# Green Innovation and Financial Performance: Bridging the Profitability-Sustainability Gap

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## ABSTRACT

*In the current era of a knowledge-based green economy, green innovation has emerged as an important driver for firms to improve their financial performance. Recent studies have emphasized the significance of green innovation in addressing environmental degradation and enhancing financial performance. Few studies have been conducted about green innovation and its effects within the context of Pakistan. This study seeks to examine the impact of different green innovation proxies including ISO certifications like ISO 5001, ISO 9001, and ISO 14000 on the financial performance (ROA) of publicly listed firms on the Pakistan Stock Exchange (PSX). The study utilized a dataset comprising 2702 observations from 351 listed companies from 2013 to 2021. The data was analyzed using weighted least square regression analysis. The study's empirical research indicates that Green Innovation has a statistically modest yet positive effect on Financial Performance in Pakistan. The research indicates that Green Innovation is significant for Financial Performance in developing countries like Pakistan. The study's findings and policy recommendations are significant for managers of various companies listed at PSX and policymakers. They can help in addressing environmental degradation and promoting sustainable development by implementing green innovation practices.*

***Keywords:*** *Green Innovation, Environmental degradation, Financial Performance, Pakistan*

## INTRODUCTION

Currently, the global community is going through a range of environmental challenges, including but not limited to increasing emissions, waste generation, pollution, global warming, habitat destruction, and resource depletion (Begum et al., 2022, Awan, et al., 2021) which exert an equitable impact on both businesses and overall society at large (Pujari, et al., 2003). Subsequent data has revealed that Asia has experienced the highest incidence of human population distress resulting from drought over the course of the previous century. (Guha-Sapir, et al., 2021)[1]. Whereas, Pakistan has seen significant economic losses of over US$ 30 billion and has observed the displacement of around 33 million inhabitants due to the detrimental and uncertain impacts of climate change (Tan, 2022)[2]. Thus, the corporate sector must actively engage in innovative and eco-led techniques that comply with their needs and benefit the community, as Green Innovation (GI) does.

[1] Guha-Sapir, D., Below, R., & Hoyois, P. (2016). EM-DAT: the CRED/OFDA international disaster database. (url: https://www.emdat.be/ Accessed on October 24, 2023).
[2] Tan, S. L. (2022). Pakistan is bearing the brunt of the climate crisis despite 'small carbon footprint,'minister says. (url: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC9708371/#B9 Accessed on October 24, 2023).

Drawing upon the Natural Resource Base View (NRBV) theory proposed by (Hart, 1995), Environmental, Green Innovation or Eco-innovation can be well operationalized in a way that pertains to the development of novel ideas or practices that encompass the comprehensive management of input and output elements across the whole life cycle of a firm's operations aiming to mitigate the adverse impact of these activities on the natural environment (Vasileiou, et al., 2022; Rennings, 2000), subsequently improves the financial efficiency or financial performance (FP) of the firm (Farza, et al., 2021). The key components of NRBV theory, which encompass pollution prevention, product stewardship, and sustainable competitive advantage, demonstrate the significance of promoting green innovation. Firms, by embracing green innovation practices and incorporating these concepts into their business plans, thereby achieving both environmental and financial sustainability for the long term. Despite the increasing academic attention confined to examining the potential impacts of GI, a significant dearth of consensus exists within the scholarly literature about the overall influence of GI on FP. The situation in question provoked a comprehensive discussion over the topic (Ghisetti and Rennings, 2014).

Scholarly literature has provided evidence in favor of the notion that GI possesses the capacity to generate positive environmental effects, as well as enhance the FP (Caviggioli, 2016; Dangelico, 2016; Li, 2014; Przychodzen and Przychodzen, 2014; Doran and Ryan, 2012; Kam-Sing Wong, 2012; Chen, 2008) but there are numerous additional investigations where findings are inconsistent, including instances of absence of a relationship, negative effects, statistical insignificance, and even a non-linear (U-shaped) association between GI – FP (Hussain et al., 2018; Testa and D'Amato, 2017; Trumpp and Guenther, 2015; Driessen et al., 2013).

