

Article

The Mediating Role of Green Technology Innovation with Corporate Social Responsibility, Firm Financial, and Environmental Performance: The Case of Chinese Manufacturing Industries

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Abstract: This research aims to examine the relationship between corporate social responsibility (CSR), firm environmental performance (FEP), and firm financial performance (FFP), as well as how green technology innovation performs a mediating role in this relationship. The manufacturing firms listed on the Shenzhen Stock Exchanges were selected as the representative sample for the study, and data were gathered from 470 managers and directors of manufacturing firms using a simple random sampling technique. The response rate was 87%. For hypothesis testing, PLS-SEM was used. In addition, green technology innovation is a positive and significant mediator between corporate social responsibility and firm financial and environmental performance. This research provides useful implications for manufacturing firms' managers, directors, and policymakers to improve corporate social responsibility (CSR) and green technology innovation in measuring the firm's financial and environmental performance. The results also have several practical implications that may benefit the management of firms. They urge all of the organization's stakeholders to consider investing in organizational social behavior and green innovation to enhance the manufacturing firms' overall performance.

Keywords: corporate social responsibility; green technology innovation; firm financial performance; firm environmental performance

1. Introduction

Manufacturing firms have been experiencing rising challenges from inside their stakeholders and outside the world to improve their financial and environmental performance across several matters, particularly social welfare and equitable employment practices [1]. Decision makers, stakeholders, and other investment firms are gradually advancing on environmental problems. They see sustainability initiatives as critical for a significant climate and economic sustainability gain. Furthermore, in the existing studies, there is not much discussion on the cumulative impact of corporate social responsibility (CSR) initiatives on firm financial and environmental performance in the Chinese manufacturing sector. In addition, corporate social responsibility and the development of green technology innovation are two of the most important aspects that impact a manufacturing firm's financial and environmental performance [2–5]. The purpose of corporate social responsibility is to consider stakeholders' diverse expectations and to positively influence an organization's

economic, social, and environmental performance [6]. The present research on corporate social responsibility mostly concentrates on its reasons and economic effects [7].

Investors are becoming more conscious of the importance of corporate social responsibility, which substantially impacts stock prices and financial performance [8]. Not only can a firm's involvement in corporate social responsibility initiatives improve shareholder value, but it also serves as an early warning indicator for potential corporate risks [9]. Corporate social responsibility initiatives have a substantial positive impact on sales and profit, resulting in a largely positive impact on firm performance when taken into account [10,11]. Corporate social responsibility activities, which include green innovation, environmental, and social activities, are specifically responsible for the large improvement in business performance that ultimately results in higher stock market returns [12,13]. Firms that participate in corporate social responsibility activities adhere to conservative business practices and judge their finances and operations to fulfill their shareholders' requirements [14]. Additionally, big firms are more likely to engage in corporate social responsibility initiatives emphasizing environmental performance [15]. Diversification into unrelated areas results in a considerable additional improvement in corporate social responsibility performance. This is because it increases the likelihood that larger social concerns will be faced, supporting long-term firm financial and environmental performance [16]. As a result, corporate social responsibility initiatives develop reputational capital and raise public trust, establishing a positive market effect toward greater financial and environmental performance [17].

Much research has been conducted to determine a relationship between corporate social responsibility and green technology innovation. The results, however, are considerably different from one another. Some of the studies that were done on the subject of the association among corporate social responsibility and green technology innovation concluded that manufacturers that participated actively in corporate social responsibility activities were more likely to implement green technology innovation measures to maximize the concerns of their stakeholders [18,19]. However, several scholars have assumed that corporate social responsibility activities do not increase the innovation of environmentally friendly technologies. This is because organizations allocate resources to maintain various external relationships [5]. Regarding the link between corporate social responsibility and green technology innovation, the positivist perspective posits that the involvement of green technology innovation influences corporate social responsibility initiatives. This is because such activities easily gain organizational attention.

As individuals become more worried regarding the environmental challenges affected, the manufacturing industry has focused more on green technology innovation [20]. It is very necessary for firms, particularly those in manufacturing sectors that produce a great deal of pollution, to take on the responsibility of preserving the environment. Firms should examine not just the advantages that could be gained by altering their operations to protect the environment but also the requirements of their customers and their responsibilities to society [21]. Pollution might, in certain contexts, be noticed as an indication of the ineffective idea of sources [22], which in turn has an impact on firms' profit. It is believed that introducing new technologies has been essential in resolving environmental issues by reducing the impact of pollution [23]. Therefore, green innovation has been recognized as crucial in addressing environmental challenges [24]. According to [25], green sustainability remains necessary and presents an opportunity to improve economic viability using win-win logic. Firms pioneers in green innovation approaches can maintain competing advantages [5]. According to [26], the manufacturing sector benefits from implementing green practices regarding their financial and environmental performance.

Currently, ample research concentrates on the effect of corporate social responsibility on non-firm performance [27,28], while the combined effects of corporate social responsibility and green technology innovation on Chinese manufacturing firms' environmental performance are unfamiliar. Additionally, there is inadequate statistical proof assessing the relationship of corporate social responsibility to green technology innovation that solves

firm financial and environmental problems. Based on the hypotheses, we developed a study model to fill in the gaps mentioned above in the literature. These hypotheses to the test, we first surveyed Chinese manufacturing firms' employees and gathered their responses. The structural equation modeling (PLS-SEM) outcomes demonstrated that corporate social responsibility and green technology innovation directly impacted firm financial performance and firm environmental performance. In addition, green technology innovation positively mediates the association among corporate social responsibility and firm financial and environmental performance.

The arrangement of this article is as follows. The first part of this article is the introduction, which describes the research background. The second part of this research presents the study's theoretical background and the development of hypotheses. The third part argues the research methodology, research techniques as well as the reliability and validity of the data. After that, in the fourth part section, the findings of the research are discussed. Moreover, in the fifth part, we explain the findings of our study and the significance of these results. The last part makes recommendations for shareholders, manufacturing firms, and CSR committees, highlights this study's limitations, and suggests potential future directions.

