A Research on the Influence of MNEs Fulfilling Social Responsibility on Green Innovation

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Abstract. With the increasingly severe global climate change and ecological environment problems, corporate social responsibility and green innovation play a vital role in promoting sustainable development. This paper takes the listed companies of Shanghai and Shenzhen A-shares in China from 2010 to 2020 as samples, and uses the OLS fixed effect model and empirical analysis methods to explore the impact of multinational corporations' fulfillment of social responsibility on green innovation, and particularly examines the moderating role of financing constraints. The study finds that there is a significant positive correlation between corporate social responsibility and green innovation, indicating that the positive performance of corporates in fulfilling social responsibility can effectively promote the improvement of their green innovation capabilities. However, this positive correlation is negatively affected by financing constraints. That is, among corporates facing greater financing constraints, the relationship between social responsibility and green innovation is weaker. In addition, the heterogeneity analysis reveals that the relationship between social responsibility and green innovation is more significant in manufacturing multinational corporations and samples from the central and eastern regions.

Keywords: Multinational corporations, Corporate social responsibility, Green innovation, Sustainable development.

1. Introduction

The "2022 China Ecological Environment Status Bulletin" released by the Ministry of Ecology and Environment of the People's Republic of China on May 29, 2023, pointed out that the annual average temperature in 2022 was on the high side, reaching 10.51℃, which was the second highest since 1951. It can be seen from this that the issue of climate change has become an urgent matter. Meanwhile, China is still facing severe ecological environment problems such as frequent natural disasters, ecological environment pollution on the mainland and in the ocean, shortages of natural resources, and the aggravation of soil pollution. For this reason, Chinese corporates should actively respond to the "dual carbon" policy goals, unswervingly follow the path of green and low-carbon development, and make every effort to achieve a balance between economic benefits and social benefits. It can be determined that the Chinese government is strengthening environmental regulations and market supervision on various corporates. However, whether it is conducive to Chinese corporates achieving a win-win situation between environmental performance and corporate performance remains debatable. At present, China's economy is slowly recovering from the impact of the outbreak of the COVID-19 pandemic. The global economy has also been sluggish due to the impact of the COVID-19 pandemic and the Ukraine war. As a developing country, we need to make more efforts to eliminate these economic and environmental threats. This paper holds that as multinational corporations, they have more obligations and capabilities to assume social responsibilities and contribute their modest efforts to China's environment and even the global ecological environment.

The "Technology and Innovation Report" released by the United Nations Conference on Trade and Development (UNCTAD) in 2023, centering on the core concept of green innovation, pointed out that to open the window of green opportunities, scientific and technological innovation should be carried out under the guidance of sustainable development goals. Corporates in developing countries that want to accelerate green transformation cannot rely solely on simply imitating corporates in developed countries. Instead, it requires more of the corporates' scientific and technological

innovation ability and creativity. Therefore, in the international context, the concept of green innovation has gradually received attention, and it is urgent for corporates to accelerate green transformation.

2. Literature Review

2.1. Corporate Social Responsibility

2.1.1. Corporate Social Responsibility Information Disclosure

Up to now, the research objects regarding the disclosure of corporate social responsibility information have mainly focused on the listed companies of Shanghai and Shenzhen A-shares, but multinational corporates have not been screened out for research.

In order to explore the objectivity of the disclosure of corporate social responsibility information, Duan Zhao et al. (2017) selected the data of China's A-share listed companies and conducted an empirical analysis based on text mining technology. The results showed that the subjectivity scores of the social responsibility reports of China's listed companies generally followed a normal distribution and showed an upward trend[1]. Ji Li et al. (2016), from the two perspectives of government constraints and management power, explored the readability of the disclosure of corporate social responsibility information of China's listed companies. The research found that management power would positively enhance the readability of social responsibility reports, and this positive correlation would be weakened by the constraint mechanism[2].

Then, what is the quality of the disclosure of social responsibility reports of China's listed companies? Previous scholars mainly conducted research on it from a micro perspective, including factors such as ownership structure and internal control. Yu Wei et al. (2017), from the perspective of shareholders, found through research that the social responsibility reports of private corporates had the highest quality, while those of local state-owned corporates had the worst quality. State-owned corporates mostly met the mandatory disclosure requirements of the regulatory authorities, and foreign shareholders would promote the quality of the disclosure of corporate social responsibility information in central state-owned corporates and private corporates[3]. Tang Xiaojian (2016) explored the impact of corporates' internal control and institutional environment on the quality of the disclosure of corporate social responsibility information. The research found that a weak institutional environment would reduce the quality of social responsibility reports and also inhibit the positive moderating effect of internal control on the quality of social responsibility reports[4]. Zou Ping (2018), combining rent-seeking theory, explored and found that there was a negative correlation between the quality of the disclosure of corporate social responsibility information and the actual tax burden[5]. Huang Heshu and Zhou Zejiang (2015) found that female executives had a significant positive impact on the level of the quality of the disclosure of corporate social responsibility information[6].

