

Hope-Hype of Green Innovation, Corporate Governance Index, and Impact on Firm Financial Performance: A Comparative Study of Southeast Asian Countries

Abstract: The current production and conception have impacted the environmental hazards. Green Innovation (GI) is the ideal solution for sustainable production, consumption, and ecological conservation. The objective of the study is to compare comprehensive green innovation (green product, process, service & organization) impact on firm financial performance in Malaysia and Indonesia, along with the first study to measure the moderation role of the corporate governance index. This study has addressed the gap by developing the green innovation and corporate governance index. Collected panel data from the top 188 publicly listed firms for three years and analyzed it using the General Least Square (GLS) method. The empirical evidence demonstrates that the green innovation practice is better in Malaysia, and the outcome also shows that the significance level is higher in Indonesia. This study also provides empirical evidence that board composition has a positive moderation relationship between GI and business performance in Malaysia but is insignificant in Indonesia. This comparative study provides new insights to the policymakers and practitioners of both countries to monitor and manage green innovation practices.

Keywords: Sustainability, Corporate Governance, Green Innovation, Environment, Climate Change.

1. Introduction

Due to the influx of emissions, waste generation, wastewater, global warming (Khan and Johl, 2019, Khan and Johl, 2020), and habitat destruction are creating enormous environmental and societal challenges (Begum et al., 2022, Le et al., 2022). The statistics show that CO₂ emissions will be high, costing \$380 billion for recovery measures in 2023. Secondly, 45% is the expected jump in fossil fuel consumption. Lastly, the electricity generation through coal-fired is set to be exceeded. Due to this, the emission is expected high time in the year 2023.

Researchers believe this also is due to the excessive usage of scarce resources, which further negatively impacts meeting the current generation's demand, and future generations' needs are compromised (Tan, 2022). This has sparked an interest in green innovation amongst

policymakers and researchers, which is expected to be significant for achieving sustainable development and low-carbon societies without impacting firm financial Performance (Zhang et al., 2022) (Hermundsdottir, 2022).

In recent years, green innovation application has (GI) helped to maintain ecological management for organizations and communities (Le et al., 2022). Due to that, it's the main reason for the upward trend of green innovation in the most developed economy (Arenhardt et al., 2016);(Zhang et al., 2020). While exploring the literature author has found various studies of green innovation in different regions of Asia (Tolliver et al., 2021). However, most studies in the Scopus database were found in China (Luo et al., 2022), but fewer studies are in Malaysia and Indonesia. Additionally, no study compares the two southeast Asian countries, Malaysia and Indonesia.

Therefore, this study aims to do a comparative study between Malaysia and Indonesia. This comparative study is imperative as Indonesia and Malaysian are listed under the top 50 in the list of polluted countries. Secondly, a country like Malaysia believes that sustainable initiatives are a strategy for greener growth which will become a new currency of the future. In addition, Southeast Asian countries like Malaysia and Indonesia aim for low-carbon countries but require green intentions and initiatives. One of the most popular Malaysia and Indonesia publicly listed companies is green innovation (Mustaffa et al., 2022); Green Innovation is an effort to position the company as the most sustainable firm to win over stakeholders and draw the attention of investors (Falchi et al., 2022).

This wave has been observed in operating and non-operating business operations and the R&D activities of various multinational companies. An innovative initiative taken by multinational companies to appoint chief sustainability officers is believed to boost further responsible and ecological movements in the firm (Yuan, 2022) (Khanra et al., 2022).

Furthermore, narrowing down the existing literature on green innovation, the author has found 47 relevant articles. These relevant article has investigated green product and green process innovation (Xie et al., 2022) and green technology innovation (Gyamfi, 2022) (Lai et al., 2022) (Ma et al., 2021) on firm financial Performance (Xie et al., 2019). Authors have further explored the limited literature role of top management (Wang et al., 2022) and governance (Zheng et al., 2022). The firm internal efficiency has also been studied in terms of green knowledge (Song, 2020) and green ability (Ahmeda et al., 2020), which significantly impacts green innovation practices. Also, the Authors Guo et al. (2020) discovered a

considerable impact on business performance and the impact of management concern for the environment and dynamic capabilities on green innovation.

However, few studies have explored the holistic view of green innovation and the moderation role of the corporate governance index over firm financial performance. Therefore, the following research question is formulated to explore the answer.

RQ1: What are the imperative variables of green innovation (Holistic View of Green Innovation)?

RQ2: Does green innovation has a positive impact on the firm financial performance of Two South Asian Countries?

RQ3: Does green innovation has a positive impact on the firm SDGs performance of Two South Asian Countries?

RQ4: Does the corporate governance index moderates the relationship between green innovation and firm financial Performance in Malaysia- Indonesia?

Therefore, to investigate the research question, this study aims to examine the critical variable of green innovation and develop the corporate governance index. This is explored through a thorough literature search and further finds the imperative gap in the literature on green innovation and firm financial performance. To develop the bridge, the following objective is being formulated:

RO1: To investigate the relationship between a holistic view of green innovation and the firm financial performance of two South Asian countries.

RO2: To investigate the relationship Between a holistic view of green innovation and the firm SDGs performance of two South Asian countries.

RO3: To develop the index of corporate governance index.

RO4: To investigate the moderation role of the corporate governance index between green innovation and firm financial performance.

To confirm these research gaps, we employed a further systematic literature review in sections 2 & 3. The empirical study with three years of panel data of 188 Malaysian and Indonesian publicly traded companies is investigated to bridge the above three gaps.

The empirical results indicate that including all major variables of green innovation shows that green innovation practice is better in Malaysia than in Indonesia; however, the outcome shows that the significance level is higher in Indonesia than in Malaysia. This research also contributes

significantly to the literature on green innovation that has a significant positive moderation role board composition betwixt GI and FFP in Malaysia found significant but insignificant in the context of Indonesia.

In addition, this study also analyzed each green innovation variable and investigated the firm financial performance, including the comparison (results are incorporated in Appendix A2-A6). This new finding bridges the gap betwixt green innovation and board of director composition. It is empirically proven to professionals and governments to enhance green innovation and governance practices for a low-carbon society.

The research is organized as follows: part 2 develops the review of past literature to identify a noticeable gap with the support of the Scopus database. In contrast, part 4 develops the theoretical framework and hypothesis. Part 5 discusses the methodology, including data collection and measuring all variables. Part 6 includes results and discussion. Lastly, it provides a conclusion, and implication, the future research due to the limitation.

2. Systematic literature review

In this part, the authors have constructed a comprehensive literature search on green innovation and the company's performance, as well as the moderation role of the corporate governance index.

