



**ROLE OF GREEN INNOVATION AND FIRM TRANSPARENCY ON THE
RELATIONSHIP BETWEEN CORPORATE ENVIRONMENTAL
RESPONSIBILITY AND FIRM PERFORMANCE OF CHINESE
MANUFACTURING COMPANIES**

By

LIU ZHILEI

**Thesis Submitted to the School of Graduate Studies, Universiti Putra
Malaysia, in Fulfilment of the Requirements for the Degree of
Master of Science**

June 2023

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Abstract of thesis presented to the Senate of Universiti Putra Malaysia in
fulfilment of the requirement for the degree of Master of Science

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June 2023

Chairman : Professor Ho Jo Ann, PhD
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This study aimed to understand whether the two dimensions of corporate environmental responsibility (CER), CER strength and CER concern, had significant influences on a firm's green innovation and performance (social, environmental and financial). This study also explored the mediating role of green innovation as well as the moderating role of firm transparency in the relationship between the two dimensions of CER and firm performance. Data was collected from 281 listed manufacturing firms in the Shanghai and Shenzhen Stock Exchange. Data was analyzed using the Feasible Generalized Least Squares (FGLS) regressions on unbalanced static panel data using Stata. The results of this study indicated that CER strength had a significant positive effect on green innovation and firm performance while CER concern had a significant negative effect on green innovation and firm performance. This study also found that green innovation played a partially mediating role and firm transparency was a significant moderator between the CER dimensions and firm performance. In this study, CER was separated into CER strength and CER concern which allowed a more comprehensive understanding of the relationship between CER, green innovation and firm performance in a more fine-grained manner and contributes further to CER literature. This study also found that the mediating role of green innovation and the moderating role of firm transparency provided novel relational pathways to explain the underlying mechanism and boundary conditions of the CER-firm performance relationship. There are three managerial implications from this study. First, organizations can benefit by focusing on the specific CER dimensions that foster green innovation and subsequently enhance firm performance. Second, to optimize firm performance, managerial efforts should be directed at embracing CER initiatives, while simultaneously fostering an environment conducive to the growth of green innovation. This strategy empowers firms to secure a competitive edge and

elevate overall performance. Finally, organizational transparency and stakeholder communication emerge as critical factors in bolstering firm performance. By prioritizing transparency, firms can contribute to improved overall performance and stakeholder relations.

Keywords: Corporate Environment Responsibility, Green Innovation, Firm Performance, Feasible Generalized Least Squares (FGLS), Manufacturing Companies

SDG: GOAL 9: Industry, Innovation and Infrastructure



Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia
sebagai memenuhi keperluan untuk ijazah Master Sains

**PERANAN INOVASI HIJAU DAN KETELUSAN FIRMA DALAM HUBUNGAN
ANTARA TANGGUNGJAWAB ALAM SEKITAR KOPORAT DAN PRESTASI
FIRMA SYARIKAT PEMBUATAN CHINA**

Oleh

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Kajian ini bertujuan untuk memahami sama ada dua dimensi tanggungjawab alam sekitar korporat (CER) iaitu kekuatan CER dan keseimbangan CER, mempunyai pengaruh yang signifikan terhadap inovasi dan prestasi hijau firma (sosial, alam sekitar dan kewangan). Kajian ini juga mengkaji peranan pengantara inovasi hijau serta peranan penyederhanaan ketelusan firma dalam hubungan antara kedua dimensi CER dan prestasi firma. Data dikumpul daripada 281 firma pembuatan yang tersenarai di Bursa Saham Shanghai dan Shenzhen. Data dianalisis menggunakan regresi *Feasible Generalized Least Squares* (FGLS) pada data panel statik tidak seimbang menggunakan Stata. Keputusan kajian ini menunjukkan bahawa kekuatan CER mempunyai kesan positif yang signifikan terhadap inovasi hijau dan prestasi firma manakala keseimbangan CER mempunyai kesan negatif yang signifikan terhadap inovasi hijau dan prestasi firma. Kajian ini juga mendapati bahawa inovasi hijau memainkan peranan pengantara separa dan ketelusan firma adalah penyederhana yang signifikan antara dimensi CER dan prestasi firma. Dalam kajian ini, CER dibahagikan kepada kekuatan CER dan keseimbangan CER yang membolehkan pemahaman yang lebih komprehensif tentang hubungan antara CER, inovasi hijau dan prestasi firma dengan cara yang lebih terperinci dan menyumbang lebih lanjut kepada kesusasteraan CER. Kajian ini juga mendapati bahawa peranan pengantara inovasi hijau dan peranan penyederhanaan ketelusan firma menyediakan laluan perhubungan baru untuk menerangkan mekanisme asas dan syarat sempadan hubungan CER- prestasi firma. Terdapat tiga implikasi pengurusan daripada kajian ini. Pertama, organisasi boleh mendapat manfaat dengan memberi tumpuan kepada dimensi CER khusus yang memupuk inovasi hijau dan seterusnya meningkatkan prestasi firma. Kedua, untuk mengoptimumkan prestasi firma, usaha pengurusan harus ditujukan untuk merangkumi inisiatif CER, pada masa yang sama memupuk persekitaran yang kondusif untuk perkembangan inovasi hijau. Strategi ini

memperkasakan firma untuk berdaya saing dan meningkatkan prestasinya. Akhirnya, ketelusan organisasi dan komunikasi pihak berkepentingan muncul sebagai faktor kritikal dalam memperkukuh prestasi firma. Dengan mengutamakan ketelusan, firma boleh menyumbang kepada peningkatan prestasi keseluruhan dan hubungan dengan pemegang kepentingan.