2.1.2. Corporate Social Responsibility and Financial Performance

In the research on corporate social responsibility and financial performance, only a small number of researchers have involved the scope of multinational corporations, while the majority have focused on examining A-share listed companies in China.

Liu Jun (2009) selected multinational corporations as the research objects and found through research that the fulfillment of social responsibility by multinational corporations had a significant positive impact on the financial performance of corporates, among which the impact of community responsibility was the strongest[7]. Jia Huifang (2017) screened out non-financial multinational corporations in China based on the "World Investment Report" released by UNCTAD. When studying the relationship between corporate social responsibility and financial performance, she reached the same conclusion as Liu Jun and also pointed out that the influence between the two had a lagging effect[8].

Among the samples of listed companies in China, there is also a positive correlation between corporate social responsibility and financial performance. Cui Yeguang and Li Bo (2018), based on

the data of listed companies in China, found that under different action mechanisms, the positive correlation between corporate social responsibility and financial performance would not be affected, and the investment in technological innovation would enhance this positive correlation[9]. Due to the time lag effect of corporate social responsibility, relevant researchers have also discussed this issue. Tang Wei and Shen Tiantian (2017) pointed out that the current financial performance would have a relatively greater positive impact on the subsequent corporate social responsibility, and the relationship between the two would be weakened among state-owned corporates[10]. Zheng Pei et al. (2020) found through research that the corporate social responsibility with a one-period lag significantly promoted the current financial performance, but the current social responsibility did not significantly promote the current financial performance [11]. Relevant researchers have also conducted research on specific industries. Wei Liling and Lu Yang (2016), targeting the food and beverage manufacturing industry, also obtained a significant positive correlation between corporate social responsibility and financial performance[12]. Of course, there are also researchers who are not limited to the discussion of the relationship between the two. Huang Yixiang and Yao Zheng (2016) incorporated impression management into the research scope. The results showed that compared with companies with superior corporate performance, companies with poor performance were more inclined to deepen the degree of impression management in their social responsibility reports, and this relationship was more prominent in heavily polluting industries[13]. Chih-Yi Hsiao and Hao-Wei Chen (2021) explored the relationship among corporate social responsibility, financing constraints, and financial performance. The research found that corporates with high financing constraints could significantly improve their financial performance by implementing effective corporate social responsibility programs[14].

Erion Çano and Xhesilda Vogli (2023) selected 115 European companies as research samples and found a weak positive correlation between corporate social responsibility and financial performance indicators. They pointed out that further in-depth analysis was needed to draw more advanced research conclusions[15].

2.2. Green Innovation

2.2.1. Green Innovation and Social and Economic Performance

Currently, domestic and foreign literature generally holds that green innovation plays a significant positive role in social and economic performance, and the research is not limited to the relationship between the two either. Zhang Xiaojun (2012) believed that the implementation of the green innovation development strategy by corporates had a significant positive impact on the social and economic performance of corporates. He also pointed out that employee participation would positively moderate the relationship between green innovation and economic performance, but there was no such moderating effect between green innovation and social performance[16]. Lu Jianci and Jiang Guangsheng (2022) made a supplement to the research on green innovation, stating that the green managers of Chief Executive Officers (CEOs) would improve the social and economic performance of corporates by promoting green innovation[17]. Dayong Zhang et al. (2019) selected listed manufacturing companies in China for research and found that there was a significant positive relationship between green patents and corporate performance. They also pointed out that the main driving force for green growth in state-owned corporates came from green utility model patents[18]. Sanjay Kumar Singh et al. (2020) selected manufacturing corporates and, based on the structural equation modeling (SEM) of covariance, found that green human resources management (HRM) would indirectly affect the environmental performance of corporates through green innovation[19]. Meanwhile, some researchers have also conducted more detailed research on green innovation. Mingfeng Tang et al. (2018) incorporated management factors and divided green innovation into process innovation and product innovation. They found that when management factors were not considered, both could significantly promote corporate performance; once management factors were taken into account, only green process innovation could have a positive impact on corporate performance [20].

2.2.2. Environmental Regulation and Green Innovation

Based on the Porter Hypothesis theory, environmental regulation, as an important influencing factor for green innovation, has been widely studied. Yu Kexin et al. (2019) conducted research on resource-based companies listed on the A-share market and found that the relationship between environmental regulation and green innovation presented an inverted "U" shape[21]. Zhu Yuke et al. (2022) considered the moderating effect of the digital economy on the basis of the relationship between green innovation and environmental regulation and found that the digital economy would make the inverted "U" shape steeper[22]. Wu Libo et al. (2021) focused on heavily polluting corporates and found that environmental regulation could significantly enhance the green innovation ability of corporates[23]. Xiang Cai et al. (2020) also took Chinese corporates in heavily polluting industries as research samples and reached the same conclusion as researchers like Wu Libo. Additionally, they pointed out that this relationship was more significant in state-owned corporates. Meanwhile, compared with labor-intensive industries, technology-capital intensive industries were more likely to be motivated by direct environmental regulation[24]. Shu Lihui and Chen Gong (2020) selected Chinese energy corporates and divided environmental regulation into command-and-control type and market-incentive type. Their research found that both types had a significant positive impact on the green innovation willingness of corporates, thereby improving the green innovation ability of corporates[25].