To do so, this study has explored the oldest database Scopus with the keywords "Green Innovation AND "Firm performance, resulting in 64 documents. On the other hand, extending the search by additional keywords "Corporate Governance" *found that no study has examined the moderation effect of corporate governance or any association between green innovation and business financial success.*

2.1. Basic Search: "Green Innovation" AND "Firm Performance."

The basic search on the relationship between green innovation and firm performance in the Scopus database has shown the major term used, "Green Innovation," environmental performance, green process innovation, green product innovation, and litter far financial performance heightened in figure 1 with the condition of five repetitions of keywords.

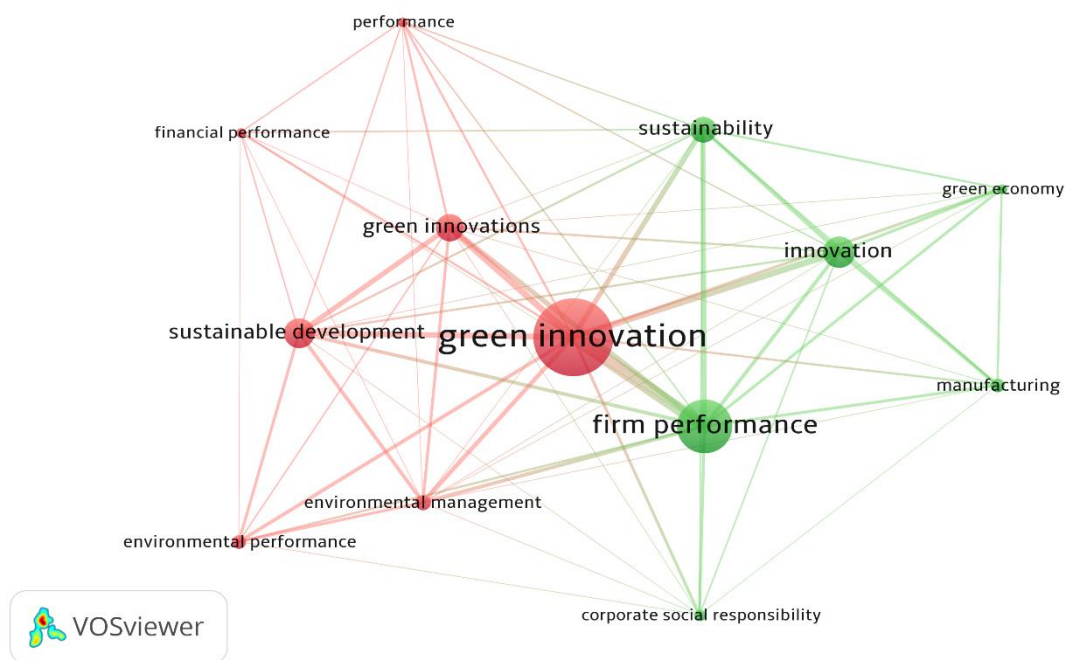


Figure 1: Term Used (Condition 5 reparation of teams)

The second basic search was Author-Co authorship linkages; however, we also explored more to investigate the major authors centred on the connection between GI and FF based on an article published and citation. We found (Reported in Table 1) that authors Wang Y, Zhang Y, Johl S.K, and Khan P.K have published two articles each, and author Chopra M. has one article in good impact factor journals. In contrast, authors Al-Sartawi A.M, Chalikias M, Galatsidas S, Chen Y. Cherian J. has 1 article with a low impact factor. Lastly, the lead author of green Innovation, Chen y, has also investigated ecological leaders' environmental and knowledge-learning concerns. Additionally, the basic exploration of the literature review, for instance, Leading Journals, organization affiliations, and countries is placed in Appendix Table A1.

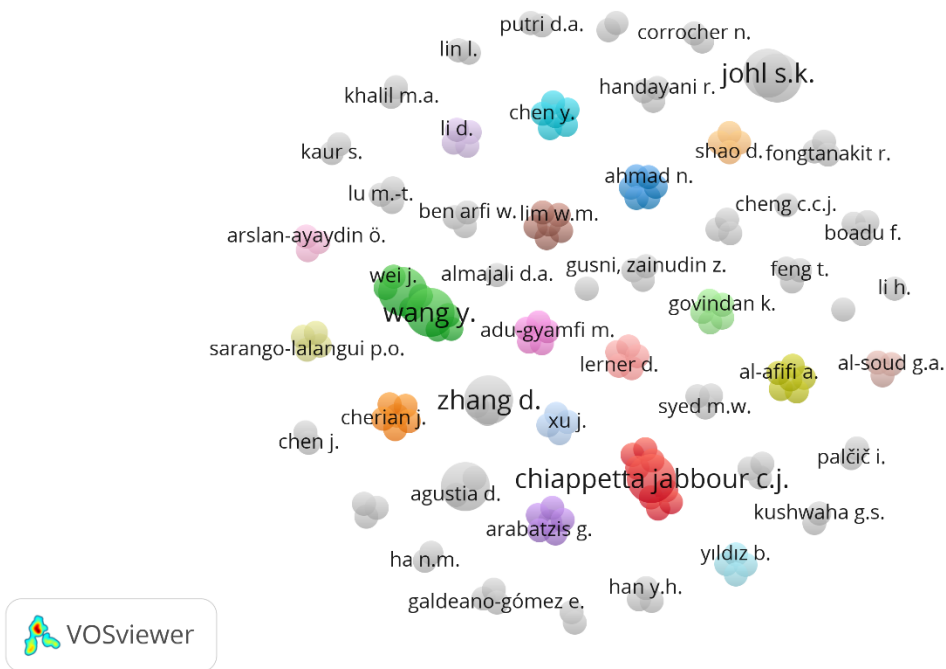


Figure 2: Author-Co-authorship linkages flower

In addition, to establish the research gap, we explored a few clusters to explain the past and present areas investigated in the relationship betwixt GI and FF in the next section.

2.2. Clusters of Green Innovation and Firm Performance

The literature review on the connection between green innovation and business performance uncovered three clusters following green innovation. In the figure, the first cluster shown in red includes innovation, green process innovation, green economics, sustainability, firm Performance, and firm size. The second cluster includes sustainable development, environmental management, and competition. The third cluster is performance assignment and performance.