2. Literature Review and Hypothesis Development

2.1. Corporate Social Responsibility and Firm Financial Performance

When a firm improves overall performance, corporate social responsibility is an integral part. The link with corporate social responsibility and the financial performance of corporations has been the subject of several theoretical and empirical studies. Despite this, the results of the investigation are not yet considered convincing, and there has been no agreement concluded on their findings [26]. According to [29], empirical research on the effect of corporate social responsibility initiatives on the financial outcomes of corporations has produced contradictory findings. Those who have recommended the negative and significant association among corporate social responsibility and financial performance [30,31] have argued that a high level of social obligation consequences in further expenses that consider a firm at a financial drawback in comparison to competitive firms that are excluding socially accountable. Similarly, these additional expenditures might affect from creating substantial donations to charity causes, sponsoring community development initiatives, operating plants in economically poor places, or creating environmental protection measures. According to [32], agency theory suggests that corporate social responsibility may harm the corporation since it may result in agency costs and unnecessary extra expenditures, consequently lowering the industry's operation. These expenses cause a dispute of concern among investors who view intensified devoting upon corporate social responsibility as an attempt towards enhance the firms' reputations, which will positively affect the firm value. However, higher spending on corporate social responsibility additionally indicates a wastage of the firm's assets, particularly if a substantial improvement does not follow in the firm's performance. This conclusion is confirmed by the findings of [33]. They found that the amount of money a firm donates and the worth of the firm has a negative correlation. When managers spend excessive resources on corporate social responsibility initiatives for their interests, agency costs rise. This has the effect of damaging shareholders' interests and definitively lowering the firm's value.

On the other hand, several researchers [34,35] suggest that there is no significant link between corporate social responsibility and the financial performance of firms. Furthermore, these studies claimed no relationship with corporate social responsibility and firm financial performance. They contend that the strongly positive link shown in earlier literatures will become less significant, but the study framework is developed with a greater level of specificity. Therefore, according to them, corporate social responsibility cannot improve firms' financial performance. Several studies have demonstrated a constructive correlation among corporate social responsibility and corporates performance [36,37] As per prior findings, corporate social responsibility is able to boost a firm's short-term and long-term

performance [38]. The meta-analysis among corporate social responsibility with financial performance was carried out by [39]. Their study examined 437 different studies and concluded that socially responsible firms had substantially higher profits than firms with a lower level of responsibility. The primary explanation for the positive relation is that corporate social responsibility helps firms gain a competitive edge. Investment in corporate social responsibility can increase a firm's profitability by lowering its operating costs, boosting the assets of its shareholders, and improving employees' skills [8]. Because clients want to acquire and give a quality for the goods produced by socially responsible businesses, firms can enhance their financial position and sales due to higher levels of competitiveness. According to the findings of several studies, corporate social responsibility boosts a firm's financial performance in many ways, including recruiting more competent workers, mitigating risks, constructing a favorable reputation, and enhancing customer satisfaction [40].

The largest number of literatures on corporate social responsibility and firm financial performance have relied upon data from western nations [41]. Many have said a positive correlation, corporate social responsibility with financial performance. Similarly, [42] studied the effect of corporate social responsibility on Pakistan's private commercial banking sector and collected data from 2008–2017. The finding of their studies indicates a strong positive association with corporate social responsibility and banks financial performance, which means commercial banks that invest more in corporate social responsibility create excellent client relationships. Furthermore, [43] conducted a study based on a data sample of Spanish-registered firms and found positive and significant relations between corporate social responsibility and financial performance. With the gap-predicted and actual presence of the corporate social responsibility into the firms in growing countries, few investigators have examined the link of corporate social responsibility with firm financial performance in highly industrialized countries in the world, specifically in the manufacturing sector. Prior scholars predicted that a similar association with corporate social responsibility and FFP would be noticed in firms in China. Therefore, we formulated the following hypothesis:

Hypothesis 1 (H1). *CSR has a positive relationship with a firm financial performance.*

2.2. Corporate Social Responsibility and Firm Environmental Performance

Several alternative explanations might be given for why corporate social responsibility activities have become widespread in the manufacturing industry. It may be due to the pressure put on them by several stakeholders and competitors [44]. A direct consequence of customers' prospects for environment-conscious goods and services, firms are more likely to support corporate social responsibility initiatives. A green entrepreneur is an entrepreneur in the manufacturing sector committed to safeguarding the natural environment, controlling activities that generate environmental threats, as well as launching green goods to the marketplace [45]. Many manufacturing firms consistently face pressure from stakeholders to be actively engaged in corporate social responsibility initiatives to lessen the effect they have on the environment [46].

Researchers in the present time are in consensus that corporate social responsibility is the extremely popular corporate approach since it creates various advantages for firms [47,48]. From a wider context, corporate social responsibility is based on the eco operations associated with specific manufacturing firms and the preventative measures or restriction of negative environmental effects produced by industries. This concept encompasses the aspects of firm governance and its environmental outcomes. According to [15], corporate social responsibility must incorporate the characteristics of revealed authority, reliability, and environmental performance.

Moreover, corporate social responsibility provides environmental data on the waste removal, including vital environmental statistics at wastewater and pollution [49]. Furthermore, a significant amount of research that has been done on corporate social responsibility concentrates on the effect that corporate social responsibility initiatives have on the organi-

zation's economic performance [38,50]. The correlation of corporate social responsibility with environmental performance has recently been the subject of much attention [3]. For instance, studies in Pakistan's manufacturing and service sectors [44] and Nigeria's manufacturing sector [51] indicated that corporate social responsibility significantly influenced organizational environmental performance. Even though prior studies have indicated that corporate social responsibility positively impacts the firm environmental performance [52]. Similarly, firms are able to increase their social related capital by selling their assets to customers who encourage environmentally friendly behaviors. It has also been suggested that implementing corporate social responsibility in the manufacturing sector may increase that firm's competitive advantage [53]. The researchers agree with the premise that activities related to corporate social responsibility may reduce the environmental effect of manufacturing firms, and we propose the following hypothesis because of the above findings.

