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Research article

Research on the Influence of ESG Performance on B YD's Innovation Ability

Linyun Deng[1] ZhiMei Deng[1] Yanying Wei[1]*

1.Nanning University

*Corresponding author: Yanying Wei

Statement:

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ABSTRACT

With the acceleration of the global economic integration process and the continuous development of information technology, the competition among automobile enterprises is becoming increasingly fierce, and innovation is becoming the main theme of the survival and development of automobile enterprises.Innovation is a necessary way for automobile enterprises to enhance their core competitiveness, which can help them improve their production and management capabilities and form sustainable long-term competitive advantages.The automobile industry of our country has also entered a new stage of the development of the automobile industry, and the objective needs of the upgrading of the automobile industry have higher requirements for the innovation ability of our automobile enterprise.This paper discusses the impact of ESG (environmental, social and governance) performance on BYD's innovation ability.By collecting indicators such as R&D investment and number of professional applications of BYD Auto from

2013 to 2022, and using Eview12.0 software, the relationship between ESG performance and enterprise innovation ability is analyzed.The research results show that ESG performance has a significant positive impact on BYD Auto's innovation ability.The results of this paper are helpful for enterprises to deeply understand the relationship between ESG performance and enterprise innovation ability, and provide reference for enterprises to formulate sustainable development strategy.

Keywords: ESG; Sustainable development; Innovation capability

Introduction

Research background

Driven by economic globalization and sustainable development, the competition among various countries is becoming more and more fierce. In such an international market environment, China must carry out scientific and technological innovation if it wants to enhance the comprehensive national strength and international status and gain the initiative of the market.

In recent years, with the increasing importance of corporate social responsibility and sustainable development, the concept of ESG has become increasingly widely accepted by all industries. ESG is the abbreviation of Environmental (environment), Social (society) and Governance (governance). It is a new development concept of enterprises comprehensively considering environmental, social and governance issues in their business development strategy. It is the main focus and effective tool to promote high-quality economic development. Enterprises with good ESG performance usually pay more attention to improving the internal governance level and improving the incentive and supervision mechanism. By strengthening the incentive and restraint of senior executives, they can effectively reduce the short-sighted behavior of senior executives, enhance the risk tolerance of senior executives, make innovative decisions to realize the sustainable and healthy development of enterprises, and promote enterprise innovation.

Research meaning

Today, the concept of green and environmental protection is prevalent around the world. As an emerging market country, China is facing increasingly stringent requirements from the international community. ESG, driven by the new development concept, the information disclosure system pays attention to the environmental protection and social responsibility of enterprises, but also takes into account the information of corporate governance. Can it really promote the long-term development of enterprises, improve the production and operation efficiency of

enterprises and get extensive social support from the government? Studying the relationship between corporate ESG performance and corporate innovation can provide a partial answer to this question.

From the perspective of investors, ESG has attracted wide attention from investors, who are gradually investing their capital in companies that perform well in ESG in the hope of achieving higher investment returns. As a leader in China's auto industry, its ESG performance is also closely watched. For enterprises, innovation ability is the key factor to ensure that they maintain their leading position in the competitive market environment, maintain the competitive advantage, and achieve sustainable development. Therefore, it is of great significance to study the impact of ESG performance on the innovation ability of BYD automobile enterprises.

Research status, both at home and abroad

Under the advocacy of ESG concept, the academic discussion and research on ESG have gradually emerged. Although the number of relevant empirical studies in China is relatively small, the existing literature generally supports a positive association between ESG and enterprise innovation. In her research, Lu Xiaoqing (2022) discussed the impact of corporate social responsibility on corporate innovation from multiple dimensions, and found that enterprises actively fulfilling social responsibility can significantly promote innovation activities[1]. Ni Guoai (2021) explored this and revealed that ESG performance has an improvement effect on the innovation ability of enterprises[2]. At the level of corporate governance, Zhen Caixia (2022) proposed the correlation between executive incentive and the innovation efficiency of enterprises, and believed that appropriate incentive measures can improve the innovation efficiency of enterprises[3]. In addition, the study of Quan Xiaofeng et al. (2019) revealed the positive correlation between executives' military experience and enterprise innovation, and found that the military time and rank were positively correlated with the degree of innovation of enterprises[4]. These studies provide a new perspective and empirical evidence for understanding the relationship between ESG and enterprise innovation.