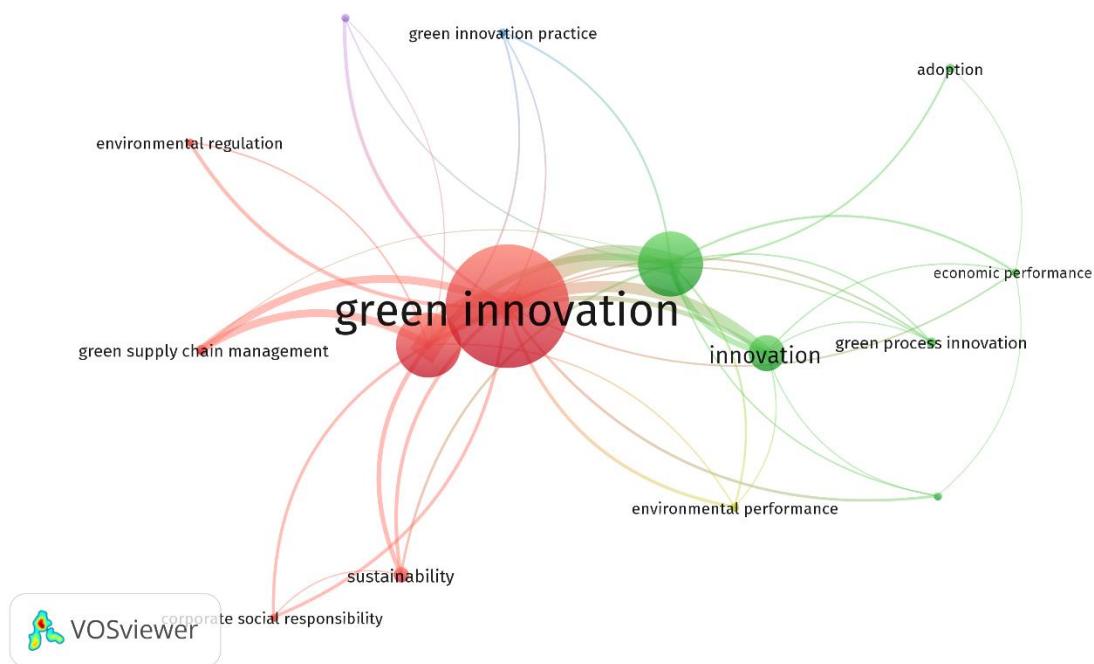


Figure 3: Three Clusters of Green Innovation and Firm Performance

The cluster powerfully highlights that the relationship between GI and FP has explored several aspects and confirmed that the governance or corporate governance index had not been investigated. In table 1, the above three clusters are examined further from the lens of firm performance and corporate governance. Chen (2015) introduced green service innovation, improving firm performance, as confirmed by the latest research. Further, the importance of green technology innovation is understood by the authors Wang et al. (2021) (Shang et al., 2022, Qing et al., 2022b) and confirmed by the author Qing et al. (2022a) with the added findings that corporate financial constraints are improved by green technology.

3. Confirmation of Research Gap

However, the authors draw the first empirical gap from Table 1, that there is a limited study covering major sub-variables of green innovation such as product, process, service, and organizational variables in a single study (Refer to Table 1). *Further, the second imperative gap is the comparative study of green innovation practices between Malaysia and Indonesia.*

Table 1: Search for research gaps

Reference	Objective	Independent	Research Method	Dependent	Result
(Aastvedt et al., 2021)	Investigates the effect of GI on the FP of O&G firms	Green Innovation Moderation Crude oil prices	-Panel data -Regression	-FFP -ROA -Profitability	The innovation score of US and European companies significantly impacts their FF. High oil costs hamper innovation and financial performance.
(Zhang, 2020)	Do GTI and GMI affect the firm financially	Green Technology Innovation (GTI) Green Management Innovation (GMI)	-Content Analysis -Panel Data		GTI and GMI help to relieve firm economic constraints.
(Qiu, 2020)	Can businesses, despite market volatility and environmental laws, achieve long-term sustainability through green innovation?	Environmental Regulation Mediation Green Process Innovation Green Product innovation	-Panel data -Regression	Financial Performance (FP) -ROE -ROA	-Environmental regulation improves FP by promoting green product and process innovation. -Market turbulence has positive significance for green product innovation and improving FP
(Duque-Grisales et al., Duque-Grisales et al., 2020)	Does firm financial performance is affected by green innovation practices	Green Innovation - Product, Process, and Service Innovation	-Content Analysis -Panel data		- GI was positively impacted through R&D -ISO14001 insignificant to FP
(Guo, 2020)	Examine how corporate environmental ethics affect green practices.	Corporate environmental Ethics (CEE) Mediation Green Innovation (GI) Moderation Personal ties	Survey - Enterprises	Firm Economic Performance -Profitability Total Sales Market share	-CEE has a direct effect on green innovation-enhancing FF
(Song, 2020)	Do knowledge shared for green innovation acquired and utilized	Green Knowledge Sharing (GKS) Mediation Absorptive Capacity	Survey - Multiple regression	Green Innovation	-Absorptive capacity positively mediates GKS and GI -Stakeholder pressure positively contingent on the mediation of absorptive capacity positively to the GKS and GI
(Lin, 2020)	Does green innovation strategy (GIS) has a relation with idiosyncratic risk	Green Innovation	-Panel data -GMM Regression	Idiosyncratic risk (IR)	-IR was lower for firms practising GIS - Relationship between GIS and idiosyncratic risk strengthens the competitive action of the firm
(Ahmeda et al., 2020)	Examine green HRM impact on green innovation	-Green Ability	-Survey	Green Innovation	-Green HRM creates ability and motivation with a significant

	with moderation transformational leadership	-Green Transformational Leadership	-Structure Equation Modeling		relationship with green innovation
(Xue, 2019)	The linkage between managerial environmental awareness and absorptive capacity as it relates to green innovation and business performance.	Green Innovation Moderation -Managerial Environmental Concern (MEC) -Absorptive capacity (AC)	-Panel data Hierarchical linear modeling	-Financial Performance -Operational Performance - Environmental Performance	- Green Innovation positively affect the firm financial, operational, and environmental performance - MCE and AC positively correlate betwixt GI & FF

This study is the first to explore a holistic view to investigate the relationship between GI and FFF of two countries. Furthermore, in quint of the third research gap. The authors further explored the literature on the role of managerial and governance. The author has found that the existing literature on internal efficiency (Table 1) has also been studied in terms of green knowledge (Song, 2020) and green ability (Ahmeda et al., 2020), significantly impacting green innovation practices. Also, the Authors Guo et al. (2020) discovered a considerable impact on business performance and the impact of management concern for the environment and dynamic capabilities on green innovation (Larbi-Siaw, 2022).

With that, the third empirical gap that the authors draw from the literature is missing the role of corporate governance, as the literature has explored the role of executives (Arici and Uysal, 2022) and transformational leadership (Begum et al., 2022). However, there is a lack of research exploring corporate governance's role in embarking on green innovation practices. Therefore the corporate governance index is being developed for the moderation role of investigation.

In conclusion, despite the growing literature on green innovation, three major gaps need to be bridged; firstly, limited studies have explored all variables of green innovation, which is lacking in most research. Secondly, there is also a lack of comparative analysis of green innovation practices in the Malaysian and Indonesian contexts.