The dissimilarity in research findings can be attributed to numerous key factors. Previous research usually failed to properly differentiate between different facets of GI (Tariq et al., 2017). The concept of GI comprises a wide range of typologies, including product and service innovations, process innovations, management innovations, and business model innovations, where each of these typologies is connected to different factors that lead them, as discussed by Murat Ar and Baki (2011) and Dost et al. (2016). Furthermore, these different types of innovations lead to varying performance results, as highlighted by Damanpour et al. (2009). As a result, studies conducted on GI issues have produced different and oftentimes contradictory findings. To enhance our insight and yield more precise results, it makes sense for researchers to dive deeper into distinct GI categories (Amores-Salvadó et al., 2014).

Moreover, the lack of consensus among prior research studies may be attributed to differences in measuring financial performance (Przychodzen & Przychodzen, 2014). A deliberate choice of appropriate financial indicators is essential in determining the GI – FP link, as each one has its unique usage for the stakeholders. Furthermore, the lack of conclusive findings in prior academic studies might be linked to the utilization of diverse and sophisticated measurements for assessing the concept of GI. The methods encompass both quantitative and qualitative elements. Vasileiou et al. (2022) assert that quantitative indicators for assessing GI encompass several factors such as environmental patents, carbon dioxide ($CO_2$) emissions, waste production, energy consumption, and noise levels. In contrast, qualitative measurements depend on subjective data, frequently obtained through ratings, which are instinctively inadequate. Hence, it is evident that further investigation is required to explore the GI – FP relationship, with more robust measures as supported by previous studies (Dangelico, 2015; Tariq et al., 2017; Molina-Azorn et al., 2009).

The existing body of research on the linkage between Green Innovation and Financial Performance has been constrained by discrepancies in the methods used to quantify Green Innovation, a lack of uniformity in evaluating Financial Performance, and a failure to sufficiently account for the influence of contextual factors. In order to fill these knowledge gaps, this study thoroughly examines the complex characteristics of Green Innovation, distinguishing between its many types and their unique impacts on

Financial Performance. In addition, the study utilizes a strong and reliable measure of Financial Performance (ROA), which includes a wide range of financial indicators that accurately represent the complex nature of organizational performance. Furthermore, this study employs ISO certifications, namely ISO 9001 (for quality management), ISO 5001 (for energy management systems), and ISO 14000 (for environmental management), as a proxy indicator for the adoption of Green Innovation. ISO certifications offer a consistent and provable evaluation of an organization's dedication to environmental sustainability and operational effectiveness, thereby serving as a dependable measure of Green Innovation initiatives.

ISO 9001 accreditation specifically improves an organization's capacity to consistently generate superior products and services, resulting in heightened customer contentment, brand affiliation, and market leadership. The ISO 5001 certification allows enterprises to enhance their energy efficiency, resulting in cost reduction and a decrease in environmental footprint. The ISO 14000 certification showcases an organization's dedication to sustainability, which appeals to environmentally aware customers, and financiers and improves brand recognition. (Tseng, et al., 2012; Husnaini and Tjahjadi, 2021; Saepudin, et al., 2022).

Organizations demonstrate their dedication to resource efficiency, pollution reduction, and functional excellence by implementing and upholding ISO certifications. This aligns with the NRBV philosophy, which emphasizes the utilization of valuable resources to attain a competitive advantage (Hart, 1995). These certifications demonstrate an organization's capacity to innovate in a sustainable manner, leading to increased financial performance through reduced costs, revenue expansion, and enhanced market position (Ma et al., 2022). This approach not only enhances the precision and significance of the findings but also provides a comprehensive analysis of the impact of green innovation strategies on both corporate and governmental organizations, intending to aid these organizations in the creation of more efficient approaches to maximize their gains through green innovation.

The subsequent portion of the paper has been structured in the following manner. The part comprises a comprehensive evaluation of the existing literature and presents concepts (literature review and hypothesis development). The next section, known as Methodology, pertains to the design of the study and is followed by the empirical findings and discussion. The final section presents both the conclusion and guidelines for future research.

# LITERATURE REVIEW

### *Green Innovation and Financial Performance*

Over the past two decades, Pakistan has been identified as the eighth most climate-affected nation as reported by the German Watch Report 2021[3], and is number three among the world's most polluted countries/regions between the years 2018 – 2022[4]. Moreover, in the last two decades, $CO_2$ emissions from oil, gas, and coal consumption in Pakistan have more than doubled (Lin, and Ullah, 2023). Therefore, Pakistan is one of the most adversely affected due to climate change causing serious environmental problems.