Kata Kunci: Tanggungjawab Alam Sekitar Korporat, Inovasi Hijau, Prestasi Firma, *Feasible Generalized Least Squares* (FGLS), Syarikat Pembuatan

SDG: MATLAMAT 9: Industri, Inovasi dan Infrastruktur



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This thesis was submitted to the Senate of the Universiti Putra Malaysia and has been accepted as fulfilment of the requirement for the degree of Master of Science. The members of the Supervisory Committee were as follows:

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LIST OF ABBREVIATIONS

CER	Corporate Environmental Responsibility
CNRDS	Chinese Research Data Services Platform
CSMAR	China Securities, Market and Accounting Research
CSR	Corporate Social Responsibility
ESG	Environmental, Social and Governance
FGLS	Feasible Generalized Least Squares
KLD	Kinder, Lydenberg, Domini
KS	Kolmogorov-Smirnov
R&D	Research and Development
RBV	Resource-Based View
ROA	Return on Assets
ROI	Return on Investment
SEI	Sustainability Exploitation Innovation
SER	Sustainability Exploration Innovation
SME	Small and Medium-Sized Enterprise
SW	Shapiro-Wilks (SW)
VDT	Voluntary Disclosure Theory

CHAPTER 1

INTRODUCTION

This chapter presents the study's background, problem statement, questions and objectives, significance, scope, and operational definitions of key terms.

1.1 Introduction

Innovation encompasses both social innovation and green innovation. Social innovation, as defined by Eichler and Schwarz (2019), is the process of bringing about social and technological change by meeting social needs. It is characterized by core elements supporting three interrelated fields: the process of social change, sustainable development, and the service industry. The distinctiveness of social innovation lies in fulfilling social demands by changing reality in terms of innovation outcomes (Cui & Huang, 2018) and processes (Lettice & Parekh, 2010). Innovation outcomes in this regard include general social goals such as fairness, welfare, environmental preservation, improved health, better education, and poverty eradication (Repo & Matschoss, 2019).

Green innovation is a key component of innovation that is recognized as an effective way for companies to accomplish sustainable success (Zhang et al., 2020) (see Figure 1.1). It encompasses environmentally protective behaviors that allow organizations to

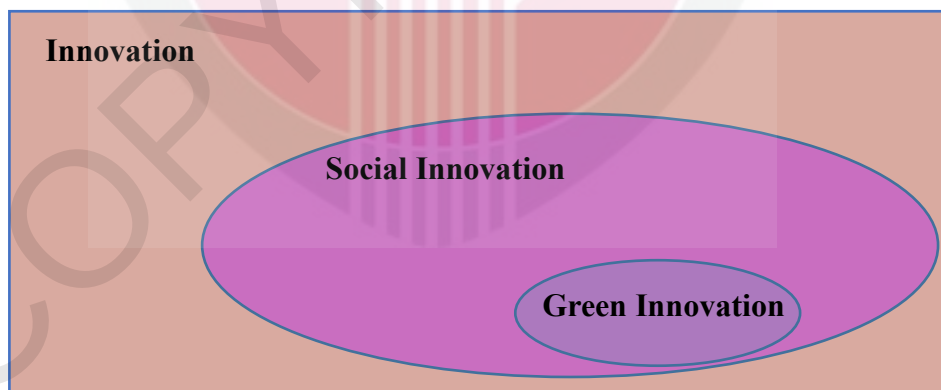


Figure 1.1 : The Relationships among Innovation, Social Innovation, and Green Innovation
(Source: Author's Own)

achieve their environmental goals and attain economic benefits by minimizing their environmental impact (Gupta & Barua, 2018). More specifically, green innovation addresses environmental problems that arise from both product-related and process-related organizational activities throughout the value chain, from production to disposal. Although there is a close relationship between green innovation and innovation in general, there are also differences in their definitions. Innovation is the practical application of concepts that leads to the creation of novel products or services or the improvement of existing ones (Fritsch, 2017). On the other hand, green innovation has two externalities, namely the spillover effects in the R&D and innovation stage and the environmental spillover effect in the adoption and diffusion stage (Rennings, 2000; Wu et al., 2020).

Green innovation is essential for achieving harmonious economic and social development, as well as for preserving the environment (Aguilera-Caracuel & Ortiz-de-Mandojana, 2013; Arenhardt et al., 2016; Chen et al., 2012; Chen et al., 2008). In fact, it has multiple benefits for countries and companies, including in the areas of sustainable competitive advantage (Singh et al., 2020; Weng et al., 2015; Wong, 2012), customer demand for environmental protection, economic performance (Burki & Dahlstrom, 2017), national ecological prestige (Dangelico, 2010), implementation of environmental regulations (Chiou et al., 2011; Lee et al., 2018; Yang et al., 2016), and public support for the government.

In the automotive sector in particular, it has been reported that green innovation helps American enterprises improve customer satisfaction with hybrid electric vehicles and create sustainable competitive advantages (Hur et al., 2013). Similarly, Malaysian transport firms' adoption of green technology innovation increases their environmental performance (Zailani et al., 2014). Green innovation has led to economic benefits, manifested as enhancements in production efficiency, optimization in resource use and attracting new customers or investments through the deployment of green innovation as seen in both the Spanish automotive components manufacturing industry (Albort-Morant et al., 2018) and Turkish manufacturing sector (Burki & Dahlstrom, 2017).

1.2 Background of the Study

According to the definition provided in the China Statistical Yearbook 2021 compiled by the National Bureau of Statistics, manufacturing refers to the industries that process or reprocess existing manufacturing resources into new products that meet the demands of the market (China Statistical Yearbook 2021; Wang, 2020). Manufacturing enterprises are not only the cornerstone of a country's modernization but also a crucial pillar of its economy. In China, the added value of the manufacturing industry in 2021 amounted to RMB 31.4 trillion, accounting for 27.4% of China's total GDP (refer to Figure 1.2) (China Statistical Yearbook, 2021). The manufacturing industry also contributed to 18% of China's employment in 2021 (China Statistical Yearbook, 2021).