Hypothesis 2 (H2). *CSR has a positive relationship with firm environmental performance.*

2.3. Corporate Social Responsibility and Green Technology Innovation

Green technology innovation generally entails the involvement of numerous external supports because it is a more complicated rational process than outdated technology innovation, which usually requires the formation, incorporation, and dissemination of awareness in various procedural arenas within a manufacturing sector. This is because green technology innovation is a more complex activity overall. It is often characterized by dynamic and diversified content, a very complicated research and development process, and high unpredictability [54]. Because of these characteristics, it is impossible to innovate in the domain of green technology innovation by depending on one's prior technical competence in a single specialized field of technology [55]. In a similar vein, extraordinary corporate social responsibility contribution can enhance with the relations between an organization and an outer stakeholder [56], assist an organization in obtaining the acknowledgement and endorsement of the stakeholders [57], and gain a larger range of resources for the improvement of green technology innovation.

High levels of corporate social responsibility participation can assist businesses in acquiring necessary external resources such as technological know-how, highly skilled employees, and outside financing by improving their association with exterior stakeholders in addition reducing the risk associated with making investments from the outside. For instance, organizations can entice financial investment from financiers [58]; human assets in the way of exceptional personnel [59]; market assets, for instance clients and merchants [60]; environmentally oriented and organizational assets from the state government and the public; moreover, science and information technology from education sectors and institutions and from research centers. Corporate social responsibility in manufacturing firms, however, cannot be overlooked these days, and there is an increasing need for environmental protection [38]. These businesses are expected to embrace environment-oriented innovative performances effectively [55,61]. In addition, studies have determined that innovation has a role in both corporate social responsibility and the performance of organizations [62,63]. However, there is currently a shortage of studies on how corporate social responsibility is performed in diverse nation contexts, especially regarding sustaining business firm financial performance via green technology innovation [64]. Therefore, providing the opportunity for scholars to explore the significance of corporate social responsibility, as well as the categorization of corporate social responsibility in countries such as China with environmentally viable improvement and green technology innovation.

As a consequence of this, these manufacturers spend both internal and external assets in a way that is harmonizing to support the innovation of environmentally friendly technologies. In addition, corporate social responsibility has the potential to encourage the innovative involvement of manufacturing firms [13] and to support the integration of

an organization's internal knowledge sources, therefore supporting a technology basis for green innovation. In light of the above, we postulate the following hypotheses:

Hypothesis 3 (H3). *Corporate social responsibility has a positive relationship with green technology innovation.*

2.4. Green Technology Innovation and Firm Financial Performance

The development of green technology innovation may influence the financial performance of manufacturing enterprises by lowering expenses. The price of raw materials might be brought down by improving the design of the product and making more use of recycled materials. It could be possible to lower the costs associated with pollution control at later phases of the manufacturing firm by establishing environmentally conscious processes. Additionally, since there is less pollution, there will be fewer fines and a lower chance of future litigation [65], which might increase the revenue for the manufacturing firm. Developing green goods might provide firms with access to more markets. In many countries, government procurement of products is subject to certain regulations for the raw materials of the commodities to be acquired, such as the reprocessing of resources and the preservation of the raw materials [66]. Therefore, green products may open up new markets, expand their market share, and raise their income from sales [67]. According to [68], implementing green technology might enhance a firm's image, make it more appealing to investors on the capital market, and encourage corporate financing.

Green technology innovation has a positive effect on a firm's economic related performance [66]. Investing in research and development for green technologies increases firm value, lowers manufacturing and processing costs, increases manufacturing scale, and grows share, as well as assisting a firm in gaining the advantages of the green technology patent of invention transfer [69]. Simultaneously, firms have the chance to secure long-term competitive dominance and establish the foundation designed for potential future growth by securing patents for green technology that result from technological innovation operations. Innovation in green technology refers to the enhancement of current manufacturing operations and the use of environmentally friendly technologies in order to manufacture products and deliver services that have either no effect on the environment at all or a limited effect on the environment than traditional methods [70]. Firm performance is often described in terms of a business's performance and associated measures, such as sales, return on investment (ROI), market and stock market performance, and associated other intangibles; nevertheless, researchers cannot disregard the importance that green technology innovation plays in the current marketplace [21]. Certain kinds of green technology-based process improvements have the potential to cut down on unnecessary production and operating expenses, therefore indirectly raising a firm's revenues and increasing its overall economic performance [71]. Similarly, the development of green innovation has a constructive influence on the dominant improvement of firms as well as their public image [72]. In light of all of these considerations to take into account, we suggest the following hypothesis:

Hypothesis 4 (H4). *Green technology innovation has a positive relationship with firm financial performance.*

2.5. Green Technology Innovation and Firm Environmental Performance

The macro and micro levels can be addressed when analyzing environmental performance. From a microscopic point of view, environmental performance encompasses a wide range of standards or direct management factors mandated by the most recent environmental regulations. These factors include water quality, air impurities emission, hard waste manufacture, and disturbance quantities [73]. Generally quantitative and standardized, these environmental indicators may be combined into a single indication or weighted to quantify various environmental consequences [74]. Therefore, a firm's environmental

performance in micro level indicates the validity of its operation from an environmental perspective. According to [75], evaluating an organization's deep-rooted efforts in pollution, protection of natural reserve, and ecological rebuilding can be performed through macro-level environmental performance. This approach is both systematic and dynamic.

Previous research [3,76,77] has shown a positive relationship between green technology innovation and an organization's environmental performance. According to [78], an organization's green technology innovation is associated with the environmental management agenda of the firm, and this relationship is capable of significantly increasing environmental outcomes. Green processes and products not only diminish an organization's destructive effect on the natural world, but they also reduce the wastage of resources and decrease costs in the process, which results in an overall improvement in the social and financial performance of the firm [79]. Firms that engage in the green process and product innovation capability may significantly change how they operate their current products and processes, or they may even develop brand-new products and processes with a suggestively lower negative environmental impact [80]. Consequently, a firm's environmental performance may be improved to some degree by any green technology innovation [81]. A firm that implements green technology has the overarching goal of satisfying its clientele's requirements while simultaneously reducing production expenses and the environmental impact caused by its operations, such as emissions of greenhouse gases [82]. Within the green technology industry, taking an environmental point of view is one of the ways to achieve sustainable firm performance, which is one facet of the concept of sustainability [83]. The Chinese government has placed a significant emphasis on implementing cleaner manufacturing to lessen the manufacturing industry's negative effects on the environment [84]. The following hypothesis is presented based on these considerations:

Hypothesis 5 (H5). *Green technology innovation has a positive relationship with firm environmental performance.*