At the same time, some scholars have focused on the impact of environmental taxes on green innovation. Li Xiangju and He Na (2018) found through research that both the impact of environmental taxes and regional competition on corporate green innovation presented an inverted "U" shape. Meanwhile, regional competition would inhibit the impact of environmental taxes on corporate green innovation[26]. Yu Lianchao et al. (2019) found that environmental taxes would force corporates to carry out green innovation and pointed out that this impact had a certain lagging effect[27]. Zhen Meirong and Jiang Xiaozhuang (2021) found that the relationship between environmental taxes and corporate green product innovation was an inverted "U" shape, while the relationship with green process innovation was a "U" shape, which was slightly different from the research conclusions of Li Xiangju and He Na[28].

2.2.3. Green Finance and Green Innovation

In the domestic and foreign literature on green innovation and green finance, the main focuses are on green credit and green bonds. Zhang Xueying et al. (2022) conducted in-depth research on Chinese listed companies and found that when corporates issued green bonds, it had a significant positive impact on their green innovation capabilities. This impact was particularly prominent in companies with high media attention and more serious principal-agent problems[29].

Scholars also studied green finance and green innovation from a policy perspective. Su Li et al. (2021) selected heavily polluting industries as research objects and found through research that the green credit policy could significantly improve the green innovation efficiency of corporates. This effect was formed through the mediating roles of increasing financing costs and R&D investment[30]. Chin-Hsien Yu et al. (2021) took A-share listed companies as research samples and found that financing constraints would inhibit the green innovation of corporates, while green finance policies could relieve the financing constraints of corporates to a certain extent and thus indirectly promote corporate innovation. Since state-owned corporates were more likely to obtain green credit than private corporates, private corporates were more vulnerable when facing higher financing constraints[31].

2.3. The Relationship Between CSR and Green Innovation

Research on the relationship between corporate social responsibility and green innovation is relatively lacking both at home and abroad, and no unified conclusions have been reached yet. Xiao Xiaohong et al. (2021), targeting listed manufacturing companies, found through research that when corporates fulfilled their social responsibilities, it could promote the green innovation level of corporates. Among this, the social capital of corporates played a mediating role, and the executive

compensation incentive played a positive moderating role[32]. Li Wuji (2023) selected A-share corporates as samples and found that when corporates fulfilled their social responsibilities, it had a significant positive impact on the green innovation performance of corporates. R&D investment and real earnings management played mediating roles in this process, organizational slack played a negative moderating role, and media attention played a positive moderating role[33]. Ding Tao and Gao Yating (2024) also found that when corporates fulfilled their social responsibilities, it would promote green innovation. Meanwhile, from the perspective of financing constraints, they confirmed that it played a mediating role between corporate social responsibility and green innovation, and ownership concentration played a negative moderating role[34]. Edward Fosu et al. (2024) used the structural equation model (SEM) to test the impact of environmental social responsibility on social performance through two mediating variables, namely green innovation and corporate image. Empirical results showed that the practice of corporate environmental social responsibility had an impact on promoting the green innovation development of corporate social performance[35]. William Mbanyele et al. (2022) took advantage of the staggered adoption of corporate social responsibility disclosure laws as a quasi-natural experiment and found that compared with countries that did not adopt CSR disclosure laws, corporates in countries that adopted CSR disclosure laws improved their green innovation output and quality[36]. Huang Li and Li Yuedi (2024) found through research that when corporates actively fulfilled their social responsibilities, it significantly promoted green innovation, and internal control played a partial mediating role in it[37]. However, Zheng Yu (2023) found through research that the behavior of disclosing social responsibility information would significantly inhibit the green innovation level of corporates. By dividing the samples into voluntary disclosure and mandatory disclosure for heterogeneity analysis, it was found that the negative impact was more significant in the voluntary disclosure samples[38].

2.4. Literature Evaluation

This chapter mainly reviews the literature related to corporate social responsibility and green innovation. It is found that although separately summarized, the domestic and foreign researches in these two aspects are relatively mature. However, in terms of the research on the relationship between them, it is rather lacking. Moreover, no scholars have screened out multinational corporations for research, which is also an important entry point of this paper.