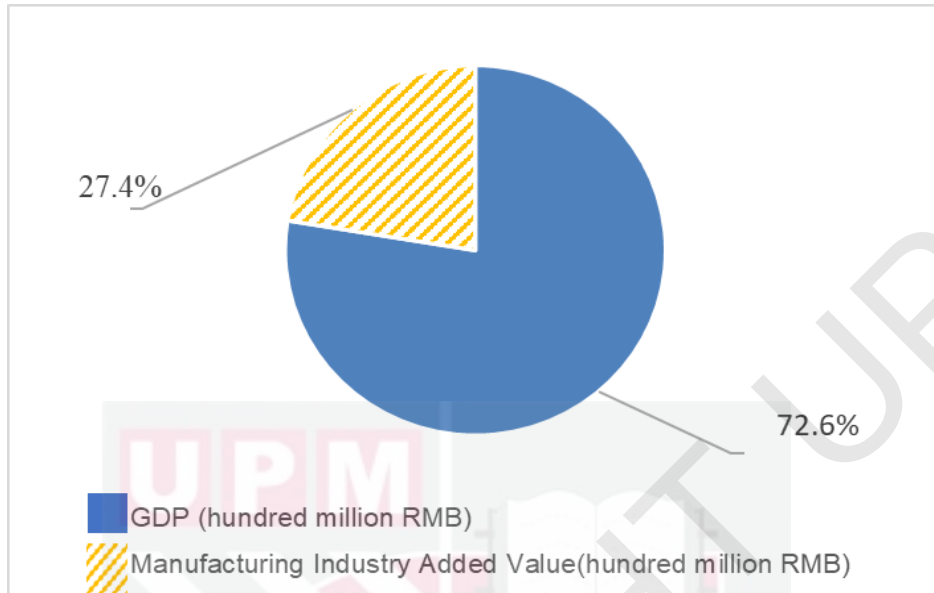


Figure 1.2 : The Ratio of Manufacturing Industry Added Value to GDP
(Source: China Statistical Yearbook, 2021)

Despite starting industrialization relatively late, China has emerged as one of the world's leading industrial nations, with its manufacturing output value ranking first in the world from 2010 to 2020 (Li et al., 2020; López et al., 2020). However, while traditional technological innovation has driven China's industrialization and proliferation economic development, it has concurrently given rise to a range of environmental issues. Compared to the three countries with the highest manufacturing value added globally (the United States, Germany, and Japan), China has the highest level of pollutant emissions. In 2013, China accounted for 28% of the world's carbon emissions and has remained the world's largest carbon emitter ever since (Zhang et al., 2020).

As of 2019, pollutant emissions in China had surpassed its environmental capacity, with more than 80% of 300 cities failing to meet the second-level national air quality standards (Yang et al., 2019). By 2020, China's carbon emissions continued to rise, with carbon dioxide emissions reaching 10,668 million metric tons (China Statistical Yearbook, 2020) (refer to Figure 1.3). This phenomenon is evidence that the one-sided pursuit of economic interests and industrial output value can have devastating impacts on the health and well-being of a country's citizens.

To address this issue, the Chinese government has implemented several environmental protection policies. For example, "China's Outline of Long-Term Objectives for 2035" includes provisions for supporting companies that utilize green innovation (Ministry of Industry and Information Technology of the People's Republic of China, 2022). The "14th Five-Year Industrial Green

Development Plan” proposed by the Ministry of Industry and Information Technology also prioritizes the development of green innovation and low-carbon competitive advantages in the industrial and manufacturing sectors (Ministry of Industry and Information Technology of the People's Republic of China, 2022).

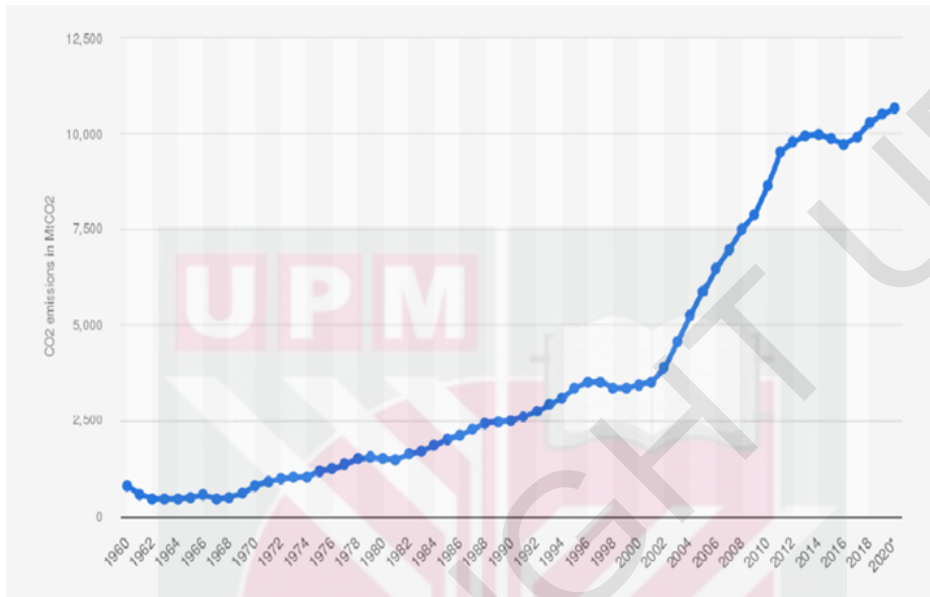


Figure 1.3 : CO2 Emissions in China from 1960 to 2020 (in Million Metric Tons)