2.6. Green Technology Innovation as a Mediator

According to a research study, adopting corporate social responsibility in a manufacturing firm eventually influences the firm's environmental performance. Nevertheless, to assess the direct impact of corporate social responsibility on a firm's environmental performance, a (mediating) variable must be included. Green technology innovation has long been recognized as a bridge between corporate social responsibility and firm environmental performance. Furthermore, rather than having a direct impact on the firm's environmental performance, corporate social responsibility first promotes green technology innovation, which in turn impacts the firm environmental performance. These are referred to as direct and indirect consequences. According to the Porter hypothesis, tough environmental rules that generate innovation may balance the costs of compliance with these requirements and positively benefit these organizations' business performance [85,86]. According to [87], environmental rules affect firm performance and indirectly motivate firms to implement green technology innovation. According to the well-known "Porter hypothesis", appropriately built environmental legislation can encourage green technology innovation and, as a result, improve firm competitiveness and productivity improvement, suggesting that the development and execution of environmental data disclosure can improve economic performance through green technology innovation [88].

According to earlier research studies on the relationship between corporate social responsibility, green technology innovation, and environmental performance, corporate social responsibility impacts green technology innovation, which leads to improved environmental performance. Moreover, corporate social responsibility increases organizational performance substantially, according to previous studies [4,89]. Nonetheless, [90,91] identified a mixed link between corporate social responsibility and firm financial performance. The innovation of a firm's technology may also lead to the firm's enhanced business performance and enhanced environmental performance. According to [92], intangible assets such

as innovation may be the missing component that might elucidate correlations between corporate social responsibility and firm financial performance.

In addition, researchers cannot rule out the possibility of green technology innovation between corporate social responsibility and firm financial performance [93]. In addition, [3] suggested that green innovation is one of the primary variables impacting the link between corporate social responsibility and firm financial performance. Consequently, the link between corporate social responsibility and firm environmental performance is unclear and mixed. As a result, the link between a firm environmental and financial performance with corporate social responsibility should be investigated further by introducing a mediating variable. Thus, green technology innovation can be considered as a mediating hypothesis, in which green technology innovation acts as a bridge between the manufacturing sector's environmental and financial performance. Green technology innovation is believed to be a key mediator between corporate social responsibility, firm financial, and environmental performance in current research. As a result, the H6 and H7 hypotheses can be formulated:

Hypothesis 6 (H6). *Green technology innovation mediates the relationship between corporate social responsibility and firm financial performance.*

Hypothesis 7 (H7). *Green technology innovation mediates the relationship between corporate social responsibility and firm financial performance.*

The proposed hypotheses are graphically presented in Figure 1.

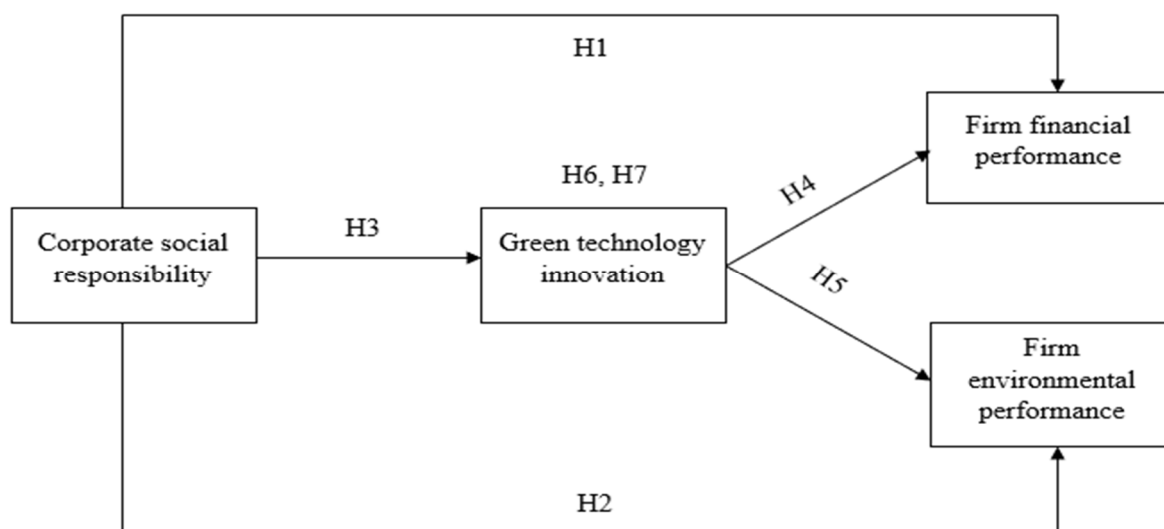


Figure 1. Research framework.

3. Methodology

3.1. Data Collection and Sample

The primary reason behind this investigation is why manufacturing firms in China represent an ideal scenario for empirically evaluating the study framework previously mentioned above. The significant gaps across particular manufacturing organizations in terms of their level of green transformation make for a diverse sample. The Chinese government, which is constrained by resources, the environment, and society, pays a great deal of attention to the transformation of manufacturing sectors, and certain manufacturing organizations have achieved fast growth by employing green technology innovation. An organization's financial performance and its impact on the environment may be improved through the development of green technology innovation, which brings us to the second point. For instance, China's implementation of a sewage charge system helps to strike a balance between the expenses and advantages of developing green technology innovation.

For the aim of this study, researchers used a quantitative approach and a structured questionnaire set as the research method to conduct a survey, which was performed through email.

The results of a questionnaire study of manufacturing organizations in 10 capital cities throughout the province have been compiled. Using the research group's initial plan collaborative effort and social network interaction, we conveyed with industrial parks, discussed the goals of our initial study, and sent emails to the managers and directors. In light of the limited sampling extent and the possibility of low response rates, we sent questionnaires to managers and directors of manufacturing organizations. In addition, this study targeted managers and directors of these manufacturing firms as survey respondents. Because these managers and directors are aware of the green and social issues of the firm's financial and environmental performance aspects, such as corporate social responsibility and green technology innovation in their manufacturing facilities. The result of this research was reached in the period of three months, from June 2022 to September 2022. Nine hundred manufacturing organizations were contacted via email and requested to participate in the study. As a result, 540 questionnaires were submitted, representing a response rate of 60%. Seventy of these responses were removed because they were deemed undesirable as a result of providing responses that were either incomplete or conflicting. Overall, 550 questionnaires were sent out to managers of listed firms using simple random sampling techniques per the cross-sectional design. Consequently, the following information is derived from a representative sample of 470 valid surveys, with an accuracy rating of 87%.