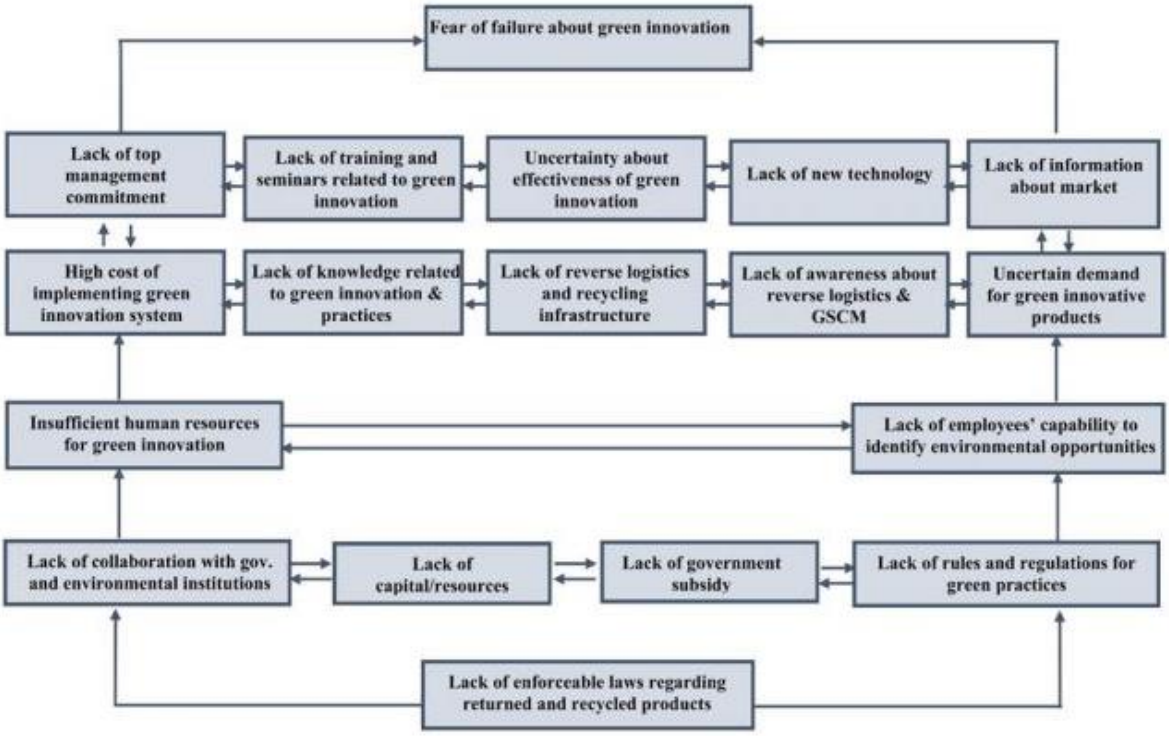
Furthermore, based on the findings of the Global Innovation Index (GII), Pakistan is positioned as one of the countries with relatively lower levels of innovation on a global scale, holding the 88th position out of 132 economies (GII, 2023)[5]. The study of growing economies, such as Pakistan, can offer valuable insights into the many tactics employed to address environmental degradation and promote the development

[3] https://www.germanwatch.org/sites/default/files/Global%20Climate%20Risk%20Index%202021_2.pdf (Accessed on 25 October 2023)
[4] https://www.iqair.com/world-most-polluted-countries (Accessed on 25 October 2023)
[5] https://www.wipo.int/edocs/pubdocs/en/wipo-pub-2000-2023/pk.pdf (Accessed on 25 October 2023)

of environmentally friendly products that mitigate ecological pollution and industrial waste (Shahzad et al., 2021). Moreover, it is worth noting that within Pakistan, a significant proportion more precisely 90 percent, falls under the category of small and medium-sized enterprises (SMEs). Interestingly, approximately 80 percent of these enterprises have chosen to establish themselves along the riverbanks in urban areas. Regrettably, these enterprises have failed to embrace innovative practices (see Figure 1, barriers to green innovation) that prioritize environmental preservation and pollution reduction (Jun et al., 2019). Consequently, a distressing consequence of this negligence is the arbitrary disposal of industrial waste into the rivers (Luken, 2000). This impulsive behavior has resulted in a distressing level of pollution, which not only poses a severe threat to marine life but also exposes human beings to a multitude of life-threatening diseases (Sahibzada and Qutub, 1993). Ultimately, this detrimental situation ends in long-term financial loss for the businesses concerned, which raises concerns among different stakeholders.