Lastly, the first study investigates the moderation of the corporate governance index in the relationship between GI and FFP. In the following section, the study will develop the theoretical framework and hypothesis for empirical research.

4. Theoretical framework and hypothesis development

This section provides further justification from the available literature to bolster our research on developing the theoretical foundation to address this research objective and three critical gaps in the literature. The following subsection provides the latest literature on each variable, such as firm financial Performance (Dependent variable) and green innovation (independent variable), which consists of green products, green processes, green service, and green organizational innovation.

Lastly, the moderation role of the board of director index includes Board Size, Independent director, independent director chair, gender diversity, youngest, oldest director, average board age, and CEO duality of 188 bursa Malaysian listed firms.

4.1.Firm financial performance

As previously stated, firms' financial performance is measured by return on assets and equity (ROA & ROE) (Zhang et al., 2022). Recent literature has adopted the ROA to evaluate the firm's asset utilization in the banking sector (Xia & Liu, 2022) or CSR (Jamil et al., 2022). This financial ratio was also selected since it is extensively used in the available literature to analyze the impact of sustainable practices (Khan et al., 2022b, Jyoti and Khanna, 2021). These financial measurements also help investors predict a company's expected profitability before investment and net income.

4.2.Nexuses of Green Innovation (GI) and Firm Financial Performance (FFP)

This section will discuss the existing literature on GI and FFP to establish the gap and develop the hypothesis. Several authors (Zhang et al., 2022) (Yi et al., 2021) (Ullah et al., 2021) have investigated GI in various other terms, such as ecological, environmental, and eco-innovation in different industries.

The research on GI emerged throughout the current industrialization in response to the fourth and third industrial revolutions' due to the rising environmental problems (Khan et al., 2022b). Green innovation aims to blend Enviromental-economic Performance in strengthening and creating values for the stakeholders, which most exciting literature has found green innovation minimizing the ecological burden (Takalo and Tooranloo, 2021).

Green innovation is the process of modifying and introducing a new product, method, or service to reduce emissions and inputs into a global green ecosystem (Khan et al., 2021a, Takalo and Tooranloo, 2021, Rui and Lu, 2021). The green innovation practices in developing countries help businesses to save resources, generate more revenues, provide an opportunity to

create competitive advantages, and, most importantly, save resources for future generations. The green innovation practices in both countries will help them retain investors, attract foreign investors and enjoy a high premium price, especially when the business is the first mover. Further, Chen (2008) indicated that the firm's efficacy, efficiency, and profitability might be reached. It creates advantages for the organization in two ways: environmentally and economically.

Sorting out available relevant literature, the existing literature has further explored the variables of green innovation, and Few researchers studied one variable, green products (Dangelico, 2016, Song et al., 2020, Awan et al., 2021). In addition, some have further investigated the green product & green processes (Wang et al., 2021) and research (Khan & Johl, 2019) by including green service, green technology, and green organizational innovation. However, limited studies have investigated all variables of green innovation (Khan et al., 2022b, Khan et al., 2021b). Therefore, the study's first novelty is comparing green innovation practices and the business performance of two countries, Indonesia and Malaysia. The comparative study will enhance both countries' green practices by exploring the initiatives, investments, and getting labeled green economies. The following section will explore the board of director composition literature and develop the Corporate Governance Index.

4.3. Board of Director Composition: A Corporate Governance Index

A rising consensus exists that a demographically diverse board is better suited to handle the concerns of different stakeholders (Carroll and Buchholtz, 2014). Recent amendments to Malaysian corporate governance regulations on board composition have sparked a debate on the diversity of the boardroom (Rahman et al., 2022). However, there is a lack of research on the connection between green innovation and the corporate governance index. Boardroom characteristics are being explored individually. For instance, Gender Diversity (He and Jiang, 2019), Board Independence, Board Size, CEO Duality (Usman et al., 2020), Board Education, Board Age (Xia et al., 2022), Chair Age, and Gender (Wang and Jiang, 2021) are included in corporate governance index.