Among the participants who were appropriate for analysis, 132 (28%) held the position of departmental manager, 84 (18%) were operational managers, 97 (21%) were production managers, and 157 (or 33%) were technical managers. As a result, the majority of those who agreed to be interviewed were either technical managers or department managers who had a strong grasp of the topics that were the focus of the questionnaire. Table 1 shows the detailed description of the participants and their demographic characteristics.

Table 1. Demographic of respondents.

Demographic	Description	Percentage (%)	Frequency	N
Job title	Department manager	28	132	470
	Operation manager	18	84	
	Production manager	21	97	
	Technical manager	33	157	
Year of organizations	5 years or less	18	88	470
	5–10 years	31	143	
	10–15 years	19	91	
	15–20 years	23	106	
	20 years and above	9	42	
Organizations ownership	Public firm	29	138	470
	Private firm	42	197	
	Joint-stock firm	10	46	
	Self-employed	19	89	
Employees' number	20 or less than	14	66	470
	21–200	18	83	
	201–400	23	108	
	401–600	27	126	
	600 and more	18	87	
Annual profit	\$3 MM and less	6	29	470
	\$4–10 MM	31	147	
	\$11–15 MM	34	160	
	\$16–20 MM	17	78	
	\$21 and more MM	12	56	

3.2. Measures

The literature review was the basis for the questionnaire's design. The items were evaluated using a five-point Likert scale, with the lowest possible score being "not at all satisfied" (NAS = 1) and the highest possible score being "very satisfied" (VS = 5). Management research scholars have adopted this kind of measure in massive quantities [94]. It also collects information on the manufacturing organization's position, business revenue, managers, and the directors of the manufacturing organization as part of the basic information assessment. Table 2 shows the results of the measurements taken for each variable.

Corporate social responsibility was measured using seven items adopted from the [95]. The firm's financial and environmental performance is the dependent variable for this study. The firm's financial performance was measured using five items that were adopted from the study of [66], and the firm's financial environmental performance was also measured using five items, but these items were adopted from the study of [96]. In addition, green technology innovation, which served as a mediating variable in this study, was evaluated using five items taken from the study of [97].

Table 2. Variables and measurement items.

Variables	No. of Items	Sources
Corporate social responsibility	7	[95]
Green technology innovation	5	[98]
Firm financial performance	5	[66]
Firm environmental performance	5	[96]

3.3. Data Analysis

Based on its reliability and validity, a measurement model was tested through its fitness test to determine if the developed research framework accurately represents the real situation objectively. The internal consistency and reliability of the established scale are tested using Cronbach's coefficient, and the scale's validity is examined. The analyses were carried out using the SmartPLS software 3.3.7 version, and Table 3 contains the research findings. Firm directors and managers filled out the survey, and the possibility of bias caused by a common method was considered. In terms of the controls that were implemented throughout the procedure, respondents were able to complete the survey confidentially, and all of the questions included within the survey were simple. In addition, distinct variables measuring various issues were divided clearly and concisely throughout the survey. A Harman single factor was used to evaluate the possible presence of common method biases. This allowed for a quantitative assessment of whether or not a common method may nonetheless still exist. The test results indicated that a single factor contributed to the chi-square value of 731.786 (df = 143). It had a degree of fit that was much less accurate than the multi-factor measurement model, which had a value of 423.147 (df = 136). As a result, it was determined that the impact of common method biases is appropriate.

Table 3. Reliability analysis and convergent validity.

Construct	Code	F. Loading	Cronbach's α	Composite Reliability	AVE
Corporate social responsibility	CSR1	0.857	0.920	0.936	0.676
	CSR2	0.720			
	CSR3	0.803			
	CSR4	0.833			
	CSR5	0.821			
	CSR6	0.838			
	CSR7	0.876			

Table 3. Cont.

Construct	Code	F. Loading	Cronbach's α	Composite Reliability	AVE
Firm environmental performance	FEP1	0.836	0.914	0.935	0.742
	FEP2	0.889			
	FEP3	0.833			
	FEP4	0.864			
	FEP5	0.883			
Firm financial performance	FFP1	0.929	0.954	0.965	0.845
	FFP2	0.941			
	FFP3	0.890			
	FFP4	0.927			
	FFP5	0.909			
Green technology innovation	GTI1	0.937	0.960	0.969	0.863
	GTI2	0.949			
	GTI3	0.921			
	GTI4	0.923			
	GTI5	0.915			

3.4. Measurement Model

This study assessed specific measures' validity, including convergent and discriminant validity, as demonstrated in Table 3. The reliability of individual measures, as well as the reliability of the composite of measures for every construct (internal consistency reliability), was also evaluated. Internal consistency reliability was the first criterion that was taken into consideration. This criterion comprised both Cronbach's alpha and the composite reliability (Figure 2) to determine whether or not the measurement model was adequate. Cronbach's alpha values should be more than 0.70, as [98] recommended, which indicates a high level of internal consistency. In addition, the composite reliability values have to be more than 0.70, indicating a high-reliability level [99]. Each item has a standardized factor loading that ranges from 0.720 to 0.949, which is more than the suggested minimum value of 0.600. According to the findings, the factor loading of every item is more than the threshold value (see figure).