**Figure 1.**

*Barriers to Green Innovation in Pakistan*




Source: (Ullah et al., 2021)

Businesses cannot be operated in isolation. Therefore, drawing upon the Stakeholder theory (Freeman, 1984), numerous compelling factors can drive organizations to switch to ecologically sustainable practices (Del Río González,2009; Horbach, 2008; Frondel et al., 2007). These elements encompass a wide range of stakeholders, including regulatory bodies, discriminating customers, conscientious investors, and others (Qi et al., 2010; Murillo-Luna et al., 2008; Sharma and Henriques, 2005) that can put pressure on firms to be focused on reducing resource consumption and generating environmentally sustainable goods and services that may be sold, with the added benefit of economic benefits for the innovator as cited in (Fliaster, and Kolloch, 2017). Subsequently, enhances the variety of organizational outcomes concerning financial, environmental, sales, social, and overall performance (Beck et al. 2018; Hou 2019; Yang and Baasandorj 2017; Rasheed et al. 2018; Xie et al. 2019; Mahoney and Roberts 2002; Walls et al. 2012;

Waheed and Yang 2018; Ağan et al. 2016; Khan et al. 2019; De Bakker et al. 2005). Therefore, from a stakeholder perspective, one can deduce that implementing GI will serve as a valuable asset to the company's financial performance.

Moreover, in the pursuit of promoting GI, a significant number of scholars have conducted studies in various contexts. These studies have yielded several outcome variables, including the mitigation of environmental risks (Castellacci and Lie, 2017), the enhancement of resource efficiency (Zhang et al., 2017), the reduction of pollution rates (Albort-Morant et al., 2018b; Castellacci and Lie, 2017), energy conservation (Chen et al., 2017), the development of cost efficiency leads to organizational flexibility (Albort-Morant et al., 2018a), the improvement of organizational performance (Roy and Khastagir, 2016), the stimulation of economic performance (Burki and Dahlstrom, 2017), and the attainment of competitive advantages (El-Kassar, and Singh, 2019). Moreover, the existing body of research mostly focuses on examining GI – FP association includes (Tang, et al., 2018; Marín-Vinuesa, Scarpellini, Portillo-Tarragona, & Moneva, 2018; Przychodzen & Przychodzen, 2015). However, the findings reported in the literature have remained inclusive or mixed due to inconsistency in identifying the appropriate proxy for measuring green innovation. Furthermore, previous research has predominantly focused on developed or advanced countries (Horbach, 2008), neglecting the examination of emerging market economies (Duque-Grisales & Aguilera-Caracuel, 2021; Danso, et al., 2019; Gallego-Alvarez, 2018). Consequently, drawing upon the literature discussed above, the researcher formulates the subsequent hypothesis for the study.

*Hypothesis 1: Green Innovation has a statistically significant and positive effect on Financial Performance.*

***Theoretical Framework***

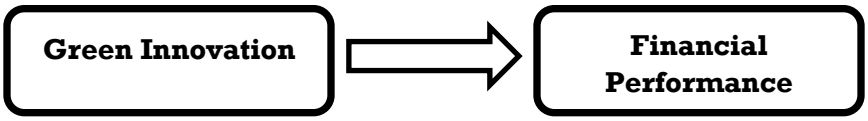
From a theoretical perspective, it is worth noting that scholars have raised concerns regarding the Resource-Based View (RBV) framework due to its limited consideration of the external environment. An extension to the RBV model was proposed by Hart (1995) termed as "Natural Resource-Based View" (NRBV) theory as a plausible alternative and strategic framework for attaining competitive advantage via the incorporation of environmental issues and sustainability factors. The Stakeholders theory, as proposed by Freeman et al. (2010) and Freeman (1984), provides additional support for the idea that a wider array of stakeholders can exert influence on firms, thereby motivating them to take a proactive approach to environmental conservation. The application of the NRBV theory is further motivated by the concept of social responsibility (Lopez-Becerra & Alcon, 2021).

Whereas a part of CSR practice, green innovation involves designing and developing environmentally friendly products and processes to address the adverse effects on the environment caused by the inefficient utilization of natural resources (Xie et al., 2019), the Natural Resource-Based View (as an expansion of the resource-based approach) also underscores the importance of the environment and explores the relationship between an organization's resources and its ability to achieve both environmental (non-financial) objectives and strategic (financial) goals (Hart, 1995; Ma et al., 2022).