ESG has been discussed abroad for more than 30 years. In recent years, scholars have analyzed the influence of ESG on the value and performance of enterprises. Wong W C，Batten J A，Ahmad A H，Mohamed－Arshad S B，Adzis A A.(2021) Through empirical analysis, it is found that ESG will reduce the capital cost of enterprises, and the enterprise value will also be significantly improved[5]. In terms of ESG and enterprise innovation research, TanY, Zhu Z (2022) studied the relationship between ESG and high-quality development of enterprises, and found that enterprise innovation investment played an intermediary role in ESG in promoting high-quality development of enterprises[6].

The development of ESG evaluation system in China can be seen that the development of ESG system in China is later than the international ESG system. In the system construction, the foreign rating system also introduces diversified ESG rating system according to the actual situation of China. Various ESG evaluation systems at home and abroad have their own characteristics, and there are great differences in issue determination, index selection, weight calculation and model construction. At the same time, they are also different in practical application fields and scope. At present, there is no index with overall high global recognition, flexibility and application reliability. When exploring the economic impact of ESG performance, the academic focus is mainly focused on several key areas, such as enterprise value evaluation, financial performance analysis, and financing cost considerations. These studies reveal the important role of ESG performance on enterprises and their economic performance from different perspectives. Most of the existing literature discusses the relationship between performance in a certain dimension of environment, social responsibility and corporate governance and corporate innovation, and there are few studies on the impact of ESG comprehensive performance on enterprise innovation.

Concept definition and theoretical basis

concept definition

ESG expression

ESG performance covers the combined performance of enterprises in three core areas: their responsibility to the environment (Environmental), contribution and interaction to society (Social), and transparency and effectiveness of internal governance (Governance). This performance evaluation framework covers many key areas, including environmental protection practice, long-term strategic planning, shaping of brand reputation, cultivation of corporate culture, protection of employees' rights and interests, and optimization of corporate governance structure. This is an investment philosophy and standard for assessing their non-financial performance, focusing on the contribution of enterprises to promoting sustainable economic development and social responsibility.

As an evaluation tool, ESG evaluation provides investors with a window of in-depth insight into the risks and opportunities of enterprises, and then promote the sustainable development process of enterprises. More and more investors and enterprises begin to pay attention to ESG evaluation, including it into one of the considerations of investment and business decisions. At the same time, ESG assessment is also closely related to the important concepts of sustainable development such as carbon neutrality. The environmental performance of enterprises in ESG evaluation can reflect their efforts and achievements to achieve environmental goals such as carbon neutrality.

Enterprise innovation

Enterprise innovation refers to the process in which the enterprise introduces new thinking, new technology, new products or services, and new business models. The purpose of the innovation is to generate potential excess profits. Enterprises are the micro-subjects of innovation activities, and innovation is an important driving force for enterprises to meet the market demand, maintain lasting competitiveness, and promote the national economic development. Enterprise innovation is not only the core component of its management and development, but also the key driving force to

drive the continuous progress of enterprises and strengthen their market competitiveness. This innovative activity has distinct creative characteristics, accompanied by certain risks, but it also brings the advantages of efficiency, systematic and comprehensive. In addition, the enterprise innovation also emphasizes the timeliness and practicality, to ensure that the innovation results can keep up with the pace of The Times, and bring practical benefits to the enterprise.

The research of this paper is mainly for the innovation behavior of automobile enterprises, draw lessons from the existing research, in order to gain stronger competitiveness in the market and realize the maximization of enterprise value, enterprises actively put production factors into new products and new technology research and development, at the same time constantly optimize their own production and operation mode and management mode, and successfully developed new products and provide innovative services, this a series of comprehensive activities for automobile enterprise innovation.

Theoretical principle

Stakeholder theory

The stakeholder theory originated in western countries in the 1960s, and with the passage of time, it gradually gained wide recognition and development. The core of this theory is to emphasize that enterprise managers need to fully consider and balance the interests of different stakeholders in the operation process. Compared with the past management philosophy that overemphasizes the interests of shareholders, the stakeholder theory proposes a new perspective, which holds that the success of an enterprise is not only dependent on shareholders, but requires the active participation and contribution of all stakeholders. Therefore, enterprises should strive to maximize the overall interests of all stakeholders, rather than just focusing on the interests of a specific group, so as to ensure the long-term prosperity and sustainable development of the enterprise.