3. Concepts, Theories and Research Hypotheses

3.1. Concept Definition

3.1.1. Multinational Corporation

Up to now, there has been no unified definition of multinational corporations. The concept of multinational corporations originated from Lessor in the United States. He referred to multinational corporations as economic organizations engaged in production and operation across national borders. However, from the current perspective, this definition is not entirely accurate. As the name implies, multinational corporations are bound to be involved in international operations in more than one country. Nevertheless, multinational corporations are not simply required to engage in foreign trade. There are also relevant indicators to measure multinational corporations, such as the Transnationality Index and the Internationalization Index. However, these indicators only play a role in measuring the degree of transnationality and internationalization of multinational corporations. Based on the definition of multinational corporations in the "Code of Conduct on Transnational Corporations" drafted by relevant United Nations agencies, the author believes that the key point of multinational corporations is to establish economic entities overseas. Given that most of the overseas economic entities of multinational corporations are subsidiaries, this paper defines multinational corporations as companies that set up subsidiaries overseas and conduct transnational operations with a global strategic mindset.

3.1.2. Corporate Social Responsibility

Corporate social responsibility requires enterprises to go beyond the sole goal of maximizing profits and take on legal responsibilities towards shareholders and employees as well as make contributions to society, the environment and consumers. In fact, the essence of corporate social responsibility lies in moral constraints and legal responsibilities. Therefore, the corporate social responsibility defined in this paper should cover responsibilities towards shareholders, employees, consumers, the environment and society, which can interpret corporate social responsibility in a more comprehensive manner.

3.1.3. Green Innovation

Green innovation is the product of the combination of green development and innovation-driven factors. Currently, the academic community defines green innovation from different perspectives, but the common aspect is making certain contributions to the environment. These contributions include reducing the burden on the environment, minimizing its impacts, and creating value for the environment. Meanwhile, relevant international organizations have also provided definitions of green innovation. The European Commission emphasizes sustainable development goals, and any innovative form that significantly promotes sustainable development goals can be called green innovation. The "Technology and Innovation Report" released by the United Nations Conference on Trade and Development (UNCTAD) in 2023 also offers an explanation of green innovation: creating or introducing products or services that reduce carbon footprint. Therefore, this paper holds that green innovation is a comprehensive concept, which encompasses contributions to the environment and behaviors that reduce resource consumption in line with sustainable development and enable enterprises to achieve long-term development.

3.2. Theoretical Basis

3.2.1. Stakeholder Theory

The stakeholder theory mainly studies the relationship between an organization and its stakeholders, emphasizes the role of enterprises in terms of social responsibility and sustainable development, and advocates achieving a balance among the rights and interests of different stakeholders. Initially, the focus of the stakeholder theory was on the economic benefits of enterprises and the interests of shareholders. At this stage, the main goal of enterprises was to maximize the interests of shareholders. With the deepening of research, the stakeholder theory has gradually broadened the scope of stakeholders, and the connections between enterprises and a wider range of stakeholders such as society, the environment, and the government have gradually attracted attention. In recent years, enterprises have become increasingly aware of the importance of cooperating and communicating with stakeholders. To some extent, stakeholders have provided capital assistance in the development process of enterprises, so enterprises have the responsibility and obligation to give back to stakeholders. Overall, the stakeholder theory is closely related to corporate social responsibility.

3.2.2. Resource Dependency Theory

The resource dependence theory is a theoretical framework that studies the interdependent relationship between an organization and its external environment. According to this theory, organizations rely on various resources from the external environment for their survival and development, such as funds, technology, and human resources. The resource dependence theory analyzes the strategies by which organizations seek resources when resources are insufficient or restricted, including establishing cooperative relationships and diversifying supply chains. With the deepening of research, the resource dependence theory has begun to consider the influence of a wider range of factors on the dependence relationship of organizations. Scholars have gradually expanded their vision from resources to other aspects, such as knowledge, information, and social capital. This expansion enables the theory to better explain how organizations utilize different types of resources

to cope with changes and challenges in the external environment. In recent years, the resource dependence theory has gradually been combined with the perspectives of organizational alliances and networks. Scholars have begun to focus on the collaborative and cooperative relationships among organizations and the ways to obtain and share resources by establishing alliances and networks. This evolution enables the resource dependence theory to better explain how organizations enhance their competitiveness through cross-border cooperation, resource integration, and knowledge sharing.

3.2.3. Impression Management Theory

Impression management theory refers to a theoretical framework that studies how individuals or organizations manage and shape the images and impressions that others have of them. Initially, the impression management theory was mainly based on the viewpoints of social psychology. Early studies focused on the interactive processes between individuals and others, exploring how individuals influenced others' impressions of themselves through self-presentation, symbolic communication, non-verbal behaviors and other means. This theory emphasized the importance of individuals in shaping and managing impressions in social interactions. With the deepening of research, the impression management theory began to focus on impression management at the organizational level. Scholars started to explore how organizations managed the impressions of their external stakeholders through means such as publicity, brand building, and public relations activities. This perspective emphasized the strategies and practices of organizations in establishing and maintaining a good image. In recent years, with the popularity of social media and the Internet, the impression management theory has gradually been combined with the perspectives of social media and the Internet. Scholars have started to study how individuals and organizations use social media platforms to shape and manage their own impressions. This evolution enables the impression management theory to better explain how individuals and organizations in the digital age influence others' impressions of them through online media and social networks.