NRBV theory also stresses the need to possess skills and resources within a firm, such as Green Innovation which subsequently leads to improved productivity and optimization of industrial operations, resulting in decreased costs and emissions. Subsequently, yields higher profitability and sustainable corporate success (Hart, 1995; Sarkis et al., 2010; Shahzad et al., 2020; Anderson, 2021). Consequently, drawing upon the Natural Resource-Based View (NRBV) theory and after conducting a thorough review of the pertinent literature, this study presents the subsequent theoretical framework and hypothesis.

**Figure 2.**

*Theoretical Framework*




# RESEARCH METHODOLOGY

### *Research Design*

The primary stage of the study design involves the development of a research plan. The present study followed a quantitative research methodology. Quantitative research is a methodical and structured methodology that encompasses the systematic gathering, examination, and dissemination of empirical data. Furthermore, the research also conforms to the tenets of the scientific method, as it demonstrates attributes such as impartiality, measurability, and logical reasoning. Therefore, the study is based on a positive research philosophy. Moreover, the research employed a descriptive and correlational investigation to examine the hypothesized proposition of the study. The data for this study is derived from secondary sources, which are inherently documented in their natural occurrence, thereby establishing the study setting as non-contrived.

### *Operationalization/Measurement of Variables*

**Table 1.** *Operational Definitions and Measurements*

| Variable | Operationalization | Formula | Document | Source |
|---|---|---|---|---|
| Green Innovation Index | An innovative approach that places significant emphasis on the reduction of waste, prevention of pollution, and the adoption of an environmental management system aimed at producing quality goods & and services. | ISO 5001, ISO 9001, ISO 14000 | Annual Reports | Clancy (2017), Iqbal (2019), Zhang et al. (2020) |
| Financial Performance | The effectiveness of a firm's ability to make use of assets in its core business operations to generate income. | Net Income x 100 Total Assets | | Bhagat and Bolton (2008) |

### *Data and Data Collection*

The data on the chosen variables was acquired from a diverse range of organizations that are listed on the Pakistan Stock Exchange. The study's sample was determined by a selection process that prioritized data availability, resulting in the identification of a limited number of organizations.

The research encompasses a comprehensive sample of 351 organizations, comprising a total of 2702 data points over the period from 2013 to 2021. Since the year 2012, the Securities and Exchange Commission of Pakistan (SECP) and the Pakistan Institute of Corporate Governance (PICG) have been diligently engaged in the advancement and execution of corporate governance – sustainability mechanisms.

***Model Specification and Tools for Data Analysis***

This research performed a special case of Generalized Least Square (GLS) i.e., the Weighted Least Square (WLS) regression analysis to test the hypothesis. WLS regression is a statistical method utilized to analyze data in which the variance of the error term varies across observations. This stands in opposition to ordinary least squares (OLS) regression, which operates under the assumption of a constant variance for the error term. GLS has the capability to address heteroscedasticity as well, but it necessitates the explicit specification of the precise type of heteroscedasticity, which was not explicitly stated in the dataset. According to Jakpar et al., (2019), studies where variables contain heteroscedasticity issues can use WLS. Moreover, WLS regression is often recommended over GLS regression when the exact form of heteroscedasticity is unknown. In WLS, the weight assigned to each observation is determined by the inverse of the residual variances. Consequently, WLS assigns more weight to data exhibiting lower variances, which means the measurements are more robust and accurate. Therefore, this study directly adopted the WLS regression for further statistical analysis using E-views software version 10.

$$\sum_{t=1}^{n} w_t \varepsilon_t^2 = \sum_{t=1}^{n} w_t (y_t - y_t^M)^2 \qquad \textbf{(Equation. 1)}$$

From Eq. 1, appropriate weights, denoted as $w_t$, can be used to mitigate the impact of residuals in areas with elevated levels of noise variance. The modified sum of squares produces the subsequent normal equations:

$$\mathbf{X^T W X b = X^T W y}$$

Where:

| | | |
|---|---|---|
| X | = | Design Matrix |
| W | = | Diagonal Matrix of Weights |
| Y | = | Vector of Regressand's Observations |
| b | = | Vector of Unknown Regression Coefficients |

# ANALYSIS AND RESULTS

The regression method proposed by Zhao et al. (2010) is used to assess the econometric model that is based on the hypotheses and theoretical framework. Each variable's features are determined by looking at the totality of all the variables utilized in the model.