Based on the stakeholder perspective and signal transmission mechanism analysis,

high quality environment, society and governance (ESG) performance can significantly improve the enterprise for key stakeholders of credibility and trust, effectively reduce information barriers, reduce the agency cost of information asymmetry, and make enterprises easier to get the required resources to support. In order to achieve the long-term stability and sustainable development of the enterprise, the enterprise needs to comprehensively and deeply consider and take into account the interests and concerns of all stakeholders.

In the practice of optimizing the environment, society and corporate governance, enterprises not only meet the expectations of stakeholders, but also further deepen the cooperative relationship with them. This effort helps companies to build a positive brand image and thus win deeper trust and support from stakeholders. This trust and support is transformed into precious human resources, capital, knowledge and other resources, which provides a steady stream of power for the innovation and development of enterprises.

Sustainable development theory

Sustainable development theory, as a core concept, emphasizes fairness, persistence and inclusiveness as its cornerstone principles, and pursues a coordinated, fair, efficient and multi-oriented common development pattern. This theory has been specifically implemented and applied in the three key dimensions of economy, ecology and society. In the process of promoting economic sustainability, the sustainable development theory actively advocates economic growth. In terms of ecological sustainability, the theory of sustainable development emphasizes that the pace of economic construction and social development must be kept in harmony with the carrying capacity of nature.

In recent years, with the increasingly prominent environmental problems, national governments and international organizations have begun to attach importance to and formulate policies on environmental protection and sustainable development, and carry out overall planning and resource management. The ESG concept is also widely

seen as a goal shared by both stakeholders and businesses. This means that, while pursuing financial performance, enterprises must also give equal attention to non-financial performance, so as to comprehensively improve their sustainable development ability.

BYD auto ESG performance and the current quo of enterprise innovation ability

BYD's ESG performance

BYD has been prominently in ESG (environment, society and governance) in recent years. Byd focuses on the relationship between corporate ESG and high-quality development, thus improving its sustainable development ability. In the three dimensions of resource consumption, greenhouse gas emissions and pollutant emissions, the core density index has been greatly improved, showing BYD's active efforts in environmental governance. In order to achieve the goal of sustainable development, enterprises continue to promote low-carbon operations in the field of manufacturing and transportation through green innovation and other means.

Table 3-1 BYD ESG Performance score in 2013-2022

Unit: points

a particular year	ESG	E	S	G
2013	64.47	57.98	43.14	82.17
2014	71.17	65.55	55.85	84.37
2015	76.89	69.62	73.72	82.74
2016	76.44	69.62	73.47	81.92
2017	80.04	72.59	75.86	86.67
2018	79.71	72.59	80.7	82.68
2019	80.76	76.65	90.92	76.01
2020	83.46	76.65	91.15	81.75
2021	81.59	70.87	86.86	83.5
2022	82.43	75.39	83.47	86.33

[Data source] According to the relevant data of CSI ESG.

Table 3-1 Statistical analysis of BYD's ESG performance from 2013 to 2022 shows that its total ESG score has shown a steady growth over the past decade. From 64.47 points in 2013 to 82.43 points in 2022, a total increase of nearly 20 points, which is a

high score in the automobile industry, which is satisfied with the guidance of national policies and the importance of BYD automobile enterprises to sustainable development. The following is the analysis from BYD's official website and social disclosure report, BYD enterprises in the environment, social, governance achievements.

In terms of environment, it increased from 57.98 points in 2013 to 75.39 points in 2022, a total increase of 17.41 points. This is due to BYD's significant progress in the field of new energy vehicles in recent years, and its electric vehicle sales continued to grow, which has played a positive role in promoting green travel and reducing carbon emissions. In addition, BYD is committed to improving the efficiency of resource use, by optimizing the energy mix and actively promoting and applying renewable energy, and reducing the environmental impact. However, companies should also set an example, including possible waste and pollution emissions during the production process, to ensure that the negative impact on the environment can be effectively controlled while expanding the production scale.