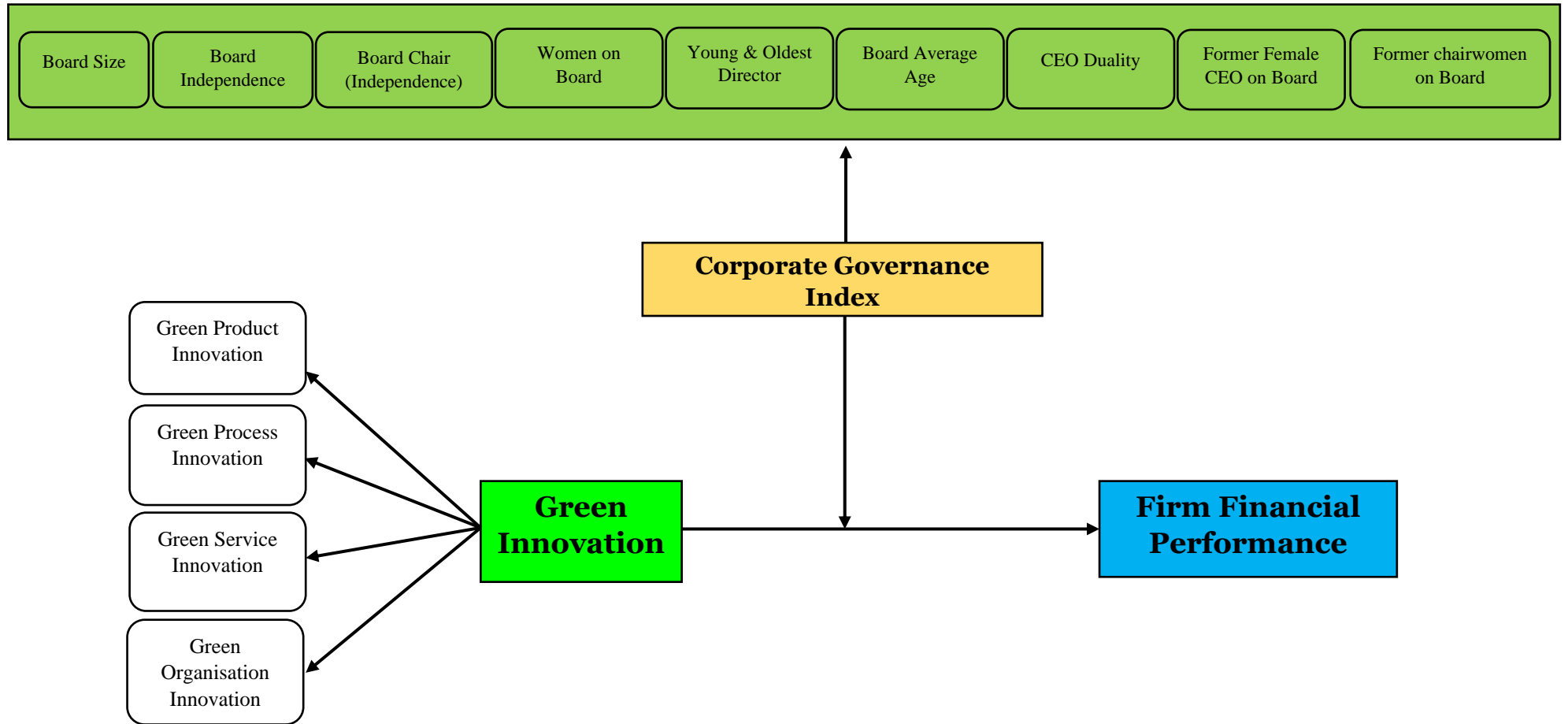


Fig 4: Moderation Role of Board of Director Composition

However, this study included Board Size, Board Independence, Board Independence Chair, CEO Duality, Women on Board, Female Chief Executive Officer or Equivalent, Female Chairperson or Equivalent, Youngest Director, Oldest Director, And Board Average Age. This study included most to cover the major board of director characteristics, developed a corporate governance index, and explored the moderation association between GI and business performance.

This study has tried to incorporate all elements of corporate governance, which firm focuses on embarking on green innovation practices. For instance, the women on board and young board exploring average age as it considered that women and young people are more concerned toward the environment and expected to have more green initiatives and investments.

5. Methodology

This section contains the most critical aspects of the methodology, for instance, sample selection, instrument adoption for data collection, and content analysis.

5.1 Variable Measurement

The measurement of green innovation practices is adopted from our previous study (Khan et al., 2022b), in which we developed the instrument to measure green innovation practices. This includes the measurement criteria of each variable of green innovation, such as green product, process, service, and organizational innovation. The dependent variable for measuring firm financial performance is also adopted from the same studies; however, this study included the two control variables.

The green innovation measurement criteria and corporate governance index is being developed into three phases.

Phase 1: In phase one, we have explored the possible literature which has reported the measurement criteria of different variables of green innovation and corporate governance index. However, a limited study has included all the variables of green innovation and corporate governance. Therefore, we developed the green innovation index (Table 2) using different sources mentioned in our previous study (Khan et al., 2021), which we are extending

further. The measurement criteria of the corporate governance index (Table 3) were developed from the literature.

Phase 2: The second phase is face-to-face validity from the experts; for that, we have interviewed two directors of sustainability, two senior professors of sustainability and governance, and lastly, one policymaker and included the views on minimizing the errors of the index.

5.1.1. Green innovation and firm financial performance

Table 2: Green Innovation (GI) and Firm Financial Performance (FFP)

Variable	Measurement Criteria	Data Source	Reference
Green Innovation			
Green Product Innovation	ISO 14001 Disassembly and Disposal Lifecycle effect of the product Continues to improve and innovate. Eco-Packaging Emission Intensity (Per product) Green product innovation training	Sustainability Reports	(Khan et al., 2021c)
Green Process Innovation	Eco Technology Emission Minimization Water Consumption Minimization waste Minimization Energy consumption Minimization Renewable Energy Consumption	Sustainability Reports	
Green Service Innovation	Green technology adoption Green Material	Sustainability Reports	
Green Organization Innovation	Green Building certification, Green Business Certification Inc (GBCI), Rainwater harvesting, Renewable energy, Recycled materials, ISO 14001 Recycling waste	Sustainability Reports	
Firm Financial Performance			
Return on Asset	Total return/ Total Assets	Third-Party	

5.1.2. Corporate Governance Index

The corporate governance index comprises the Board Size, Board Independence, Board Independence Chair, CEO Duality, Women on Board, Female Chief Executive Officer or Equivalent, Female Chairperson or Equivalent, Youngest Director, Oldest Director, and Board

Average Age. The variable definition is explained; the data collection is also presented in table 3.

Table 3: Corporate Governance Index Variable and Definition

Board of Director Characteristics	Data Collection	Definition
Board Size	#	The total executive and nonexecutive (excluding the secretary) personnel in the board is considered as Bord Size
Board Independence	#	Number of independent directors
Bord Independence Chair	0 =Not Available on Board 1= If chair	The board chair is an independent director
CEO Duality	0 =Not Available on Board 1= If CEO Duality	Chief Executive Officer and Chairman
Women on Board	#	Number of Women on board
Former Female Chief Executive Officer or Equivalent in Board	0 =Not Available on Board 1= If CEO Duality	Is the Former Female Chief Executive Officer or Equivalent on the Board
Former Female Chairperson or Equivalent in Board	0 =Not Available on Board 1= If CEO Duality	In Former Female Chairperson or Equivalent in the Board
Youngest Director	#	The Youngest Director's age is included in the index
Oldest Director	#	The Oldest director's age is included in the index
Board Average Age	#	The Board Average Age is included in the index

Phase 3: In the third phase, the validity and reliability of the corporate governance index and the green innovation measuring instrument must be checked. Cronbach's alpha was carried out, which resulted in 0.755; the outcome is supported by the lead author of green innovation, Chen

(2016). Lastly, Cronbach's alpha was 0.822 for the corporate governance index, which is above the thumb rule value of 0.7 Cronbach's alpha.

The novelty of the study is the corporate governance index, which is developed by taking the mean of all mentioned variable of corporate governance due to the belief that it's not the one variable of governance that affect the firm, but the whole corporate governance variable has a role in promoting and implementing the green innovation practice in the organization.

5.2. Data Collection and Sample

In the literature on sustainability, content analysis is widely accepted. The content analysis started by downloading the company's annual and sustainability reports and numerically seeking out pertinent green innovation practices and codes. *The author has adopted dummy variables "code = 0" if the firm is not practicing, "code = 1" if practicing with minimal discloser, code =2 practiced with high discloser without quantitative information, and code= 3 as practiced with qualitative information discloser (Johl and Toha, 2021).* This study employed the general least square (GLS) method and analyzed panel data from 188 publicly listed Malaysian firms from 2017 to 2019.