**Table 2.** *Summary Statistics*

| | ROA | GII_INDEX | ROA(-1) |
|---|---|---|---|
| **Mean** | 1.214659 | 0.026756 | 1.213153 |
| **Median** | 0.028087 | -0.579990 | 0.027639 |
| **Std. Dev.** | 61.78688 | 1.019800 | 61.78691 |
| **Skewness** | 51.95045 | 1.628478 | 51.95045 |
| **Kurtosis** | 2699.900 | 5.165346 | 2699.899 |
| **Jarque-Bera** | 8.20E+08 | 1722.130 | 8.20E+08 |
| **Probability** | 0.000000 | 0.000000 | 0.000000 |
| **Sum** | 3282.008 | 72.29546 | 3277.938 |
| **Sum Sq. Dev.** | 10311388 | 2809.021 | 10311399 |
| **Observations** | 2702 | 2702 | 2702 |

Based on the data presented in Table 2, it can be observed that the average (median) values for Return on Assets (ROA) are 1.215 (0.028), for GII_Index are 0.026 (-0.057), and for ROA (-1) are 1.213 (0.027). The standard deviations for these variables are 61.78, 1.019, and 61.78 respectively. In addition,

when considering the asymmetry and the tail weight of a probability distribution, such as skewness and kurtosis, and applying the Jarque-Bera statistics, it appears that the dataset does not align with the assumption of a normal distribution.

This assumption is essential for conducting ordinary least squares (OLS) analysis. Hence, it may be more appropriate to consider alternative methods for the analysis, as ordinary least squares (OLS) may not be the most suitable approach in this case.

**Table 3.** *Covariance, Correlation Probability*

| | **ROA** | **GII_INDEX** | **ROA(-1)** |
|---|---|---|---|
| ROA | 1.000000 | | |
| GII_INDEX | -0.011138 | 1.000000 | |
| | **0.5628** | | |
| ROA(-1) | -0.001342 | -0.011118 | 1.000000 |
| | **0.9444** | **0.5635** | |

The correlations among the three variables in Table 3, the results reveal that there is a negligible but negative relationship exists among the variables. Moreover, it is important to note that this correlation is not statistically significant, as shown by the p-values > 0.05. Based on the observed correlation coefficients, it can be inferred that there is no presence of multicollinearity among the variables ROA, GII_INDEX, and lag values of ROA.

**Table 4.** *Durbin Watson, Heteroscedasticity LR Test*

| | **Value** | **Df** | **P-Value** |
|---|---|---|---|
| Durbin Watson | 0.2315 | | |
| Likelihood Ratio | 37677.50 | 318 | 0.0000 |

The Durbin-Watson test is commonly employed to evaluate the potential presence of autocorrelation in a given dataset. It is assumed that there is a null hypothesis suggesting the lack of autocorrelation in the data. The findings indicate the presence of a positive autocorrelation among the error terms in the dataset, as demonstrated in Table 4. Furthermore, we propose considering an alternative approach to the concept of "fixed effect," which is a statistical technique commonly employed in econometric analysis to account for unobserved heterogeneity.

Additionally, we suggest utilizing the weighted least square model to effectively address issues of autocorrelation and heteroscedasticity present in the dataset (Erhemjamts and Huang, 2019). The outperform estimators can be achieved by carefully considering the weighting of the data, while also taking into account the genuine conditional variance (Romano & Wolf, 2017).

Homoscedasticity, which refers to the equality of variability among variables in a dataset, is typically assessed through hypothesis testing. Based on the obtained p-value of 0.0000, the study provides strong evidence to reject the null hypothesis with a high level of confidence.

It appears that there may be heteroscedasticity present, as the residual variance seems to be constant. When estimating a model, it is important to take into account the potential presence of autocorrelation and heteroscedasticity, as these factors can have an impact on the results. It is important to consider all relevant factors to ensure accurate findings, as noted by Gujarati and Porter (2003). According to Bacha, Ajina, and Saad (2020), the utilization of the weighted least square approach, aims to create a more consistent scatter plot by grouping dependent variables that exhibit similar variance.