3.3. Research Hypothesis

Based on the stakeholder theory and the resource dependence theory, if an enterprise intends to carry out activities related to green innovation, it needs to rely on the resource injection from stakeholders. However, it must first gain the trust of stakeholders so that they will voluntarily invest capital and resources. Therefore, enterprises can build a bridge of trust between themselves and stakeholders by fulfilling their social responsibilities[39]. Meanwhile, based on the impression management theory, when an enterprise fulfills its social responsibilities, it can create an image of being responsible and highly capable, thus winning the favor of investors. Similarly, as multinational corporations, creating a good corporate image is conducive to extensive financing and promoting the implementation of green innovation projects. To sum up, this paper puts forward the following hypothesis:

H1: The fulfillment of social responsibilities by multinational corporations can promote green innovation.

Based on the impression management theory, it is assumed that when an enterprise is under relatively large financing constraints, it may use impression management to cope with the pressure from external investors and stakeholders. In this case, the enterprise may be more likely to demonstrate its commitment to social responsibilities through public relations and marketing means rather than through actual green innovation investments. To sum up, this paper puts forward the following hypothesis:

H2: Financing constraints will have a negative moderating effect on the relationship between the fulfillment of social responsibilities by multinational corporations and green innovation.

4. Empirical Study

4.1. Sample Selection and Data Sources

This paper selects the listed companies of Shanghai and Shenzhen A-shares from 2010 to 2020 as the research samples. According to the definition of multinational corporations in Chapter Three of this paper, it judges whether a listed company belongs to a multinational corporation by whether it has overseas subsidiaries or not. Therefore, this paper excludes the listed companies without overseas subsidiaries, and also excludes the enterprises in the financial industry as well as those labeled as ST and ST*. Eventually, 13,680 sample data are obtained.

Among them, the data on corporate social responsibility comes from the total score of the rating system of the "Listed Company Social Responsibility Report" on Hexun Website. The data on green innovation comes from the China Research Data Services Platform (CNRDS), and other data comes from the China Stock Market & Accounting Research Database (CSMAR).

4.2. Variable Selection and Basis

4.2.1. Green Innovation

Currently, the academic community has not reached a consensus on the measurement of indicators for green innovation. Existing literature has focused on measuring it from the perspectives of product innovation and energy consumption, as well as the R&D investment in green innovation. Considering that it is difficult to obtain a complete and independent measurement method, this paper draws on the method of Wang Xu and Wang Fei (2019) and uses the sum of the number of applications for independent and joint green invention patents and green utility model patents (GI) of enterprises to measure it[40]. The reason for using the number of patent applications to measure green innovation is that when enterprises apply for patents, they are already carrying out green innovation activities. If the number of patents obtained is used to measure it, there will be a certain lag. Meanwhile, this paper takes the logarithm (LnGI) after adding one to GI to ensure the accuracy of the research results.

4.2.2. CSR

Up to now, the academic community has not reached an agreement on the measurement of corporate social responsibility. This paper draws on the practice of Xiao Xiaohong et al. (2021) and uses the corporate social responsibility scores on Hexun Website for evaluation. Hexun Website adopts a multi-angle, multi-index and multi-level approach to measure the social responsibility of enterprises, covering aspects such as shareholders, employees, consumers, the environment and society. It can evaluate the fulfillment of corporate social responsibility in a relatively comprehensive and objective manner, which also conforms to the conceptual definition of corporate social responsibility in this paper. In addition, this paper processes the corporate social responsibility score data by reducing it by 100 times to avoid the influence of the dimension.

4.2.3. Control Variable

This paper draws on previous studies and selects several appropriate control variables to avoid the impact of variable omission on the empirical results. The control variables in this paper include: (1) The natural logarithm of the number of years since the establishment of the enterprise (LnAge); (2) The natural logarithm of the total assets of the enterprise at the end of the year (LnSize); (3) The asset-liability ratio (Lev), which is the ratio of the total liabilities at the end of the year to the total assets; (4) The cash flow ratio (Cashflow), which is the proportion of the net cash flow generated by operating activities in the total assets; (5) The Tobin Q value (TobinQ), which is calculated as market value / (total assets - net intangible assets - net goodwill); (6) The proportion of independent directors (Indep), which is the proportion of independent directors in the total number of the board of directors; (7) The combination of the two positions (Dual). If the chairman and the general manager of the enterprise are held by the same person, it takes the value of 1, otherwise it takes the value of 0; (8) Whether it is a state-owned enterprise (SOE). State-owned enterprises are assigned a value of 1, and

others are assigned a value of 0; (9) The growth rate of operating revenue (Growth). In addition, this paper also controls for industry effects (ind) and year effects (year).