Table 4: Number of Observations

Business Sector	Frequency	Percentage (%)
Construction	5	2.5
Consumer Product & Service	46	23
Energy	10	5
Financial Service	7	4.76
Health Care	7	3.5
Industrial Product and Services	46	23
Plantation	9	4.5
Property	18	9
Real Estate Investment Trust	11	5.5
Technology	6	3
Transportation & Logistic	6	3
Utilities	10	4.5
Telecommunications & Media	7	3.5
Total	186	100

5.3. Model Development

Since the panel regression differs from general time series and cross-sectional regression models, this study utilized panel data estimation due to the data for three years of 188 public listed firms in Malaysia (Akhtar et al., 2020, Johl and Toha, 2021). The four models are developed below:

Model 1: $ROA_{it} = \beta_0 + \beta_1 G_innov (Indonesia) + \beta_2 f_size_i (Firm\ Size) + \beta_3 f_age_i (Firm\ Age) + \mu_{it}$

Model 2: $ROA_{it} = \beta_0 + \beta_1 G_innov (Malaysia) + \beta_2 f_size_i (Firm\ Size) + \beta_3 f_age_i (Firm\ Age) + \mu_{it}$

Model 3: $ROA_{it} = \beta_0 + \beta_1 HSI + (G_Innov*BC) + \beta_2 f_size_i (Firm\ Size) + \beta_3 f_age_i (Firm\ Age) + \mu_{it}$

Model 4: $ROA_{it} = \beta_0 + \beta_1 HSI + (G_Innov*BC) + \beta_2 f_size_i (Firm\ Size) + \beta_3 f_age_i (Firm\ Age) + \mu_{it}$

6. Data Analysis and Result

The data analysis steps and the result are reported in the following section, including Diagnostic Result, Descriptive, Pearson Correlation, and Regression, with support of previous literature.

6.1. Diagnostic Test Result

The next step is to conduct the diagnostic test; The primary issue in static panel regression is the presence of multicollinearity. Because our dataset contains 188 firms over three years, before performing the regression, it is crucial to test for multicollinearity. The data was free of multicollinearity because the results demonstrated lesser than the thumb rule, i.e., 0.80 (AL-Zyadat et al., 2022).

In the next diagnostic test, Breusch–Pagan test was performed to eliminate the error terms or to check the heteroscedasticity of the model of the four. The robust test eliminates the heteroscedasticity issue while performing the analysis (Khan et al., 2021a). Furthermore, to identify the best estimation between fixed and random effect, the Hausman test was performed for all four models; the results reveal a mix of random and fixed effect regression. Hence, the random and fixed effect was determined to be the optimal estimator for running the regression (AL-Zyadat et al., 2022)

7. Result and Discussion

Table 5 summarizes the descriptive statistics for the research's primary variables: ROA as the predictor variable, green innovation as the explanatory variable (which includes the green product, process, and organizational innovation), and corporate governance index as a moderating variable.

Table 5 presents the descriptive statistics of green innovation, including sub-variables of green innovation. Secondly, moderating variable is the board of directors' composition and the firm age and size as control variables.

Table 5: Descriptive Result

Variable	Obs	Mean	Std. Dev.	Min	Max
ROA	567	.0359	.0344	-.086	.12
Green_Product_Innovation	567	.5797	.4786	0	1.57
Green_Process_Innovation	567	1.159	.5970	0	2.63
Green_Service_Innovation	567	.3227	.3294	0	1.33
Green_Organisation_Innovation	567	.8573	.4856	0	2.22
Green_Innovation	567	.6506	.3119	.045	1.33
Board Composition %	567	20.81	2.167	13.01	26.58
Firm Age	567	43.10	27.73	2	154
Firm Size	567	6.522	1.0136	4.449	9.915

Table 6 reports the Pearson correlation coefficients of the variables. The Pearson correlation table found significantly correlated sub-variables of green innovation with the Return on assets except for green service innovation. The control variable is also considerably correlated with ROA.

Table 6: Pearson correlation

	1	2	3	4	5	6	7	8	9
ROA	1								
Green_Product_Innovation	0.1776***	1							
Green_Process_Innovation	0.1538***	0.6902***	1						
Green_Service_Innovation	0.0687	0.6115***	0.6932***	1					
Green_Organisation_Innovation	0.1445***	0.6082***	0.8443***	0.6935***	1				
Green_Innovation	0.1453***	0.6082***	0.9204***	0.8853***	0.8923***	1			
Board Composition %	0.0104	0.1232***	-0.1492***	-0.1934***	-0.1497***	-0.1307***	1		
Firm Age	0.0152	0.1875***	0.1063*	0.0528	0.0686	0.1076*	-0.0527	1	
Firm Size	-0.0415	0.0260	-0.1149**	-0.1163**	-0.1524***	-0.1119**	0.1419***	0.0162	1

7.1. Regression

The result and discussion section are divided into two major parts: direct regression of GI and FFP and moderation regression of the corporate governance index.

7.2. Direct Relationship: Green Innovation (GI) and Firm Financial Performance (FFP)

Table 7 depicts the regression of green innovation practices in two neighbouring countries (Malaysia and Indonesia) on the FFP. The two primary regressions were run for the two most important models in this study, model 1 representing the effect of GI practice on Return on asset (ROA) in Malaysia and model 2 representing the effect of GI practice on ROA in Indonesia.

The result reported in Table 7 shows that green innovation practices positively impact firm return on assets (Coef 0.341 & p values 0.000) in Malaysia (Saudi et al., 2019). The result is similar in Indonesia, where green innovation practices also positively impact FFP. The result is positive because green innovation practices not only minimize the cost but, most importantly, maximize the resources utilization which enhances the asset utilized, which is also supported by the previous authors Saudi et al. (2019); Saudi et al. (2019), (Qiu et al., 2020) Zhang et al. (2022).

Table 7: Nexus of Holistic Green innovation (GI) Firm Financial Performance (FFP): Moderation Corporate Governance Index

Variables	Firm Financial Performance (ROA)	Firm Financial Performance (ROA)
	Malaysia	Indonesia
	Model 1	Model 2
Green_Innovation	.0341***	.2315**
Firm size	-.0007	-.012***
Firm Age	.0036	.0049
_cons	-.0070*	.4576
R-sq.		
Model: GLS	Random	Fixed (Robust)
Prob > F	0.0000	0.0011
Moderation (Corporate Governance Index)		
	Model 3 (Interaction Model)	Model 4 (Interaction Model)
Green_Innovation	.1126**	.4226**
Board Composition (BC)	.0026*	.0226
Green_Innovation *BC	-.0037*	-.0106
Firm Age	-.0006	-.0118***
Firm Size	.0035*	.0040
_cons	-.0615*	.4399
GLS	Random Effect	Random Effect
R-Square	0.1459	0.0246
Observation (576)		
Prob > F	0.0000	0.0057

In addition, the two-control variables, firm age, and size have mixed findings. In Malaysia, the firm size shows negative significance but appears as positive significance in Indonesia. The second control variable, firm age, has a positive significance but is insignificant in Malaysia and Indonesia, respectively.

7.3.Moderation

In the same table, 7 also illustrates the moderation effect of board composition over green innovation practices and FFP. Table 7 represents model 3, the moderation of Board Composition on the relationship between GI and Return on Asset in the context of Malaysia. The result shows that green innovation positively impacts the Return on assets in the base model (**0.0341*****). The green innovation remains the same in the moderation model (**0.0339*****), but the board of director composition is insignificant. However, the interaction model has shown a positive relationship between the board of director composition moderation (-.0037***) on GI and FFP.