(Source: China Statistical Yearbook, 2020)

Nonetheless, proposing policies alone is insufficient to solve the problem of environmental pollution. Firstly, the penalties imposed by policies are inadequate, reducing the cost of environmental violations for enterprises (Hu & Wang, 2019). For some firms that have significantly contributed to GDP and tax revenues over the years, their profits far exceed the fines imposed by the government, which may not raise their concern. Meanwhile, the lack of transparency hinders the effective supervision of many enterprises (Shi & Guo, 2022). By reducing transparency, enterprises can evade legal risks without improving their environmental responsibility and green innovation capacity (Qi & Fan, 2020). Secondly, due to economic interests, manufacturing companies in some regions have made significant contributions to the local economy. In China, the manufacturing industry contributed 32.6% of GDP in 2021 (China Statistical Yearbook, 2021) (refer to Figure 1.4). The government lacks the necessary enforcement capabilities to crack down on these enterprises. Therefore, the government's efforts alone are inadequate to solve the problem of environmental pollution.

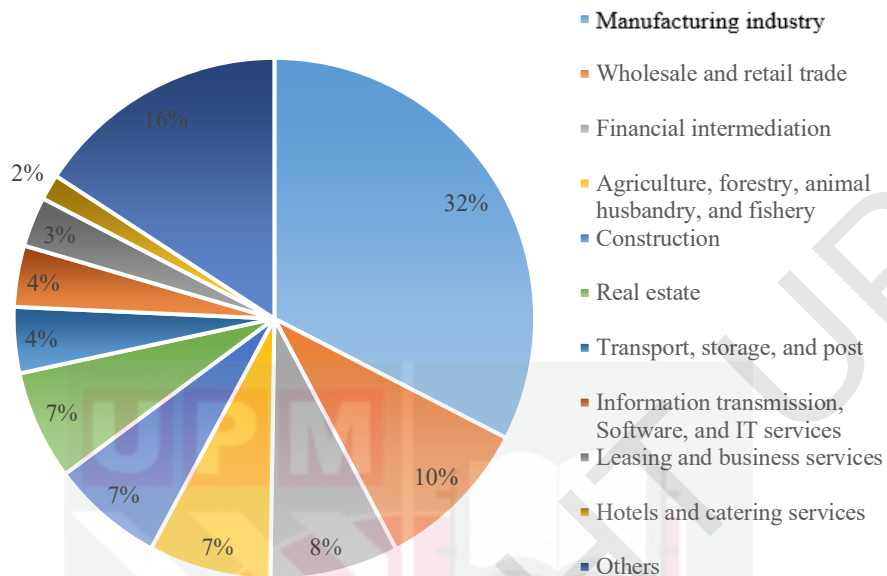


Figure 1.4 : Distribution of GDP in China in 2021 by Industries
(Source: China Statistical Yearbook, 2021)

The manufacturing industry is the primary sector of energy consumption and carbon emissions among the major economic entities in China. As the world's largest manufacturing country, particularly in 2018 when energy consumption was at its lowest, manufacturing accounted for 54.78% of China's total energy consumption (Du & Zhou, 2019). While the proportion of manufacturing in total energy consumption has declined in recent years, over half of the energy consumption still comes from the manufacturing industry annually (China Statistical Yearbook, 2019), as depicted in Figure 1.5.

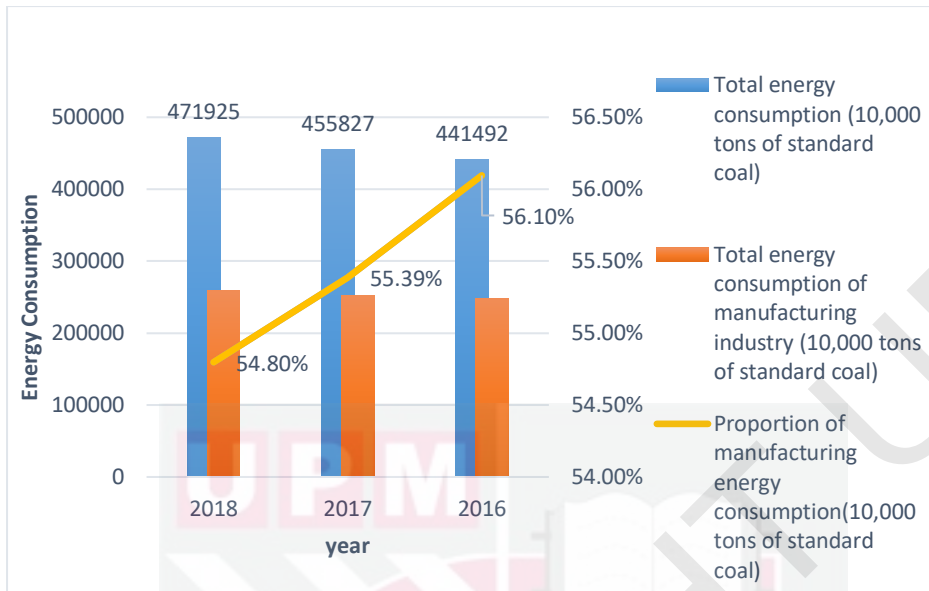


Figure 1.5 : The proportion of manufacturing energy consumption in total industrial energy consumption from 2016-2018

(Source: China Statistical Yearbook, 2019)

China's manufacturing firms emit a significant amount of toxic substances and waste in their daily operations. Furthermore, China's air pollution emissions are considerably higher than those of other countries with large manufacturing industries. In 2020, China emitted 10.67 billion metric tons of carbon dioxide, surpassing Japan (1.149 billion metric tons) and Germany (604.8 million metric tons) (Lamb et al., 2021). From 2002 to 2019, China's manufacturing industry has consistently accounted for a substantial proportion of global carbon emissions (refer to Figure 1.6). These facts demonstrate the considerable negative impact of China's manufacturing industry on the environment.