On the social side, BYD has more than doubled from 43.14 points in 2013 to 83.47 points in 2022, with BYD focusing on employee welfare and community development. Enterprises actively fulfill their social responsibilities, participate in social public welfare undertakings, and support the local economic development. The score received the highest score of 91.15 in 2020, which is due to the new pneumonia epidemic in this year. At the important moment of fighting the epidemic, BYD auto company showed a strong sense of social responsibility and stepped forward without hesitation. In the emergency situation of serious shortage of medical supplies, BYD quickly made strategic adjustments, optimized the production layout, and concentrated on the innovative design and manufacturing of protective materials production equipment. In addition, BYD is not limited to the epidemic response, but also highly concerned about the social responsibility of the supply chain, and is committed to promoting the upstream and downstream enterprises of the supply chain to the road of sustainable development. However, the protection of labor rights,

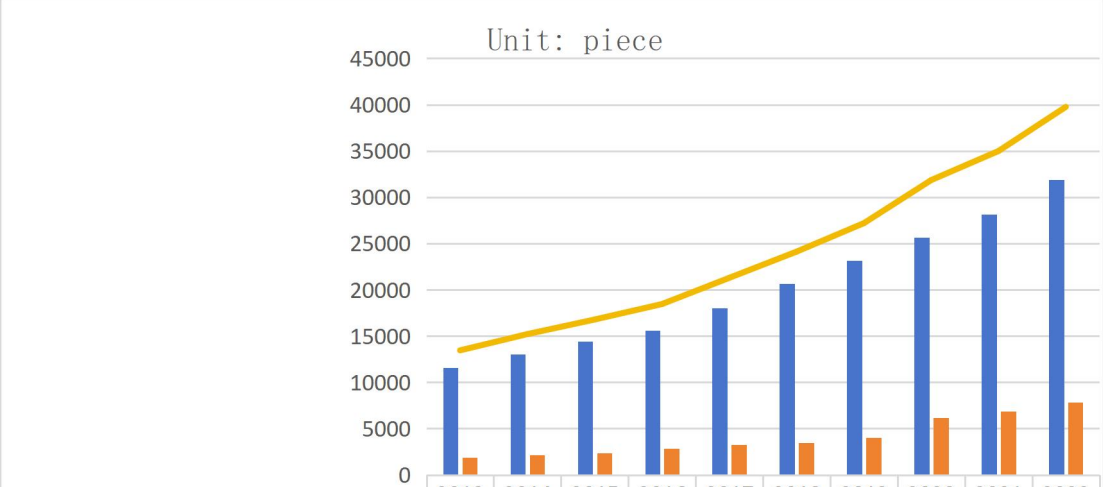
product quality and customer satisfaction still need to be strengthened to ensure the harmonious coexistence between enterprises and all sectors of society.

In terms of governance, BYD only showed a trend of slow growth in its ESG score, which reflects its remarkable achievements in building a corporate governance structure and internal control system, and reflects its strict compliance and respect for laws and regulations. Protect shareholders' rights and interests. Enterprises actively fulfill the obligation of information disclosure, improve the transparency, and provide investors with a more sufficient basis for decision-making. Although the enterprise has made some achievements in the process of operation, there is still some space for optimization in the level of internal control and risk management, which is crucial to ensure the stable operation and sustainable development of the enterprise.

BYDenterprise innovation ability

Patent situation

Byd has formulated the intellectual property strategy, completed the intellectual property work in the three stages of "quantity doubling", "quality improvement" and "patent design", and realized the accumulation of original intellectual property quantity, the improvement of patent quality and the intellectual property protection of related patent portfolio. At present, enterprises have entered the stage of valuable patents, the focus on improving the quality of patents and obtaining valuable patents.



	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Application for Chinese patents	11590	13057	14419	15572	18018	20670	23182	25656	28148	31908
Apply for foreign patents accumulatively	1862	2153	2366	2883	3272	3450	4016	6195	6845	7855
Total number of patent applications	13452	15210	16785	18455	21290	24120	27198	31851	34993	39763

Figure 3-1 BYD accumulated patent applications in 2013-2022

[Data source] According to the BYD CSR report collated into.

With the country vigorously promoting new energy vehicles, as can be seen from Figure 3-1, the number of BYD patent applications in 2013-2022 maintains a high level, showing a linear growth, and the annual application volume continues to increase. Over the past decade, byd's cumulative number of patents filed in China has grown from 11,590 in 2013 to 31,908 in 2022, a growth rate of nearly 175%.; The number of foreign patents applied for increased from 1,862 in 2013 to 7,855 in 2022, up by 5,726. It can be seen that BYD has made remarkable results in the patent application, and has shown a positive growth trend.