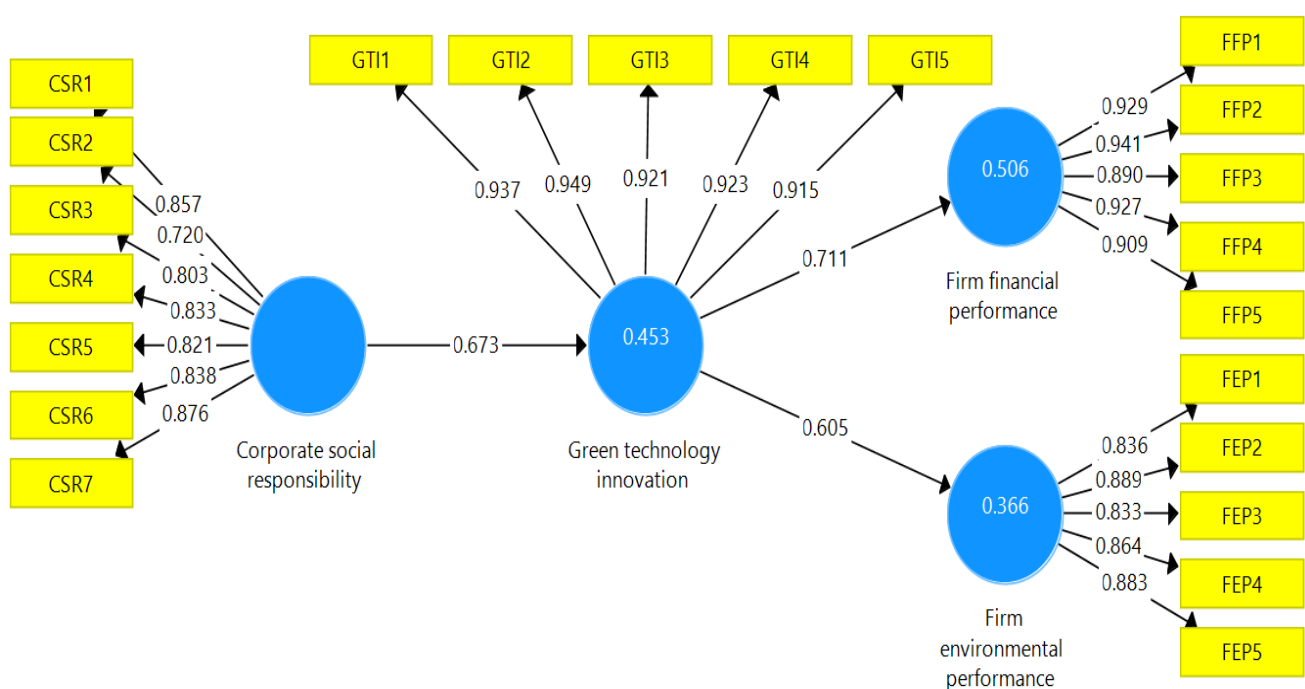


Figure 2. Measurement model.

The validity and reliability of the variables have also been investigated through the method of calculating the average variance extracted (AVE). The validity has been shown by obtaining an AVE of more than 0.50 across the table for all variables. This research fulfills the criteria of reliability, as well as the convergent reliability of all variables.

In order to complete the calculation of the measurement model, the last criteria are discriminant validity. When researchers observe that two indicators must differ statistically, they refer to a situation referred to as discriminant validity [100]. A conventional metric for computing discriminant validity was suggested by [99]. The discriminant validity of a conventional metric can be evaluated using one of two approaches: either one compares the square root of the AVE to the correlational values, while the other one compares the AVE to the squared correlational values (Table 4).

Table 4. Discriminant validity Fornell and Larcker criterion.

Variables	CSR	FEP	FFP	GTE
Corporate social responsibility	0.822			
Firm environmental performance	0.739	0.861		
Firm financial performance	0.721	0.611	0.919	
Green technology innovation	0.673	0.605	0.711	0.929

Note: CSR stands for corporate social responsibility, FEP denotes firm environmental performance, EFP is firm financial performance, and GTE represents green technology innovation.

According to [100], after 36 years, the latest method was presented to calculate the discriminant validity termed heterotrait-monotrait (HTMT), which replaced the outmoded standard metric approach. In this study, we used discriminant validity, including [100] and HTMT (Tables 4 and 5). When there is a smaller gap between the loadings, the HTMT is a suitable strategy. The HTMT value should be 0.85 for all latent variables with different natures and 0.90 for all latent variables. All latent variables have HTMT values less than 0.85, as shown in Table 5. The requirements for discriminant validity are therefore accomplished.

Table 5. Discriminant validity HTMT criterion.

Variables	CSR	FEP	FFP	GTI
Corporate social responsibility				
Firm environmental performance	0.809			
Firm financial performance	0.744	0.643		
Green technology innovation	0.691	0.624	0.742	

Note: CSR is corporate social responsibility, FEP denotes firm environmental performance, EFP stands for firm financial performance, and GTE represents green technology innovation.

3.5. Regression Model Test

Structural Model

After performing the outer model, we tested the hypotheses they made in the first part of this article in this portion. There are five direct and two indirect hypotheses in this study. We performed the analysis with the SmartPLS 3.3.7 version and ran bootstrapping with 5000 sub-samples. The structural model is shown in Figure 3. Furthermore, Table 6 shows that corporate social responsibility is strongly associated with firm financial performance ($\beta = 0.479$, $p = 0.000$, t -value = 7.414), and the result is supported by H1. Additionally, corporate social responsibility is positively and significantly related to firm environmental performance ($\beta = 0.407$, $p = 0.000$, t -value = 7.615), which supports H2. As shown by ($\beta = 0.673$, $p = 0.000$, t -value = 14.603) and supported by H3, corporate social responsibility has a strong effect on green technology innovation. Additionally, green technology innovation has a positive and significant effect on firm financial performance ($\beta = 0.711$, $p = 0.000$, t -value = 12.398), which confirms H4. Green technology innovation improves the firm's environmental performance by a considerable impact ($\beta = 0.605$, $p = 0.000$, t -value = 12.661),

which confirms H5. While the results of green technology innovation as a mediating vary with corporate social responsibility, firm financial performance and firm environmental performance relationships show that green technology innovation is positively and significantly mediated ($\beta = 0.631, p = 0.000, t\text{-value} = 9.708$; $\beta = 0.541, p = 0.000, t\text{-value} = 10.208$), and therefore H6 and H7 are supported.