In Table 7, the regression result of moderation is also reported concerning the Return on assets for both countries. The result shows a difference then Malaysia; in Malaysia, the interaction model has shown positive moderation of board composition (BC). Whereas, in the context of Indonesia, the base model found positive green innovation (**0.2315****), which remains the same in moderation (**0.2456****) as well as interaction model (**0.4226*****), but the moderation (Board composition) remains insignificant in moderation model and interaction model.

This first research empirically supports the corporate governance index's moderation role in the relationship between GI and FFP. The results show that the corporate governance index between positive moderates in Malaysian green innovation practices but is insignificant in Indonesia's green innovation practices. There is a limited study that has explored this relationship in the Malaysian context, but the direct relationship between board characteristics such as board size, independent commissioners, and ownership and green innovation in an emerging market is reported as positive (Asni and Agustia, 2022). However, our study explored the highest corporate governance characteristic, which resulted in positive in Malaysia but insignificant in the Indonesian context. The author also argues that the result reported is due to the recent reforms in the Malaysian corporate governance code 2017 & 2021 (Rakia et al., 2023), which made it mandatory to report the practices and practice green governance, but on the other hand, there are notices less focused on green governance in Indonesia.

On the other hand, firm age shows a negative significance in the control variables, whereas firm size has no significance in the model. Hence, Indonesia's board composition has mixed findings on the relationship between GI and ROA.

Moreover, this research has also performed an individual analysis of each variable of green innovation, including product, process, service, and organization, to explore which variable has a significant effect on the Return on assets, along with extra analysis on Return on equity. The result is incorporated in the appendices Table A2, A3, A4, and A5.

8. Implication

Due to the Covid 19 pandemic, the world's greenhouse gas emissions, garbage output, and other environmental concerns have diminished. However, these environmental issues are projected to double into an endemic phase. This has also created a VUCA situation in every industry; therefore, there is a strong need for green governance in Asian countries. Green governance enables businesses to unlearn their reactive, individualist attitude and adopt a holistic strategy for implementing green innovation techniques that reduce costs and increase revenue, which is noticed in this comparative study of two countries. This study has several consequences for industry and policymakers.

8.1. Practical Implication

The increase in emissions, waste, water contamination, and other environmental challenges are giving birth to a new ecological pandemic that needs to be addressed as soon as possible. As a solution, there is a need to shift from normative to proactive behavior. This allows a role of corporate governance in the adoption and practices of GI and its impact on FFP.

According to the findings of this study, the chemical, agriculture, and textile industries are the most polluting industries that this study looks at, which are contributing considerably to large-scale pollution. These industries need to minimize environmental pollution, and social challenges through green innovation practices, such as; while developing the product green lifecycle are strongly recommended to consider. Secondly, while the whole study's author has noticed several green services initiatives, green organizations seem reactive in both countries, which will be only possible with the firm's initiatives of green corporate governance (Shah et al., 2022).

Furthermore, the board of directors must devote significant attention to developing green governance that enables green innovation methods (Shah et al., 2022, Shah et al., 2021).

However, the author would like to draw attention to women's participation at managerial and board levels was found to be lower than in Malaysian (Lim et al., 2019, Guizani and Abdalkrim, 2022) and Indonesian (Nainggolan et al., 2022) corporate governance code.

Additionally, the green innovation practice and proper corporate governance can minimize the impact mostly in most polluted industries such as pharmaceutical, chemical, energy & oil, and gas. For instance, researchers (Malik et al., 2023) have used Ionic liquids for the separation of ethanol and lactic acid (Khan et al., 2022a) from water and salicylic acids from wastewater (Ting et al., 2021). Another exemplary research on hydrogen-based energy solutions for clean emission with better efficiency (Qureshi et al., 2022). This green initiative minimizes environmental challenges and improves the cost of operation and the positive impact on the firm triple bottom line.

Boosting the business's triple bottom line will allow the firm to relate to the market and investors (Lai et al., 2021). This combination of environmentally friendly practices and support for green government initiatives will directly support the 17 sustainable development goals of the United Nations. (Jan et al., 2021) and deal with this current environmental pandemic. Similarly, this study also has implications for policymakers as it creates advantages for firms, society, and government; the detailed implication to policymakers is discussed in the following subsection.

8.2. Implication to Policymaker

The study also has implications for policymakers, specifically in developing environmental challenges and corporate governance policies. Malaysian-Indonesian governments and policymakers should encourage proactive green innovation practices. However, many initiatives are being reported in the literature of both countries. Still, grants/rebates can be used to encourage green innovation or punitive measures such as tariffs and quotas, but it is not long-term initiatives. Malaysia-Indonesia needs a proactive, holistic approach to developing long-term planning, such as green innovation credits, green electricity, and green buildings.

These initiatives will boost the relevance of environmental concerns to the top managers. These ecological concerns further enhance the green culture in the organization and increase the green innovation practices and visibility to other late movers' firms.

In addition, the second implication is on the policymaker's corporate governance, as current research has found a positive moderation role of the corporate governance index between the

Malaysian green innovation practices and firm financial performance, which clearly indicates that if the green governance structure is advocated in governance policy that will enhance the further impact on creating green culture and practices in the business activities of the firm.

Lastly, while developing a green governance structure, there is a need to make target-based remuneration to achieve green innovation practices. For instance, green innovation practices can be divided into a few thresholds, each with a percentage of compensation.

9. Conclusion

Sustainability and corporate governance are the soul and heart of the business. On the other hand, a country like Malaysia and Indonesia aims for a low-carbon society without impacting economic activities. However, it requires green intention as well as initiatives. One of the most popular amongst the Malaysia and Indonesia publicly listed companies is green innovation. Green Innovation is an effort to position the company as the most sustainable firm to win over stakeholders and draw the attention of investors (Falchi et al., 2022).

The study's objective is to do a comparative holistic view of green innovation (covering product, process, service & organization) and its impact on firm financial Performance in Malaysia and Indonesia, along with the first study to measure the moderation role of the corporate governance index. This study has addressed the gap by developing the green innovation and corporate governance index. The data was collected from the top 188 publicly listed firms for three years and analyzed using the General Least Square (GLS) method as predicted by the diagnostic test.

The empirical evidence demonstrates that the green innovation practice is better in Malaysia, and the outcome also shows that the significance level is higher than in Indonesia. In addition, this study provides empirical evidence that board composition has a positive moderation relationship between GI and business performance in Malaysia but is insignificant in Indonesia. To conclude, this comparative study provides new insights to the policymakers and practitioners of both countries to boost green culture and innovation activities at the firm and national levels.

