015). The wages of social responsibility—where are they? A critical review of ESG investing. *Rev. Financ. Econ.* 26, 25–35.
- [12] Takahashi, K. Yamada. (2021). When the Japanese stock market meets COVID-19: impact of ownership, China and US exposure, and ESG channels. *Int. Rev. Financ. Anal.* 74, 101670.
- [13] Nollet J, Filis G, Mitrokostas E. (2016). Corporate social responsibility and financial performance: A non-linear and disaggregated approach. *Economic Modelling*. 52, 400-407.
- [14] Capelle-Blancard G, Petit A. (2019). Every little helps? ESG news and stock market reaction. *Journal of Business Ethics*. 157(2), 543-565.
- [15] Fisher-Vanden, K., Thorburn, K. S. (2011). Voluntary corporate environmental initiatives and shareholder wealth. *Journal of Environmental Economics and Management*. 62, 430-445.
- [16] Lyon, T., Lu, Y., Shi, X., Yin, Q. (2013). How do investors respond to green company awards in China? *Ecological Economics*. 94, 1-8.
- [17] Blichfeldt, H., Faullant, R. (2021). Performance effects of digital technology adoption and product & service innovation—a process-industry perspective. *Technovation*. 105, 102275.
- [18] Wales, W.J. (2016). Entrepreneurial orientation: a review and synthesis of promising research directions. *Int. Small Bus.* 34, 3-15.
- [19] R.E. Freeman, R.A. Phillips. (2002). Stakeholder theory: a libertarian defense. *Bus. Ethics Q.* 12, 331–349.
- [20] C.K. Ho. (2005). Corporate governance and corporate competitiveness: an international analysis. *Corp. Govern.* 13, 211–253.
- [21] Xiao-Na Yin, Jing-Ping Li, Chi-Wei Su. (2023). How does ESG performance affect stock returns? Empirical evidence from listed companies in China. *Heliyon*. 9, e16320.
- [22] Tianhang Xue, Qin Guo, Wen Xiao. (2022). The mechanism and empirical study of ESG's influence on enterprise value in the context of dual-carbon targets. *Social Science Front.* 11, 89-99.
- [23] Broadstock D C, Matousek R, Meyer M, et al. (2020). Does corporate social responsibility impact firms' innovation capacity? The indirect link between environmental & social governance implementation and innovation performance. *Journal of Business Research*. 119, 99-110.
- [24] Yunmeng Zhang. (2021). Corporate ESG performance, financing constraints, and green technology innovation. *Business Accounting*. 11, 33-39.
- [25] Yuan Chang, Yongpeng Zeng, Shunchun Huang. (2022). Cash holdings, R&D investment and high-quality development of firms: An analysis based on the mediation effect and panel threshold model. *East China Economic Management*. 6, 58-67.