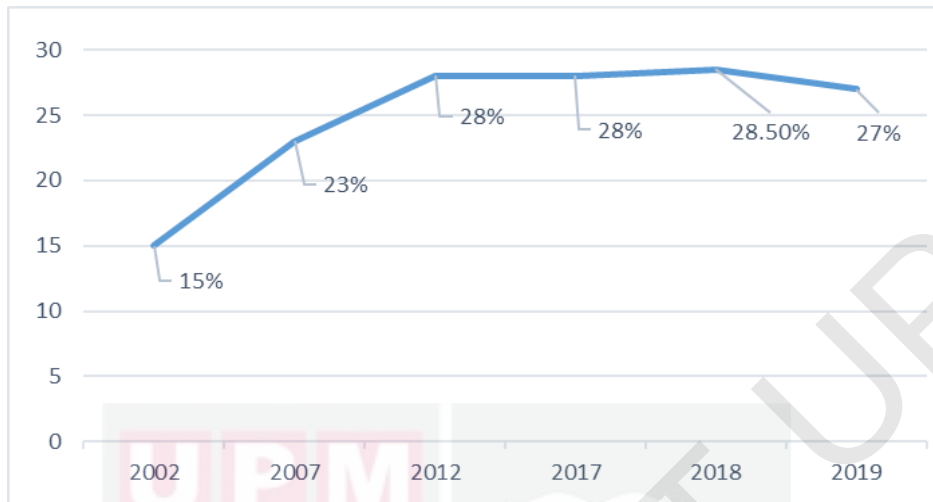


Figure 1.6 : China's Manufacturing Industry's Share in Global Carbon Emissions From 2002 to 2019

(Source: Larsen et al., 2022)

The high energy consumption and carbon emissions of the manufacturing industry have led some Chinese companies to actively address the problem of environmental pollution by implementing environmental protection practices and demonstrating corporate environmental responsibility (hereafter CER), also known as green corporate social responsibility. For instance, Alibaba launched the Ant Forest project, which aims to increase the forest area in China. Practicing CER has provided many benefits for these companies, including increased net present value, reduced investment risk, and improved environmental, financial, and social performance. Specifically, information disclosure, referred to as firm transparency in corporate studies, has played a crucial role in achieving these performance gains. Firms with higher levels of transparency tend to be more attractive to investors (Mulaessa & Lin, 2021). As a result, Chinese firms have recently placed greater emphasis on CER to meet stakeholder demands for environmental reporting disclosure and transparency (Kuo et al., 2021). However, in China, the implementation of CER is primarily undertaken by listed and state-owned manufacturing enterprises, and listed and state-owned manufacturing enterprises bear greater social and regulatory pressures because investors generally hold negative attitudes towards their CER (Lam et al., 2016). While the government has tried to secure more CER assessments for energy and manufacturing companies by enhancing regulatory levels (Jiang et al., 2018), negative evaluations of CER still occur in Chinese manufacturing firms (Chen et al., 2020).

For firm transparency, many companies focus only on presenting a positive image rather than providing comprehensive and accurate environmental performance information (Marquis & Qian, 2014). Due to a lack of detailed and reliable information, stakeholders find it difficult to assess the company's true

environmental impact and its commitment to CER, which could impact its corporate performance. Furthermore, despite government efforts to promote CER reporting, many companies are still reluctant to disclose their environmental information due to concerns about potential negative effects on their reputation and financial performance (Chen et al., 2015; Setiani, 2023). Investors and consumers lack awareness and understanding of the importance of corporate transparency and CER. Without strong pressure from these groups, companies may not see the need to enhance transparency (Dhar & Chowdhury, 2021).

Green innovation encompasses product innovation in various fields, including energy conservation, waste recycling, non-toxicity, and green product design (Zhang et al., 2020). Leading Chinese manufacturing companies have recognized the crucial impact of green innovation for the environment and sustainable development (Song et al., 2020); consequently many of them are currently exploring the use of green innovation within their organizations. An example is Kunlun Industry, a joint investment between the Chinese Academy of Sciences and British Petroleum, which has developed advanced clean coal high-efficiency conversion technologies to enhance the quality of clean coal products for mining companies in northeastern China (Duan, 2019). In today's business environment, successful green innovation is considered a crucial mechanism for companies to expand market share and achieve long-term survival (Fliaster & Kolloch, 2017). By adopting green innovation, companies can improve their market position, attract customers, offer green services, and gain a competitive edge (Hur et al., 2013).

Although green innovation has achieved commendable results and has begun to penetrate various industries, there are still challenges and issues in its current state. Many companies hesitate to invest in green technologies due to high initial costs and uncertain return on investment (ROI) (Cillo et al., 2019). As the benefits of green innovation often manifest in the long term, this can deter companies that prioritize short-term profits, exacerbating the hesitancy. Second, the process of adopting green innovation can be complex and time-consuming, involving significant changes to current business operations and practices. Companies often face resistance from employees accustomed to traditional methods and practices (Tang et al., 2018). Finally, the lack of specialized management talent in the field of green innovation can also hinder its implementation. Successful adoption of green innovation requires professional skills and knowledge, which many companies currently lack (Cillo et al., 2019).

Therefore, this study aims to conduct an in-depth study to explore the relationships between green innovation, CER, firm transparency, and firm performance. In particular, this study seeks to identify the mechanisms between these variables and investigate how Chinese manufacturing companies should adjust their environmental protection strategies to maximize the returns from their CER and green innovation activities.