4.3. Basic Regression Model

To verify that the fulfillment of social responsibilities by multinational corporations significantly promotes green innovation, that is, Hypothesis H1, this paper constructs the following benchmark model:

$$LnGI_{i,t} = \alpha + \beta \cdot CSR_{i,t} + \gamma \sum Control_{i,t} + \sum year + \sum ind + \varepsilon \quad (1)$$

Among them, $LnGI_{i,t}$ represents the green innovation level of enterprise i in year t, $CSR_{i,t}$ represents the social responsibility score of enterprise i in year t, $Control_{i,t}$ represents all the above control variable data of enterprise i in year t, year represents the time fixed effect, ind represents the industry fixed effect, and ε represents the disturbance term.

4.4. Basic Regression Model

4.4.1. Descriptive Statistics

Conducting descriptive statistics on each variable can help to gain a deeper understanding of the characteristics of the samples. As can be seen from Table 1, the total number of valid samples in this paper is 13,680. The minimum value of the natural logarithm of the number of green patent applications (LnGI) is 0, and the maximum value is 7.062, indicating that there are significant differences in the green innovation levels among multinational corporations in China. The mean value of corporate social responsibility (CSR) is 0.243, with an average score of 24.3 points, reflecting that the overall performance of multinational corporations in fulfilling their social responsibilities in China is relatively poor. The mean value of whether it is a state-owned enterprise (SOE) is 0.276, suggesting that 27.6% of the multinational corporations in the samples are state-owned enterprises. The mean value of the combination of the two positions (Dual) is 0.311, indicating that 68.9% of the multinational corporations in the samples maintain the independence of the board of directors.

Table 1. Descriptive statistics for the main variables

Variable	Obversation	Mean	SD	Minimum	Maximum
LnGI	13,680	0.530	0.990	0	7.062
CSR	13,680	0.243	0.154	-0.185	0.909
LnAge	13,680	2.865	0.349	1.099	3.555
LnSize	13,680	22.49	1.343	19.57	26.40
Lev	13,680	0.435	0.200	0.0319	0.927
Cashflow	13,680	0.0491	0.0666	-0.224	0.256
Growth	13,680	0.177	0.397	-0.653	3.894
Indep	13,680	0.378	0.0557	0.273	0.600
Dual	13,680	0.311	0.463	0	1
TobinQ	13,680	1.947	1.259	0.802	16.65
SOE	13,680	0.276	0.447	0	1

4.4.2. Correlation Analysis

To avoid multicollinearity among variables, this paper conducts a correlation test among various variables. According to the correlation coefficient matrix (see the attached table), the correlation coefficients among all variables are all much smaller than 0.8, so the possibility of multicollinearity among variables can be excluded. Meanwhile, the natural logarithm of the number of green patent applications (LnGI) has a correlation coefficient of 0.082 with corporate social responsibility (CSR), and there is a significantly positive correlation at the 1% significance level, which preliminarily verifies Hypothesis H1 of this paper.

4.4.3. Basic Reggression Analysis

Since the correlation test does not take into account variables other than the two variables in question, it is necessary to control for variables to ensure the rigor of the research conclusions. The regression results in Table 2 show that the coefficient of the relationship between the performance of corporate social responsibility (CSR) and the level of corporate green innovation (LnGI) is 0.306, indicating a significantly positive correlation at the 1% significance level. This verifies Hypothesis H1 of this paper. Enterprises that perform better in terms of social responsibility pay more attention to environmental protection, and thus are more inclined to carry out green innovation activities, which improves their green innovation capabilities.

Table 2. Result of basic regression

	LnGI
CSR	0.306***
	(0.0569)
LnAge	-0.125***
	(0.0245)
LnSize	0.254***
	(0.00823)
Lev	0.103**
	(0.0490)
Cashflow	0.475***
	(0.120)
Growth	-0.103***
	(0.0190)
Indep	-0.218
	(0.134)
Dual	0.0887***
	(0.0168)
TobinQ	0.0337***
	(0.00694)
SOE	0.126***
	(0.0197)
Constant	-5.057***
	(0.192)
Observations	13,680
R-squared	0.277
Industry	YES
Year	YES

Note: ***, ** and * denote the significance levels of 1%, 5% and 10% respectively, and the standard errors are shown in parentheses.