Patent classification

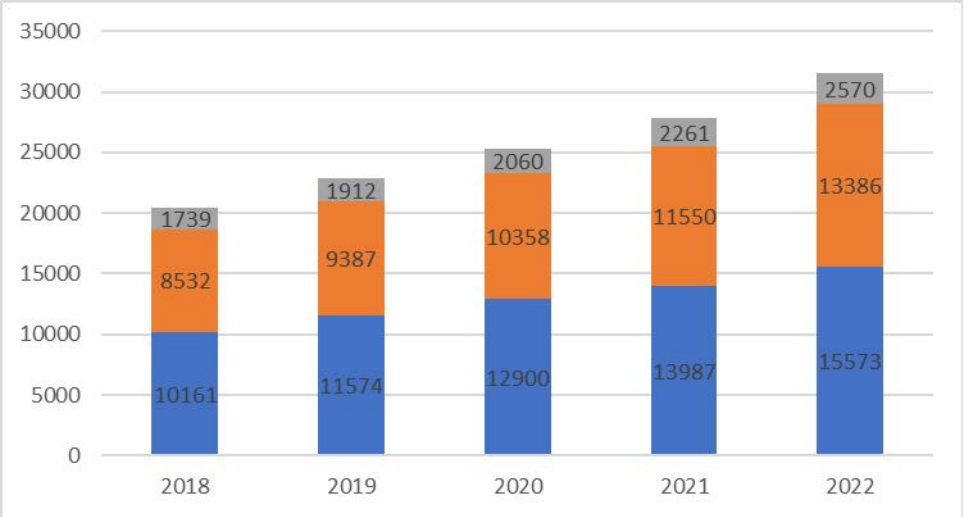


Figure 3-2 BYD's various domestic patent applications in 2018-2022

[Data source] According to the BYD CSR report collated into.The invention patent is blue, the utility model patent is orange, and the design patent is gray

In terms of BYD patent types, BYD's patent application covers a number of aspects. As can be seen from Figure 3-2, between 2018 and 2022, the number of invention patents increased from 10,161 to 15,573, an increase of 5,412; the number of practical patents increased from 8,532 to 13,386, up nearly 5,000, with an average annual increase of 1,000. Appearance patents rose on a slow trend, up 831 in five years. In the patent application composition of BYD enterprise, invention patent and utility model patent occupy the core position, which significantly reflects the direction of technology research and development of the enterprise. From the perspective of the growth trend, although the growth trend of invention patent and utility model patent is similar, they have different emphasis in substance. From the perspective of patent strategic layout, BYD's patent application not only penetrated into the core technology fields of new energy vehicles, such as battery technology, motor drive and electronic control system, but also widely extends to the cutting-edge technology fields such as intelligent driving and Internet of vehicles. This comprehensive patent layout will help BYD consolidate its leading position in the field of new energy vehicles and lay a solid foundation for its future development.

Research design

Research hypothesis

When discussing the operation of enterprises, if we use the perspective of stakeholder theory, we can find that the excellent performance of enterprises in the three dimensions of environment, society and governance is undoubtedly one of the important factors for its success. Will be more likely to win wide recognition and firm support from all kinds of stakeholders. This recognition and support reflects the active fulfillment of corporate social responsibility, and it also builds a solid foundation on the road of promoting the sustainable and steady development of enterprises. On the one hand, when discussing the driving factors of corporate innovation, it is worth noting that the excellent environmental, social and corporate governance ESG performance can be widely recognized by employees at the internal level. Especially when the enterprise actively performs its social responsibility, this performance can win the recognition of high-quality employees and outstanding R & D talents, thus attracting them to join the enterprise. Employees, especially R & D personnel, as the direct executors of innovation activities, attract and retain high-quality and creative R & D talents. In the process of helping enterprises to innovate, this way can not only continuously provide intellectual resources for enterprises. On the other hand, it may be difficult to support the smooth progress of innovation activities by relying only on the internal knowledge system of the enterprise, and the knowledge obtained from the outside plays a key role in improving the enterprise's innovation ability. When demonstrating their excellent ESG practices, enterprises can significantly enhance their long-term friendly relations with external stakeholders such as suppliers and consumers, thus building a broad and solid network of cooperation. The improvement of such knowledge system provides a solid guarantee for the innovation activities of enterprises, and further promotes the innovation and development of enterprises. Based on the above analysis, hypothesis 1.