1.3 Problem Statement

The first research gap identified in this study is related to the unidimensional construct of CER used in previous research (Luo & Du, 2015; Post et al., 2011). CER is a subset of CSR that focuses on environmental protection and performance (Hao & Kang, 2019; Kwon & Erola, 2022; Wu et al., 2018). However, this study proposes that CER should be a bi-dimensional construct consisting of strength and concern. CER strength encompasses maximal energy and resource usage, waste reduction (Bansal & Roth, 2000), the green product design (Gilley, 2000), and pollution control methods (Moon & DeLeon, 2007). On the other hand, CER concern pertains to the disclosure of data about the disposal of waste, including industrial emissions and waste as well as pollution-causing activities (Post, 2011). This study argues that the unidimensional approach to CER used in previous studies may lead to a loss of validity and fail to capture the breadth of conduct of a firm (Griffin & Mahon, 1997). Additionally, CER concern has been neglected in previous studies and requires further attention (Hao & Kang, 2019; Wu et al., 2020a). Although several scholars have explored the role of CER concern in corporate performance, there is still ignorance regarding the activity of CER concern. This ignorance can lead to an incomplete understanding of how a firm's CER impacts its performance (Hao & Kang, 2019; Wu et al., 2020a). For example, Hao and Kang (2019) pointed out that, based on Stakeholder Theory, stakeholders' responses to CER concern and CER strength are quite different, which can have completely different implications for firm performance. Wu (2020) also suggested that the previous approach of measuring CER strength as the only dimension of CER is likely to obscure the impact of CER concern. This, in turn, can lead to misjudgment of the relationship between CER concern and firm performance.

The second literature gap pertains to the nexus of CER and firm performance. Researchers have examined the impact of CER on various performance measures at the organizational and macro-social levels (e.g., Aguinis, Herman, & Glavas, 2012; Bai & Chang, 2015; Boulouta & Pitelis, 2014; Cavaco & Crifo, 2014; Kim, Li, & Li, 2014; Muñoz, Pablo, & Peña, 2015; Rhou, Singal, & Koh, 2016). However, there appears to be an inconsistent relationship between CER and corporate performance. Some findings indicate a positive relationship between the two (Cornett, Erhemjamts, & Tehranian, 2016; Jo, Kim & Park, 2015; Kim, Kim & Qian, 2015; Park, Kim & Wier, 2015), while others have found a negative relationship (Brammer & Pavelin, 2006; Heinkel, Kraus, & Zechner, 2001) or no significant relationship (Aras, Aybars, & Kutlu, 2010; Lin, Ho & Sambasivan, 2019a; Lin et al., 2019b). In earlier studies examining the direct effect of CER on firm performance, many empirical studies have also observed an inconsistent relationship (Orlitzky, Schmidt & Rynes, 2003; Margolis, Elfenbein & Walsh, 2007; Wang, Dou & Jia, 2016). As a result, the direct relationship is considered imprecise or spurious because many conditions can affect it. Thus, empirical studies that ignore relevant moderators can lead to biased results and misjudge the impact of CER on firm performance (Albertini, 2013; Dixon Fowler, Slater, Johnson, Ellstrand & Romi, 2013; Orlitzky et al., 2003).

Given the findings and reasons mentioned above, the inconsistent impact of CER on firm performance may be due to the effect of moderators. One possible moderating variable is firm transparency, which is the measure of a company's disclosure to the general public of pertinent and significant information on its corporate management and operations (Wu et al., 2018a). Firms can obtain favorable responses from their stakeholders by willingly incorporating environmental measures in their key strategic and operational processes, assuming that their stakeholders can perceive these environmentally responsible behaviors (Wang & Qian, 2011). The more a company engages the public, the more probable it is that external stakeholders will recognize and support its CER. The degree to which a company is accessible to the public is described by the increase in corporate transparency (Chiu & Sharfman, 2011). In addition, based on the Voluntary Disclosure Theory (VDT), firm transparency may moderate the effect of CER on firm performance because firms sometimes conceal unfavorable information to influence investors' behavior. If investors interpret the concealment (or non-disclosure) as a sign of the presence of unfavorable information (i.e., CER concern), it can reduce the firm's performance (Nishitani et al., 2021). Hence, under the VDT, changes in firm transparency will affect CER, which, in turn, affects firm performance.

The last research gap pertains to green innovation's role as a mediator between CER and firm performance. Limited research has examined the mediating influence of green innovation on how CER leads to firm performance. First, there may be a direct effect of green innovation on CER because to achieve appropriate CER activities, the most beneficial way is to implement a green strategy. A green strategy is regarded as vital for sustainable operations based on the Resource-Based View (RBV) (Rizki & Hartanti, 2021). In this regard, green innovation is an effective green strategy and is commonly regarded as a fundamental strategy in sustainable development efforts (Carvalho et al., 2018). For example, both the RBV and Stakeholder Theory posit that CER facilitates green innovation since it helps firms gain a competitive advantage (Rizki & Hartanti, 2021). As an important factor in enhancing corporate value, CER can promote the strategies of green practice factors to achieve sustainable development goals (Tsenduren et al., 2021).

Second, green innovation is associated with firm performance (Martinez-Conesa et al., 2017) because it can build a good environmental reputation for companies (Rizki & Hartanti, 2021), establish a positive corporate image for stakeholders (Zhang & Zhu, 2019), increase stakeholder investment in the company, and enhance financial performance (Xie et al., 2019). Green innovation can lead to positive environmental performance for companies while improving relevant indicators in CER strength (He et al., 2021; Kraus et al., 2020a). In consideration of these reasons and empirical studies, green innovation's significance in business demands further examination because it contributes to the achievement of sustainability-related performance (Rezende et al., 2019). Therefore, this study proposes that green innovation plays a mediating role in the link between CER and firm performance.