4.4.4. Robustness Test

Table 3. Result of robustness test

	(1)	(2)	(3)
	LnGI	L.LnGI	LnGI
CSR		0.206***	0.298***
		(0.0638)	(0.0583)
NCSR	0.400***		
	(0.0730)		
LnAge	-0.124***	-0.113***	-0.112***
	(0.0245)	(0.0286)	(0.0259)
LnSize	0.253***	0.263***	0.254***
	(0.00826)	(0.00912)	(0.00907)
Lev	0.119**	0.0956*	0.0996*
	(0.0496)	(0.0554)	(0.0528)
Cashflow	0.450***	0.563***	0.474***
	(0.121)	(0.138)	(0.128)
Growth	-0.107***	-0.131***	-0.111***
	(0.0190)	(0.0232)	(0.0198)
Indep	-0.215	-0.163	-0.163
	(0.134)	(0.148)	(0.144)
Dual	0.0886***	0.0866***	0.100***
	(0.0168)	(0.0188)	(0.0181)
TobinQ	0.0336***	0.0304***	0.0331***
	(0.00694)	(0.00789)	(0.00796)
SOE	0.127***	0.133***	0.119***
	(0.0197)	(0.0216)	(0.0210)
Constant	-5.056***	-5.285***	-5.103***
	(0.192)	(0.214)	(0.210)
Observations	13,680	10,931	11,508
R-squared	0.277	0.285	0.281
Industry	YES	YES	YES
Year	YES	YES	YES

Note: ***, ** and * denote the significance levels of 1%, 5% and 10% respectively, and the standard errors are shown in parentheses.

Firstly, replacement of the explanatory variable. Since the corporate social responsibility score (CSR) in this paper already includes the performance of environmental responsibilities, this paper deducts the score of this part to obtain a new corporate social responsibility score (NSCR). This approach can eliminate the high endogeneity caused by environmental responsibilities. Model 1 in Table 3 shows the regression results after replacing the explanatory variable. NCSR and LnGI are still significantly and positively correlated at the 1% level, indicating that the regression results of this paper are robust. Secondly, lagged variables. Due to the certain lag in the impact of current corporate social responsibility on green innovation, the explained variable is replaced with the green innovation level of the lagged first period. The explanatory variable CSR remains significant, ensuring the accuracy of the results. Thirdly, exclusion of the sample size. Due to the outbreak of the COVID-19 pandemic at the beginning of 2020, global economic growth was hindered and stagnated, and many small and medium-sized enterprises were negatively impacted to a certain extent. This paper believes that enterprises will have more or less influence on green innovation due to the stagnation of business income growth. Therefore, the data of 2020 are excluded for regression. The results are shown in Table 3, and the results are still robust.

4.5. Further Analysis

4.5.1 The Moderating Effect of Financing Constraints

This paper will next explore the moderating effect of financing constraints on the relationship between the performance of corporate social responsibility (CSR) and the level of corporate green innovation (LnGI). This paper uses the SA index to measure the financing constraints of enterprises and takes the absolute value of it. Considering that the calculation formula of the SA index includes the establishment years and scale of enterprises, the two control variables, LnAge and LnSize, are excluded during the regression to avoid the impact of collinearity between them and the moderating variable on the regression. The regression results are shown in Table 4. The results show that the independent variable, the moderating variable, and the interaction term are all significant, and the interaction coefficient is negative. This indicates that financing constraints have a negative moderating effect on the relationship between the performance of corporate social responsibility and the level of corporate green innovation. Among enterprises with greater financing constraints, the relationship between social responsibility performance and green innovation is weaker, which verifies Hypothesis H2 proposed earlier in this paper.

Table 4. Result of moderating effect

	LnGI
CSR	3.115***
	(0.593)
SA_CSR	-0.623***
	(0.159)
SA	-0.404***
	(0.0512)
Lev	0.753***
	(0.0447)
Cashflow	0.827***
	(0.122)
Growth	-0.0873***
	(0.0194)
Indep	-0.169
	(0.137)
Dual	0.0345**
	(0.0171)
TobinQ	-0.0191***
	(0.00687)
SOE	0.267***
	(0.0195)
Constant	1.252***
	(0.204)
Observations	13,680
R-squared	0.245
Industry	YES
Year	YES

Note: ***, ** and * denote the significance levels of 1%, 5% and 10% respectively, and the standard errors are shown in parentheses.

4.5.2. Heterogeneity Analysis

Firstly, the analysis is conducted based on whether the companies are multinational manufacturing enterprises. As shown in Table 5, CSR is significant in the sample of multinational manufacturing

enterprises, which is consistent with the research conclusion of Mu Tao et al. (2023) [41]. However, it is not significant in the sample of non-manufacturing multinational enterprises. This may be because manufacturing enterprises are the main entities of energy consumption and environmental pollution, and they face greater expectations and pressures. Moreover, the government's environmental supervision of manufacturing enterprises is usually stricter, and manufacturing enterprises need to comply with more environmental protection regulations and standards, which prompts them to invest more resources and efforts in green innovation.

Secondly, a regional heterogeneity analysis is carried out. In this paper, the regions where multinational enterprises are located are divided into the western region, the central region, and the eastern region. According to the table, in the samples of the central and eastern regions, the core explanatory variable CSR is significant, while it is not significant in the western region. This may be because the economic development levels in the eastern and central regions are generally higher than that in the western region. Enterprises in these regions may have more resources and funds to invest in green innovation. At the same time, the performance of social responsibility may be more valued by consumers and investors. Additionally, mature industrial chains and industrial clusters may have been formed in the eastern and central regions, and enterprises in these clusters can more easily promote green innovation through cooperation and communication.