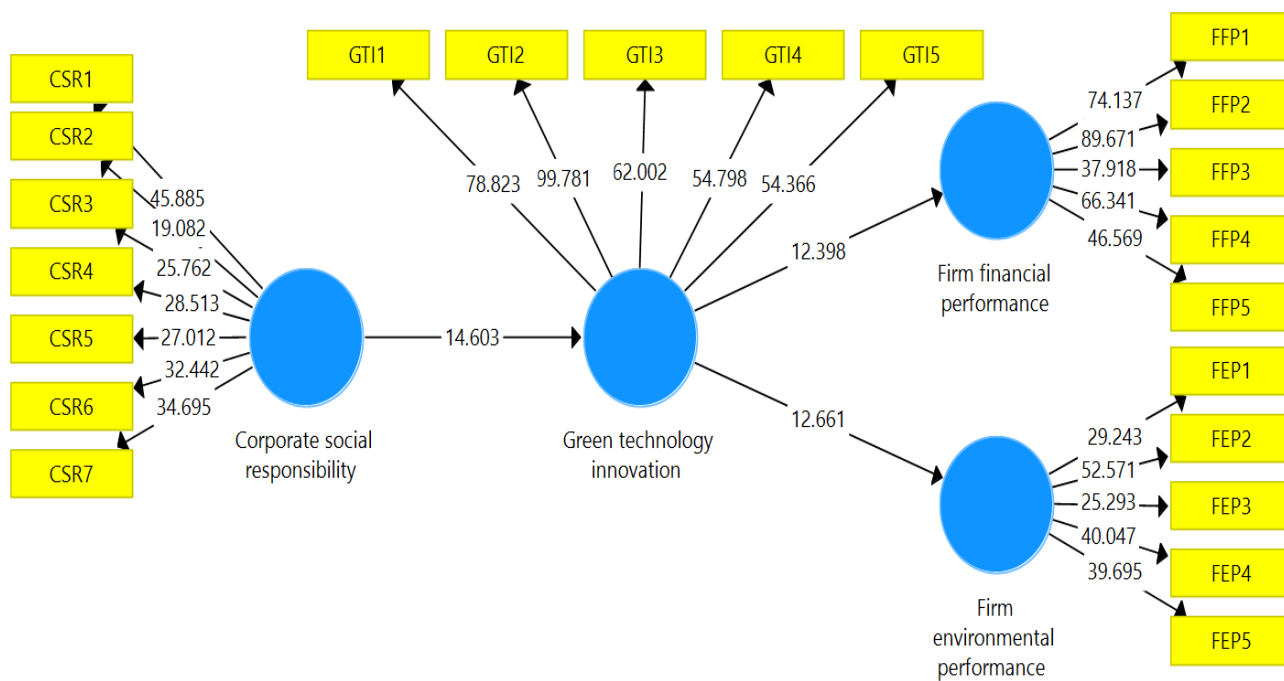


Figure 3. Structural model.

Table 6. Direct and indirect hypotheses results.

Hypotheses	Paths	β Values	t -Values	p -Values	Results
H1	CSR $\rightarrow$ FFP	0.479	7.414	0.000	Supported
H2	CSR $\rightarrow$ FEP	0.407	7.615	0.000	Supported
H3	CSR $\rightarrow$ GTI	0.673	14.603	0.000	Supported
H4	GTI $\rightarrow$ FFP	0.711	12.398	0.000	Supported
H5	GTI $\rightarrow$ FEP	0.605	12.661	0.000	Supported
H6	CSR $\rightarrow$ GTI $\rightarrow$ FFP	0.631	9.708	0.000	Mediated
H7	CSR $\rightarrow$ GTI $\rightarrow$ FEP	0.541	10.208	0.000	Mediated

Note: CSR represents corporate social responsibility while FFP denotes firm financial performance. Environmental firm performance is represented by FEP. GTI is green technology innovation.

Some researchers have shown that it is essential to calculate Q2 to determine whether or not the model has any predictive value [101]. The blindfolding method is the one that is used to calculate Q2 in SmartPLS. According to [102], the Q2 value ought to be greater than zero. According to [103], a Q2 value between 0.02 and 0.015 implies a relatively small influence, a Q2 value between 0.15 and 0.35 shows a relatively medium effect, and a Q2 value larger than 0.35 indicates a considerably large predictive significance. According to the findings of this research, green technology innovation (with a Q2 value of 0.387) has a larger effect, firm financial performance (with a Q2 value of 0.423) also has a larger significant effect, and firm environmental performance (with a Q2 value of 0.255) has a medium predictive relevance effect. According to this study's findings, exogenous variables reflect a large amount of light on endogenous variables.

The amount of variation that can be attributed to external variables as a whole is denoted by the statistics known as R2. According to the findings of this research, exogenous variables can explain 37% of the firm's environmental performance, 51% of the firm financial

performance, and 45% of the green technology innovation. [104] identifies three distinct levels of R^2 : weak (R^2 between 0.02 and 0.13), moderate (R^2 between 0.13 and 0.26), and substantial (R^2 more than 0.26). According to the findings of this research, firm environmental performance, firm financial performance, and green technology innovation all meet the criteria as substantial. In addition, to calculate the value of R^2 for endogenous variables, some researchers recommended determining the effect size, or f^2 , of each path in the inner model [105]. Whether or not an exogenous variable substantially influences the value of the f^2 can determine an endogenous variable. According to [103], a value of f^2 between 0.05 and 0.15 is regarded to have a small influence, a value of f^2 between 0.15 and 0.35 is considered to have a medium effect, and a value of f^2 more than 0.35 is considered to have a large effect. Green technology innovation has a larger effect on both firm environmental performance and firm financial performance. In addition, corporate social responsibility has a larger influence on green technology innovation ($f^2 = 0.829$).

4. Discussion and Conclusions

The purpose of this research was to investigate the relationship between corporate social responsibility, a firm's financial performance, and firm environmental performance of Chinese manufacturing firms, with a focus on the role of green technology innovation as a mediator. According to [3,34], corporate social responsibility and green technology innovation are regarded as organizational resources that have the potential to play a significant role in improving a firm environmental and financial performance. The findings are consistent with those of [15,27], who stated that corporate social responsibility positively affected a firm's financial performance and firm environmental performance. The results reflect the findings of both studies of [5], which showed that green technology innovation is positively related to firm's financial performance because green technology innovation is regarded as an intrinsic component of increasing firm's financial performance. This finding demonstrates that a firm's financial performance positively determines green technology innovation. Research has been conducted in various organizational and cultural contexts on the correlation between corporate social responsibility, firm's financial performance, and firm environmental performance. However, the importance of mediating factors in this circumstance has been disregarded, especially in the industrial sectors.