H1: ESG performance promotes the innovation ability of enterprises.

Sample selection and data source

In China, as an emerging field, ESG has a relatively short development history. Especially in terms of data collection and evaluation, the Wind ESG database plays a crucial supporting role in the ESG field. The statistical start of its ESG rating data dates back to 2009, providing valuable historical data to support relevant research and decision-making. It marks the initial exploration and attempt in this field. Based on this, the constituency of this paper is 2013-2022, BYD auto enterprise ESG performance score as the measurement data. Other variables were obtained from the BYD CSR report. Then, the multiple regression analysis was performed using the Eview12.0 software.

Variable design

Explained variable

enterprise innovation ability. Enterprise innovation performance refers to the annual number of patent applications, patents including invention patents, utility model and appearance design three categories, learn from Li Wenjing, etc[7](2016), the total number of three patents plus 1 natural logarithm to show the innovation ability of the enterprise.

Explanatory variable

ESG expression. Current studies on ESG performance mainly use the evaluation data from third-party evaluation agencies. With the promotion and development of the concept of responsible investment, many evaluation institutions at home and abroad began to build the ESG evaluation system, and the standards, reference indicators and coverage of different evaluation institutions are different. The domestic ESG evaluation system mainly includes China Securities, Commercial Road Ronglu, Runling Global, Harvest Fund, etc. China card ESG evaluation system, is based on the disclosure of public diversification of listed companies information comprehensive review, the information not only covers the regular report, temporary announcement, social responsibility report and sustainable development report and

other key documents, also widely absorbed the government, relevant regulators released authoritative data and the real-time information of the news media, to ensure the comprehensiveness and accuracy of the evaluation system. On the basis of referring to the international mainstream ESG evaluation framework, the system is carefully adjusted and optimized according to the actual situation of China, so as to ensure its high applicability. This system has remarkable features, such as fast update speed, convenient data access, and extensive coverage, providing an effective ESG evaluation tool for enterprises and the community. Therefore, this paper draws on the practices of Wang Linlin, Xie Hongjun, Lu Xue and Gao Jieying, and selects the ESG rating data as the measurement data of ESG performance[8].

Controlled variable

According to the existing research, the enterprise scale and profitability are selected as the control variables of this paper.

Enterprise size (Size). Larger companies tend to have greater access to resources, which means they can pool more resources to drive innovation activities. Based on this understanding, this paper refers to the research method of Yu Minggui et al., and decides to use the natural logarithm of the total assets at the end of the enterprise as the index to measure the scale of the enterprise.

Net profit margin (Roa). When evaluating the operating performance of an enterprise, profitability is a key indicator, which directly reflects the ability of enterprises to effectively use and transform their capital input. A strong profitability enterprise, usually shows that it can more effectively convert capital into income, thus has relatively more abundant available funds to support its operation and development, in order to improve social recognition, enterprises are more willing to put money into innovation in this paper, using the net profit / total assets to measure profitability.

Table 4-1 Variable definition table

type of variable	Variable name	variable symbol	Variable description
explained	Enterprise	RD	Total number of patents plus 1

variable	innovation		
explanatory variable	ESG	ESG	China Securities ESG
controlled variable	scale	Size	Total assets taken
	net profit rate	Roa	Net income / total assets

Model building

Based on the basis of the theory and the current situation of BYD automobile enterprises, this paper selects the total number of ESG and enterprise patents to express the innovation level of enterprises, and measure the effect of ESG performance on BYD's innovation ability. Select the relevant data of CSI ESG and BYD CSR reports from 2013-2022, in which X refers to the score performance of CSI ESG, and RD refers to the total number of BYD patents plus 1 and then the natural log (RD), thus establish the following measurement model:

$$LnRD_1 = \beta_0 + \beta_1 ESG + \beta_2 \mathrm{LnSize} + \beta_3 \mathrm{Roa} + u_1 \quad (4\text{-}1)$$

Empirical analysis of the impact of ESG performance on BYD enterprise innovation ability

Descriptive statistical analysis

Table 5-1 Descriptive statistical results

	RD	ESG	Size	Roa
Mean	10.03785	77.696	25.8784	2.58
Median	10.02844	79.875	25.94984	2.4
Maximum	10.59072	83.46	26.92552	5
Minimum	9.506957	64.47	25.08016	0.8
Std.Dev.	0.368802	5.864007	0.541684	1.475579
Observations	10	10	10	10

Table 5-1 presents the descriptive statistical results of the main variables. From 2013 to 2022, the average value of sample enterprise innovation (RD) was 10.03, the median was 10.02, and the standard deviation was 0.36, indicating that there are differences in the innovation output of BYD automobile enterprises, and the great practical significance of studying the influencing factors of enterprise innovation.