1.4 Research Objectives

The main aim of this study was to examine the relationships among CER, green innovation, firm transparency, and firm performance in the manufacturing sector. The specific objectives of this research were:

1. To examine the effect of CER (strength and concern) and green innovation on firm performance (social, environment and financial performance).
2. To examine the influence of CER (strength and concern) on green innovation.
3. To investigate the mediating role of green innovation in the effect of CER (strength and concern) on firm performance (social, environment and financial performance).
4. To examine the moderating role of firm transparency in the effect of CER (strength and concern) on firm performance (social, environmental and financial performance).

1.5 Research Questions

The objective of this research was to examine the influence of CER on the performance of manufacturing firms in China and to understand the mechanism underlying the CER-firm performance relationship. Additionally, this research sought to identify the boundary condition under which CER influences firm performance. The specific research questions were as follows:

1. Do green innovation and CER (strength and concern) influence firm performance (social, environment and financial performance)?
2. Does CER strength and CER concern effect the green innovation?
3. Does green innovation mediate the effect of CER (strength and concern) on firm performance (social, environment and financial performance)?
4. Does firm transparency moderate the effect of CER (strength and concern) on firm performance (social, environment and financial performance)?

1.6 Significance of Study

This section discusses the significance of the study from two perspectives: theoretical significance and managerial significance.

Theoretical Significance

This study fills the theoretical gaps pertaining to CER and green innovation. First, this study divides CER into bi-dimensional variables, namely CER strength and CER concern. It then explores the influence of these two dimensions on firm performance and green innovation. Previous studies lack an in-depth exploration of the CER dimension. Some researchers (e.g., Qi & Fan, 2020; Wu et al., 2020) believe that treating CER as a unidimensional variable can reflect the overall performance of CER. However, others (e.g., Hao & Kang, 2019; Khosroshahi et al., 2019; So et al., 2018) argue that CER has positive and negative indicators, and different dimensions of CER can have entirely different effects on innovation and performance based on Stakeholder Theory.

Therefore, by showing that different dimensions of CER can have completely different effects on the innovation performance of firms, this study extends Wu's (2020) study of CER. It also builds on Zhang's (2020) study on green innovation by examining the specific branches of CER and innovation, i.e., green innovation and firm performance, based on the Triple Bottom Line (TBL) concept to identify the effects of different dimensions of CER on both variables. Second, this study helps to establish a new understanding of firm performance through the TBL perspective to avoid the prejudice caused by only focusing on one type of firm performance (Birkel & Müller, 2021; Zhang et al., 2020).

Third, this research addresses the gap that scholars in the field of green innovation rarely pay attention to which is examining green innovation as a mediator. The current study offers insights into the mediation mechanism of green innovation using panel data as it no longer only focuses on cross-sectional data but time series, which also responds to the call of earlier studies (Chouaibi et al., 2021; Kraus et al., 2020a). In particular, it contributes to knowledge by analyzing how CER translates into firm performance through the mediation of green innovation, thereby linking the research on CER and green innovation (Li et al., 2017b; Song & Yu, 2018; Wu et al., 2019; Wu & Liang, 2020a) as well green innovation and firm performance (Iranmanesh et al., 2017; Karimi Takalo et al., 2021a; Xie et al., 2019; Zailani et al., 2015).

Fourth, the present findings contribute to understanding how firm transparency moderates the effect of CER on firm performance. Previous studies (Galbreath & Shum, 2012; Kraus et al., 2020b; Surroca et al., 2010) have provided different perspectives on the CER-performance link and have suggested looking into the possibility of moderators. Although some researchers believe that companies with high firm transparency can attract internal and external stakeholders to support CER and improve performance (Qi & Fan, 2020; Wu et al., 2018), others argue that companies with high firm transparency can instead make stakeholders more sensitive and reluctant to support corporate environmental action (Khosroshahi et al., 2019; So et al., 2018). This study introduces firm transparency as a moderating variable to discover how it affects the CER-firm performance nexus. Based on the VDT, firm managers are free to choose to disclose financial data and other information based on their decision-making

requirements to improve firm transparency (Meek et al., 1995). In this case, stakeholders are more willing to invest in "good" firms (Shehata, 2014). Thus, firm transparency can further explain the conditions under which the correlation between CER and firm performance increases or decreases.

Managerial Significance

First, this study contributes to manufacturing firms' strategic decision-making process by helping them predict the different impacts of CER strength and CER concern initiatives on green innovation and firm performance. Based on the findings, the study can make recommendations to companies on whether they should decide to strengthen or weaken CER by addressing its different dimensions. Managers can further benefit by focusing on the CER dimension that promotes green innovation and firm performance. Specifically, if CER strength is positively correlated with green innovation or firm performance, firms should enhance CER strength. Meanwhile, if CER concern is negatively correlated with green innovation or firm performance, they should reduce the relevant input to CER concern. For example, developing a green corporate culture is one of the specific practices of CER strength, and firms can continuously improve the content and level of their green corporate culture to promote firm performance. Firms can also increase their support for green innovation capabilities by reducing solid waste emissions, one of the specific practices of CER concern. Therefore, this study can help firms incorporate the environmental thinking of CER into the corporate strategy level and adjust the level of green innovation and performance through different CER strategies.

Second, this study is useful to manufacturing firms in understanding the specific aspects of green innovation for improving firm performance. If firm managers fail to properly understand the various returns of green innovation in the long run due to distorted research results, they may make wrong decisions. By examining more dimensions of green innovation and firm performance, this research avoids a one-sided perception of green innovation impacts and allows firms to have a more comprehensive understanding of its effects. Furthermore, understanding the mediating role of green innovation is essential since there have been very limited studies on it (Kraus et al., 2020b; Zhou et al., 2019). Specifically, green innovation's mediating effect enables managers to understand that green innovation is not redundant when it comes to achieving CER and promoting firm performance. Managers can then promote green innovation through CER, which indirectly affects firm performance. Therefore, to achieve better firm performance, managers can strive to implement CER while providing room for growth in green innovation, so that the firm can gain a competitive advantage and better performance.