The corporate social responsibility and green technology innovation literature in manufacturing firms will benefit from the contribution of this research. The findings demonstrate that corporate social responsibility positively affects the firm's financial performance of Chinese manufacturing sectors. These findings are consistent with earlier research [106,107]. In addition to that, this study shows that corporate social responsibility is positively and significantly affected by firm environmental performance, and the findings are consistent with [3,15]. The findings also provide credence to the concept that corporate social responsibility positively affects a firm's financial performance and firm environmental performance. According to the results of this investigation, the concentration of satisfaction experienced by a manufacturing firm's stakeholders increases when the firm invests its resources in activities related to corporate social responsibility (CSR). Further evidence suggests that corporate social responsibility and green technology innovation are seen positively in China's manufacturing sector and are potential investment sources. These firms are seen as profitable, making them a preferred investment choice. According to [108,109], firms that spend resources on social responsibilities and green technological innovations can make more revenue than firms that invest less in corporate social responsibility and green technology innovation. In general, investors are prepared to spend more resources on firms that demonstrate a commitment to social responsibility and green technologically innovative. Therefore, the research has supported the hypothesis that corporate social responsibility positively correlates with green technology innovation, firm financial performance, and firm environmental performance.

In order to evaluate the indirect impact of corporate social responsibility on firm financial performance and firm environmental performance because green technology

innovation, as a mediator, previously, the role of green technology innovation as a mediator in the association between these variables has been neglected. According to [110], a positive green technology innovation leads to advantages for financially and non-financially related firms. In addition, firms must improve their public image by developing a green technology innovation that is deemed as a market activity. Stakeholders consider these aspects when developing their ideas on a firm's situation in the market. As a result, we have studied the role that green technology innovation performs as a mediator in the relationship between corporate social responsibility, firm's financial performance, and firm environmental performance. According to the findings, the association between corporate social responsibility, a firm's financial performance, and firm environmental performance is partially mediated by green technology innovation. These outcomes are in line with previous studies [83,111]. This study aims to clarify how corporate social responsibility may have a positive influence on a firm's financial performance and firm environmental performance through the use of empirical evidence. It is possible to conclude that the positive influence that corporate social responsibility has had on a firm's financial performance and firm environmental performance is associated with the development of green technology innovation. By encouraging the use of environmentally friendly technologies inside businesses and focusing on improving both firm's financial performance and firm environmental performance, corporate social responsibility helps increase the profitability of China's manufacturing sectors.

On the other hand, this study found several intriguing results, seeing as it used green technology innovation to investigate firm environmental performance, and found a match with another study by [112]. The findings suggest that corporate social responsibility and green technology innovation directly impact firm's financial performance and firm environmental performance; moreover, management cannot ignore it because prior research has shown that corporate social responsibility and green technology innovation significantly increase a manufacturing firm's financial and environmental performance. Consequently, the management must consider these findings. On the other hand, corporate social responsibility has an increasingly major impact on green technology innovation. In addition, the results of this research indicate that green technology innovation must be regarded as a major predictor. In conclusion, the green technology innovation has significantly and positively mediated the relationship between corporate social responsibility, firm's financial performance, and firm environmental performance. In addition, the conclusions of this study confirm this as green technology innovation, which greatly explains the relationship between corporate social responsibility, firm's financial performance, and firm environmental performance, and is regarded as the primary organizational resource.

4.1. Theoretical and Managerial Implications

The theoretical contribution includes a certain kind of study outcome that can give unique understandings into a sensation that is deemed as important for enhancing the value of an organization. This research provides a new perspective by analyzing study constructs through the lens of empirical data. This research makes several contributions that might be helpful to academics, policymakers, and practitioners. The present investigation contributed by establishing the link between corporate social responsibility, firm's financial performance, and firm environmental performance, with the green technology innovation performing the role of a mediator in the relationship. As a result, the current study substantially promotes the manufacturing industries. In the present study, corporate social responsibility, green technology innovation, firm's financial performance, and firm environmental performance have all been incorporated into a single research model for the first time, as far as the most knowledgeable researchers know. Management cannot ignore this fact, even though corporate social responsibility and green technology innovation have a direct impact on firm's financial performance and firm environmental performance, owing to the importance these factors have had in previous research.

In examining how corporate social responsibility and green technology innovation in manufacturing firms determine firm's financial performance and firm environmental performance, the present study impacts the increasing body of research on organizations' environmental and financial performance. Meanwhile, the study that is being done now acknowledges how manufacturing firms can improve their corporate social responsibility and green technology innovation to have better environmental and financial performance. The management of manufacturing firms is unable to disregard corporate social responsibility and green technology innovation because earlier examination has revealed that this variable has a major impact on both firm's financial performance and firm environmental performance [34,113,114]. To determine how effectively a firm does financially and environmentally, managers and researchers of the future should emphasize corporate social responsibility and green technology innovation.

It is the responsibility of management to formulate organizational policies to achieve organizational goals. Because this is the case, the managerial goal is to boost the firm's financial and environmental performance. Consequently, management must formulate policies to reduce pollution, waste, and productions and conserve energy and water. Furthermore, they must reduce the amount of nonrenewable material, chemicals, and aspects and develop the firm's vision, improving financial and environmental performance. Based on the conclusions of current research study, academics and organizations are encouraged to emphasize green technology innovation and corporate social responsibility when analyzing the firm's environmental and financial performance.

4.2. Limitations and Future Direction

Despite this research study's contributions and consequences, this study does have a small number of limitations that might be addressed by other research in the future. First, this was a cross-sectional, and the scholars are not positive that corporate social responsibility and green technology innovation in manufacturing firms give the same outcomes over a longer period. In light of this, future researchers might use the same research model in their investigations to determine whether or not the results of their research differ. The data for this study came from a Chinese manufacturing firm, but researchers might also gather information from large companies to compare the two sets of findings in the future. In addition, the firm financial performance and firm environmental performance are calculated in this research with the support of corporate social responsibility and green technology innovation. To determine whether or not it is relevant, the researchers can employ green HRM as a mediator factor between corporate social responsibility, firm financial performance, and firm environmental performance. In conclusion, this study was carried out in Chinese manufacturing firms, which reflect a certain culture. However, future researchers will improve on this, and the same study model will be able to be evaluated in developing and developed economies to compare and contrast the findings.

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