**Table 5.** *Fixed Effect Panel Regression, Sample Adjusted 2013-2021*

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| ROA(-1) | 0.371973 | 0.058855 | 6.320165 | 0.0000 |
| GII Index | -0.008170 | 0.005284 | -1.546122 | 0.1246 |
| C | 0.049090 | 0.011347 | 4.326168 | 0.0000 |
| **Effects Specification** | | | | |
| R-squared | 0.785244 | Mean dependent var | | 0.093757 |
| Adjusted R-squared | 0.754564 | S.D. dependent var | | 0.159445 |
| S.E. of regression | 0.079192 | Durbin-Watson stat | | 0.231468 |
| F-statistic | 25.59510 | Redundant test | | 0.000000 |
| Prob(F-statistic) | 0.000000 | Hausman test | | 0.044133 |
| Sum Squared Resid | 0.790190 | | | |

Table 5 demonstrates that, with a significance level of 1%, the coefficient of ROA(-1) suggests that a one-unit increase in ROA(-1) leads to a 0.371973-unit increase in ROA. The results indicate a strong correlation between ROA and ROA(-1). There is no statistically significant linear relationship between the GII Index and ROA, as evidenced by the lack of significance of the coefficient of the GII Index at the 5% level. The average ROA of the sample businesses was 0.049090 units, exhibiting a difference of 0.049090 units compared to the comparison group. The model's R2 value of 0.785244 indicates that approximately 78.52% of the variability in the dependent variable, ROA, can be accounted for by the independent variables in the model. The adjusted R-squared value of 0.754564 is a more conservative measure of the goodness of fit, as it accounts for the number of independent variables in the model. The model exhibits a satisfactory fit to the data, as evidenced by the significant F-statistic of 25.59510 at the 1% level. Fixed effects are appropriate in this scenario as the Hausman test yields a non-significant result of 0.044133 at the 5% significance level. The fixed effect panel regression findings indicate that the average ROA of the companies in the sample is higher than that of the companies in the comparator group. However, due to the violation of the assumptions of heteroscedasticity and autocorrelation, the final decision will be made using the weighted least squares estimation, as indicated in Table 6.

**Table 6.** *Weighted Least Square Panel Regression, Sample Adjusted 2013 2021, Cross section 318 Total panel observation Unbalanced 2702*

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| ROA(-1) | 0.287761 | 0.055296 | 5.204008 | 0.0000 |
| GII Index | 0.011750 | 0.002180 | 5.390056 | 0.0000 |
| C | -0.489094 | 0.037925 | -12.89621 | 0.0000 |
| **Effects Specification** | | | | |
| R-squared | 0.727798 | Mean dependent var | | 0.172391 |
| Adjusted R-squared | 0.691344 | S.D. dependent var | | 58.88545 |
| S.E. of regression | 32.00124 | Akaike info criterion | | -2.057187 |
| Sum squared resid | 2439357 | Schwarz criterion | | -1.667132 |
| Log-likelihood | 168.1460 | Hannan-Quinn Criteria | | -1.898694 |
| F-statistic | 19.96502 | Durbin-Watson stat | | 2.053790 |
| Prob(F-statistic) | 0.000000 | | | |

Table 6 indicates that there is a correlation between ROA (-1) and ROA, as the coefficient of ROA(-1) demonstrates statistical significance at the 1% level. Also, it is worth noting that the GII Index and ROA exhibit a strong positive correlation, which is further reinforced by the statistically significant coefficient at the 1% level. There appears to be a positive relationship between green innovation and the financial performance (ROA) of businesses. Furthermore, the coefficient of determination ($R^2$) indicates that the model accounts for a significant portion, specifically 72.78 percent, of the observed variability in ROA with an adjusted R-squared value of 0.691344, providing a more conservative estimate of the goodness-of-fit.

Overall, the model is widely regarded as the most suitable choice, as evidenced by the F-statistic (19.96502). Moreover, the Durbin-Watson statistic value is 2.05, which typically falls within the acceptable range of 1.5 to 2.5. This suggests that there is no significant evidence to suggest the presence of autocorrelation in the residuals. Therefore, it can be inferred that the Green Innovation Index (GII) has a statistically significant, albeit moderate, impact on Return on Assets (ROA).

The increasing recognition of the deterioration of the natural environment has prompted scholarly investigations into green innovation, yielding significant contributions to the existing body of literature. Nevertheless, previous research is inclusive of the potential linearity or nonlinearity of the relationship between green innovation and enterprises' financials (Miroshnychenko, Barontini & Testa, 2017; Przychodzen et al., 2020). Our research has contributed novel perspectives to this field of study by establishing a correlation between green innovation and financial performance.