Finally, this study focuses on the moderating role of firm transparency in the link between CER and firm performance. Through research on the moderating effect of firm transparency, companies can understand whether disclosing more company information (both financial and non-financial information) promotes the positive influence of CER on firm performance. If this idea is confirmed, the

company can gradually change its original transparency and disclosure strategy to improve its performance while enhancing stakeholders' ability to supervise the company's behavior. In addition, research on the moderating role of firm transparency can help raise awareness of information sharing in companies, manage the interface between companies and stakeholders, and develop organizational policies accordingly in response to stakeholder requirements to ensure that stakeholders perceive the company's CER.

1.7 Scope of Study

Different types of organizations have varying interpretations of green innovation (Abbas & Sağsan, 2019). For example, mining and manufacturing companies tend to focus on whether green innovation can help their production process comply with environmental regulations (Borsatto & Bazani, 2021; Qi et al., 2020), whereas food retailers tend to prioritize whether green innovation can build their social reputation (Du et al., 2017). Due to differences in the business sector, particularly in more heavily regulated industries such as industrial or manufacturing, there are different standards for measuring green innovation (Takalo et al., 2021a). As manufacturing has significant social, economic, and environmental effects on society, it is best to concentrate on one industry when investigating green innovation (Takalo et al., 2021b). Therefore, this study concentrated on listed manufacturing enterprises in China because China is a major manufacturing country with a relatively comprehensive industrial system. The reason for using data from listed companies is that they have complete information such as CER, green innovation, firm transparency, and social/environmental/financial performance, which enabled the study objectives to be accomplished. All data was obtained from the Chinese government or Chinese professional research institutions, including the China Securities Market and Accounting Research (CSMAR), Chinese Research Data Services (CNRDS) Platform, and HEXUN net, ensuring reliability and accuracy. The data covered a total of five years from 2015 to 2019.

1.8 Definition of Key Terms

This section introduces the variables in this study, including CER, green innovation, firm performance, and firm transparency.

Corporate Environmental Responsibility (CER)

CER is defined as a demonstration of a company's ability to incorporate environmental considerations into its ongoing business operations and management (Li et al., 2020).

CER Strength and CER Concern

CER strength refers to responsible actions taken by firms that aim to safeguard and enhance the environment (Dowell & Muthulingam, 2017). This approach meets stakeholders' expectations and helps firms develop strong connections with external stakeholders (Wang et al., 2017) and gain resources from their network (Flammer & Kacperczyk, 2016). CER concern represents environment-related scandals involving firms, such as the significant excretion of polluted solid, liquid, or gas waste, or the excessive consumption of non-renewable energy (Wu, 2014). Such actions contradict stakeholders' expectations and provoke their negative responses, which can damage the relationships that have been established between firms and their stakeholders (Klassen & McLaughlin, 1996).

Firm Performance

This study defined firm performance based on the concept of triple bottom line performance. The TBL concept holds that a business should evaluate its performance not only based on stakeholders with whom the business has a direct transactional relationship (e.g., employees, customers, suppliers) but also external stakeholders like the government and local communities (Hourneaux et al., 2018). TBL performance refers to a firm's performance expressed in economic, environmental, and social dimensions (Elkington & Rowlands, 1999; Henry et al., 2019; Sánchez-Infante Hernández et al., 2020). Accordingly, in this study, firm performance included three dimensions: environmental performance, social performance, and financial performance (Hourneaux et al., 2018; Hubbard, 2009). Environmental performance was assessed using the ESG (Environmental, Social, and Governance) metric from the China Securities Market and Accounting Research (CSMAR) database (Freedman, 1990; Omran et al., 2021).

Social performance in this study refers to a firm's performance in terms of the impact of its behavior on various societal areas, such as customers, employees, communities, supply chains, and business associates (Alfred & Adam, 2009). Social performance in this study was assessed using the social performance score provided by the widely recognized Hexun.net database in China (Zhang et al., 2020).

Financial performance refers to a company's financial status, and it is one of the essential indicators of firm performance. Financial performance was evaluated in this study by measuring the company's annual return on assets (ROA) (Villalonga et al., 2019; Wang et al., 2022).

Green Innovation

Green innovation indicates technological innovation that aims to reduce waste, global warming, water use, air pollution, and the usage of coal, oil, and electricity to promote energy conservation (Kraus et al., 2020a). It can enable companies to positively impact their environment and engage in sustainable development (Chen et al., 2006; Hart & Dowell, 2011; Rehman et al., 2020). Green innovation facilitates firms in maintaining a sustainable competitive advantage by developing environment-friendly technology, knowledge, and capabilities and by meeting consumers' demands for eco-friendly goods (Albort-Morant et al., 2016). Green innovation patents were measured based on the number of green innovation-related product patents issued by the company each year (Zhang et al., 2020).

Firm Transparency

Firm transparency is described as the level of a firm's disclosure to the general public of significant and relevant data about its operations and management (Wu et al., 2018a).

1.9 Organization of Thesis

This thesis is organized in six chapters. The specific chapters are organised as follows. Chapter 1 introduces the background, problem statement, objectives, significance, scope, and key terms. Chapter 2 provides a literature review. Chapter 3 develops the research framework and hypotheses. Chapter 4 discusses the methodology. Chapter 5 presents the results of data analysis. Finally, Chapter 6 explains the discussion of the study's findings, theoretical and practical contributions, limitations and future research directions, and conclusions.

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