ESG performance (ESG) minimum 64.47, maximum 83.46, median 79.87, median in the upper half of the score range, close to the maximum. This shows that BYD's ESG performance is relatively high within the range of its possible scores.

The average enterprise size (Size) is 25.88, the median is 25.95, and the standard deviation is 0.54, indicating that the size difference of BYD automobile enterprises is small.

The average profitability (Roa) is 2.58, the minimum value is 0.8, and the standard deviation is 1.47, indicating that the profitability of BYD auto enterprises is relatively good at the average level.

Correlation analysis

Table 5-2 Correlation analysis between the explained and explanatory variables

	RD	ESG	Size	Roa
RD	1			
ESG	0.865859853	1		
Size	0.955312208	0.827663346	1	
Roa	0.132470971	0.378004546	0.292313	1

Through correlation analysis, the correlation coefficients between enterprise innovation (RD) and ESG, enterprise size (Size) and net profit rate (Roa) were 0.8658,0.9553 and 0.1324, respectively, indicating that there is a significant positive correlation between enterprise innovation and ESG, enterprise size (Size) and net profit rate (Roa).

Regression results and the analysis

Variables have been tested by LM test and White test with significant results are shown in the appendix.

According to the parameter estimation results in Table 5-3, the increase of ESG plays a positive role in promoting the number of patents applied by BYD auto enterprises, which indicates that the performance of ESG has a promoting effect on the innovation ability of enterprises, confirming the hypothesis H1.

Growth in business size (Size) and net profit margin (Roa) will also drive growth in corporate innovation. The feasibility coefficient of the regression model is 0.968116 and the adjusted feasibility coefficient is 0.952175, indicating that the regression model has a high fitting effect, and the independent variable ESG performance largely explains the number of patents applications for the dependent variable. From the results of p test, ESG (0.0497), enterprise size (0.0012) and net profit margin (0.0376) passed the p test at the confidence level of 5%, indicating that ESG, enterprise size (Size) and net profit rate (Roa) are positively correlated with enterprise innovation, which means that the higher ESG score, enterprise size (Size) and net profit margin (Roa), the higher the innovation ability of BYD automobile enterprises will be.

Table 5-3 Regression results of the impact of ESG performance on the innovation of BYD automobile enterprises

Variable	Coefficient	Std.Error	t-Statistic	Prob.
C	-4.54583	1.799184	-2.52661	0.0449**
ESG	0.020703	0.008445	2.451577	0.0497**
Size	0.506607	0.088503	5.724176	0.0012***
Roa	-0.05235	0.019695	-2.65823	0.0376**
R-squared	0.968116	Mean dependent var		10.03785

Adjusted R-squared	0.952175	S.D.dependent var	0.368802
S.E.of regression	0.080653	Akaike info criterion	-1.908136
Sum squared resid	0.03903	Schwarz criterion	-1.787102
Log likelihood	13.54068	Hannan-Quinn criter.	-2.04091
F-statistic	60.72819	Durbin-Watson stat	1.878158
Prob(F-statistic)	0.00007		

[Note] A p-value less than 0.1 is significant at the 10% level, a p-value less than 0.05 is significant at the 5% level, and a p-value less than 0.01 is significant at the 1% level

The economic significance is that for each additional unit of ESG, the enterprise innovation capacity increases by 0.02 units, and the enterprise size (Size) increases the enterprise innovation capacity by 0.5 units. And net profit margin (Roa) coefficient is negative, but does not directly reflect the innovation of byd automobile enterprise, net profit margin is a measure of enterprise profitability, when discussing the enterprise innovation ability, we need to consider its research and development strength, product innovation and other multiple dimensions, these aspects constitute the core elements of enterprise innovation ability. Therefore, innovation ability may have an impact on net profit margin, but net profit margin itself cannot directly reflect innovation ability. The parameters are estimated as follows:

$$LnRD_1 = -4.454583 + 0.020703ESG + 0.506607\text{Size} - 0.05235\text{Roa} \quad (5\text{-}1)$$