Table 5. Result of heterogeneity analysis

	Manufacture	Non-manufacture	West	Midland	East
	LnGI				
CSR	0.493***	0.0199	0.150	0.491***	0.297***
	(0.0731)	(0.0871)	(0.227)	(0.165)	(0.0626)
LnAge	-0.160***	-0.117***	-0.854***	-0.340***	-0.0517*
	(0.0307)	(0.0396)	(0.106)	(0.0815)	(0.0266)
LnSize	0.307***	0.152***	0.273***	0.242***	0.256***
	(0.0105)	(0.0128)	(0.0340)	(0.0265)	(0.00904)
Lev	0.233***	-0.219***	0.0867	0.455***	0.0475
	(0.0618)	(0.0772)	(0.196)	(0.152)	(0.0539)
Cashflow	0.386**	0.494***	0.111	0.141	0.582***
	(0.156)	(0.178)	(0.504)	(0.361)	(0.131)
Growth	-0.138***	-0.0593**	-0.119*	-0.0933*	-0.0945***
	(0.0259)	(0.0260)	(0.0647)	(0.0484)	(0.0215)
Indep	-0.0646	-0.303	-0.0834	-0.0292	-0.314**
	(0.169)	(0.207)	(0.551)	(0.385)	(0.147)
Dual	0.114***	0.0275	-0.0506	-0.0856	0.111***
	(0.0202)	(0.0293)	(0.0797)	(0.0521)	(0.0181)
TobinQ	0.0379***	0.0207*	-0.00140	0.0370*	0.0336***
	(0.00889)	(0.0106)	(0.0311)	(0.0214)	(0.00758)
SOE	0.0600**	0.211***	0.393***	0.117**	0.0849***
	(0.0256)	(0.0294)	(0.0720)	(0.0548)	(0.0226)
Constant	-6.228***	-2.694***	-3.681***	-4.452***	-5.235***
	(0.242)	(0.305)	(0.801)	(0.585)	(0.211)
Observations	9,381	4,299	903	1,568	11,207
R-squared	0.258	0.346	0.439	0.310	0.293
Industry	YES	YES	YES	YES	YES
Year	YES	YES	YES	YES	YES

Note: ***, ** and * denote the significance levels of 1%, 5% and 10% respectively, and the standard errors are shown in parentheses.

5. Conclusions and Suggestions

5.1. Research Conlusions

This paper conducts an in-depth empirical study to explore the impact of the performance of social responsibility by Chinese multinational enterprises on green innovation and examines the moderating role of financing constraints. We find that there is a significantly positive correlation between the degree to which multinational enterprises fulfill their social responsibilities and their level of green innovation. This indicates that when enterprises attach more importance to social responsibility, they are more inclined to invest in green innovation, which helps to promote the sustainable development of enterprises. This study further reveals the negative impact of financing constraints on the relationship between corporate social responsibility and green innovation. In enterprises with greater financing constraints, the positive correlation between social responsibility and green innovation is weakened, suggesting that financing constraints may limit enterprises' investment in green innovation. This paper also conducts a heterogeneity analysis of enterprises of different types and regions and finds that the relationship between social responsibility and green innovation is more significant for multinational manufacturing enterprises as well as enterprises in the central and eastern regions. This may be related to the environmental regulatory pressure, resource availability, and the expectations of consumers and investors faced by enterprises in these regions and industries.

5.2. Policy Suggestion

At the micro level, enterprises should enhance their awareness of social responsibility, incorporate social responsibility into their core strategies, and ensure that the fulfillment of social responsibility is integrated with all aspects of corporate operations. When facing financing constraints, enterprises should optimize resource allocation, give priority to investing in green innovation projects, and ensure long-term sustainable development. Secondly, multinational corporations should strengthen communication with stakeholders. Through transparent and timely information disclosure, they can establish trust relationships with investors, consumers, and other stakeholders. In the context of globalization, multinational corporations should actively strengthen international cooperation, introduce advanced green technologies and management experiences, and enhance the international competitiveness of domestic enterprises.

At the meso level, industry associations and regulatory authorities should establish incentive mechanisms, such as tax incentives and financial subsidies, to encourage enterprises to carry out green innovation. At the same time, it is necessary to strengthen cooperation between enterprises, universities, and research institutions, jointly develop green technologies and products, and improve innovation efficiency and market competitiveness. By formulating and raising industry environmental protection standards, the ability of enterprises within the industry to enhance green innovation can also be promoted.

From a macro perspective, the government should use financial instruments such as green credit and green bonds to provide financing support for green innovation projects and reduce the financing costs of enterprises. The government should formulate and improve laws and regulations related to environmental protection and green innovation to provide legal guarantees for enterprises to fulfill their social responsibilities and promote green innovation. The government can establish a unified environmental information disclosure platform to improve information transparency and promote information exchange among enterprises, the government, and the public.

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