Lastly, unlike other studies, this study has also had some limitations. Firstly, this study has not focused further on any industry. Therefore, special research is also needed to investigate the industry based. Secondly, this study doesn't include green quality innovation, which is also a new area of research.

Thirdly, Financial Performance was measured using one accounting ratio. Future studies should explore the impact on shareholder confidence and the market. Fourthly, Future research should use GMM, 2LS, and 3LS regression analyses to generalize the findings.

10. Future study

This study also proposes a model shown in Figure 6 that explores the pressure to practice green innovation in the organization for better financial performance and firm sustainable development goals. The proposed model is projected to contribute to the firm's sustainable development goals and achieve the country's SDGs by 2030. Therefore, apart from this study's limitation, the proposed model will be an extension of this study. This proposed model will further explore the impact of green innovation on a firm's financial performance and contribution toward the sustainable development goal performance. This study also indicates another empirical gap in Corporate governance practice, specifically in Malaysia, where the new corporate governance code 2021 has been released.

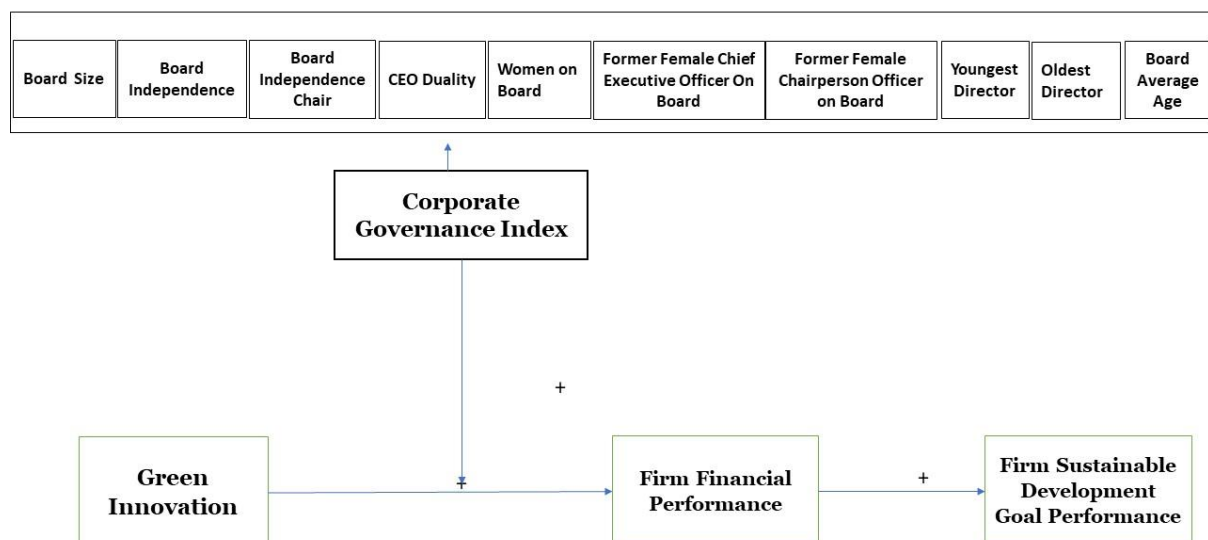


Figure 6: Does the Green Innovation and Corporate Governance Index achieve SDGs at the firm level?

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Satirenjit Kaur Johl: Conceptualization, Supervision, Proofreading, and Improvising Quality

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Appendix A: Extra Analysis: Individual Analysis

A1: Top Authors (Document Number and Citation)

Author	Top Authors		
	Documents	Citation	Journal Impact Factor
Wang Y	2	56	9
Zhang Y	2	57	9
Johl S.K	2	23	10.3
Khan P.A	2	23	10.3
Al-Sartawi A.M	1	27	0
Chalikias M	1	27	0
Galatsidas S	1	27	0
Chen Y.	1	5	1.35
Cherian J.	1	4	0
Chopra M.	1	3	9

A2: Nexus of Between Green Product Innovation and Firm Performance

ROE	Indonesia			Malaysia		
	Coef.	Std. Err.	P> z	Coef.	Std. Err.	P> z
Green_Product_Innovation	.0141504	.0033802	0.000***	.0215726	.0050468	0.000***
Firm size	-.0000772	.0000826	0.350	.0001724	.0001171	0.141
Firm Age	.0056001	.0021637	0.010**	.0080094	.0030923	0.010**
_cons	-.0054699	.0147904	0.712	-.0214832	.0211527	0.310
R-sq:	0.0838			0.0805		
Model: GLS	Random			Random		
Prob > F	0.0000			0.0000		

A3: Nexus of Green Process Innovation and Firm Performance

ROE	Indonesia			Malaysia		
	Coef.	Std. Err.	P> z	Coef.	Std. Err.	P> z
Green_Process_Innovation	.0094777	.0028581	0.001***	.0178626	.0042239	0.000***
Firm size	-.0000748	.0000831	0.368	.000165	.0001173	0.159
Firm Age	.0049034	.0021801	0.025**	.0067643	.003099	0.029**
_cons	-.0038137	.0148707	0.798	-.0212467	.0211495	0.315
R-sq:	0.0547			0.0968		
Model: GLS	Random			Random		
Prob > F	0.0000			0.0000		

A4: Nexus of Green Service Innovation and Firm Performance

ROE	Indonesia			Malaysia		
	Coef.	Std. Err.	P> z	Coef.	Std. Err.	P> z
Green_Service_Innovation	.0281282	.0041437	0.000***	.0276219	.006424	0.000***
Firm size	-.0000562	.0000807	0.486	.0002106	.0001167	0.071*
Firm Age	.0045073	.0021246	0.034**	.0068155	.0030982	0.028**
_cons	-.0001241	.0143806	0.993	-.011749	.0209578	0.575
R-sq:	0.1225			0.074		

Model: GLS	Random	Random
Prob > F	0.0000	0.0000

Table A5: Nexus of Green Organization Innovation and Firm Performance

ROE	Indonesia			Malaysia		
	Coef.	Std. Err.	P> z 	Coef.	Std. Err.	P> z
Green_Organisation _Innovation	.0155184	.0032985	0.000***	.0213775	.0049435	0.000***
Firm size	-.0000574	.0000819	0.484	.0002052	.0001167	0.079*
Firm Age	.0052197	.0021553	0.015**	.0074729	.0030921	0.016**
_cons	-.0089455	.0148137	0.546	-.0252173	.0212869	0.236
R-sq:	0.0814			0.0988		
Model: GLS	Random			Random		
Prob > F	0.0000			0.0000		

Note: *** Significant at 1%, ** Significant at 5%, * Significant at 10%