Robustness test

In this paper, to verify the robustness of the study, we applied a strategy of changing the explanatory variables. Specifically, we replace the total number of BYD auto company patents plus a natural log of 1 with a natural logarithm of 1 for calculating only the cumulative number of Chinese patent applications. The change aims to further examine the role of ESG performance in driving enterprise innovation capabilities. As shown in Tables 5 – 4, when tested after this adjustment, our study hypothesis 1 is still supported, demonstrating the robustness of the study conclusions.

Table 5-4 Robustness test of the impact of ESG performance on the innovation of BYD automobile enterprises

Variable	Coefficient	Std.Error	t-Statistic	Prob.

C	-3.55196	1.431593	-2.48113	0.0477**
ESG	0.020794	0.00672	3.094582	0.0213**
Size	0.461052	0.070421	6.547081	0.0006***
Roa	-0.05153	0.015671	-3.28806	0.0167**
R-squared	0.976745	Mean dependent var		9.862013
Adjusted R-squared	0.965118	S.D.dependent var		0.343609
S.E.of regression	0.064175	Akaike info criterion		-2.365227
Sum squared resid	0.024711	Schwarz criterion		-2.244193
Log likelihood	15.82614	Hannan-Quinn criter.		-2.498001
F-statistic	84.00353	Durbin-Watson stat		1.992343
Prob(F-statistic)	0.000027			

[Note] A p-value less than 0.1 is significant at the 10% level, a p-value less than 0.05 is significant at the 5% level, and a p-value less than 0.01 is significant at the 1% level

Conclusions

In the process of deeply exploring the construction of the innovation ability of BYD automobile enterprises, this study adopts the method of regression analysis, focusing on the potential connection between ESG performance and the enterprise innovation ability. The analysis results show that ESG performance has a significant positive impact on the improvement of enterprises 'innovation ability, thus verifying the positive effect of ESG performance in promoting the development of enterprises' innovation ability. This finding means that as companies perform well in environmental, social and governance areas, as ESG performance improves, which enables companies to take a better position in the fierce market competition. This dominant position not only highlights the core competitiveness of the enterprise, but also lays a solid foundation for its sustained and steady development. Furthermore, this study found that enterprise size is another key factor affecting innovation capacity. As BYD auto company has the advantage of scale, this enables it to invest more resources and energy in research and development and innovation to improve its innovation ability. Therefore, there is a mutual promotion and complementary relationship between the scale of BYD automobile enterprises and the innovation ability. This enhancement not only promotes the gradual expansion of the scale of the enterprise, but also significantly improves its competitive position in the market, thus laying a solid foundation for the sustainable development and growth of the enterprise

in the future.

Integrating improved ESG performance into the company's strategic planning and the continuous commitment to improving its ESG level has become an indispensable path for enterprises to achieve high-quality development. By strengthening environmental protection, actively fulfilling social responsibilities and optimizing the corporate governance structure, enterprises can not only enhance their own innovation ability and market competitiveness, but also contribute to the sustainable development of the society. By increasing the investment in research and development, environmental protection, social responsibility and other aspects, the comprehensive competitiveness of enterprises can be enhanced, so as to provide strong support for the expansion of enterprise scale.

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Appendix

Appendix 1: LM checklist

Variable	Coefficient	Std.Error	t-Statistic	Prob.
C	-1.85905	2.698097	-0.68902	0.5287
ESG	-0.00772	0.011766	-0.65609	0.5476
Size	0.094537	0.134461	0.703085	0.5208
Roa	0.004694	0.02255	0.208146	0.8453
Obs*R-squared				0.3124

Results showed that the LM statistic (n * R^2) P> 0.05, accepts the null hypothesis, there is no sequence correlation for the disturbance term, i. e., the residue.

Appendix 2: White Test Form

F-statistic	0.736427	Prob.F(3,6)	0.5675
Obs*R-squared	2.691198	Prob.Chi-Square(3)	0.4417
Scaled explained SS	1.061564	Prob.Chi-Square(3)	0.7864

The results show that the White test amount (n * R^2) And p> 0.05, accepting the null hypothesis that there is no heteroscedasticity in the residual sequence.