According to Aguilera-Caracuel, and Ortiz-de-Mandojana, (2013), it has been observed that green innovative firms tend to be located in environments where there are more robust environmental regulations and a stronger emphasis on environmental norms. However, when considering the performance of green innovative firms in comparison to non-green innovative firms, it is evident that there is no significant improvement in their financial performance.

The South Asian economies particularly, Pakistan, is currently facing challenges related to air pollution, global warming, water scarcity, poverty, and food scarcity. These issues have had a negative impact on the environment, and climate change is considered a significant contributing factor to these problems. One of the factors contributing to climate change is the increase in the absorption of greenhouse gases (GHGs), as there has been a noticeable rise in the absorption of major greenhouse gases, including $CO_2$, due to the significant growth in industrialization and other human activities. Pakistan and India are among the significant contributors to the emission of $CO_2$ in this South Asian region (Bhutta et al., 2022). Hence, the study aimed to investigate the impact of green innovation on the overall financial performance of companies, with a specific focus on Pakistan.

Following hypothesis testing, WLS regression analysis was conducted, revealing that green innovation has a statistically significant positive impact on overall financial performance (ROA), albeit with a relatively smaller magnitude. Thus, our hypothesis remains consistent with the NRBV theory proposed by Hart (1995). The tiny effect can be attributed to several factors, such as outdated technologies, insufficient awareness, resistance from board members, and the geographical location of the company leading to arbitrary disposal of industrial waste. Pakistan ranks 88th out of 132 countries in the Global Innovation Index 2023, indicating its position as one of the least innovative countries.

Our research contributes to the body of knowledge on green innovation literature in a way for instance, this study contributes to green innovation research by examining the linear relationship between green innovation and firms' financial performance. More specifically, our findings revealed that firms pursuing green innovations do not always experience higher financial performance than non-green innovative firms; rather, only a high level of green innovation can enhance firms' financial performance. These findings are in line with the studies (Aguilera-Caracuel & Ortiz-de-Mandojana, 2013; Rezende et al., 2019) and differ from the results of Miroshnychenko et al. (2017) and Przychodzen et al. (2020). Overall, our study helps us better understand how firms' financial performance differs, depending on the different levels of green innovation. Moreover, from a managerial aspect, it is suggested that firms should consider leveraging their green innovation capabilities to potentially improve their financial performance, by considering the potential benefits of increasing investment in green innovation practices aimed to provide long-term advantages in both environmental and economic aspects.

## CONCLUSION

Drawing upon the NRBV theory, this study aimed to examine the significance of Green Innovation in enhancing Financial Performance within the context of Pakistan, among the ongoing and interconnected challenges posed by climate change. The dataset included in this study comprised data obtained from a total of 351 distinct companies that were officially listed on the Pakistan Stock Exchange (PSX) over the period spanning from 2012 to 2021. The data was analyzed using a method called weighted least square regression analysis. The empirical research conducted in this study suggested that Green Innovation significantly enhances the Financial Performance in Pakistan. The research findings suggest that Green Innovation holds considerable importance in the realm of Financial Performance within developing nations, such as Pakistan.

Moreover, the findings are also in line with the German Watch Report 2021 where Pakistan's position as one of the least creative nations in terms of environmentally friendly policies. Thus, it implies that organizations should utilize their green innovation capacities to possibly enhance their financial performance, with a focus on the long-term advantages in terms of both the environment and the economy. Overall, the RBV paradigm, when expanded to incorporate natural resource considerations through NRBV, offers a theoretical foundation for comprehending how green innovation has a beneficial impact on financial performance. The study's results are also consistent with this theoretical framework, suggesting that companies have the opportunity to improve their financial performance by implementing strategic green innovation projects within the context of a non-resource-based view (NRBV).

## LIMITATIONS AND DIRECTION FOR FUTURE RESEARCH

The present study centered its attention on all publicly listed companies in the Pakistan Stock Exchange (PSX) and made a noteworthy contribution to the existing body of literature. However, it is important to note that the findings of this study may not apply to all contexts, since there are alternative robust measures that might be employed to yield more reliable and robust outcomes. Furthermore, in the future, it is imperative to acknowledge the significance of management-related variables, such as corporate governance, and sustainable/green transformational leadership in assessing organizational performance.

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