

Environmental, social, and governance (ESG) practices and Environmental performance: The mediation role of Technology Innovation

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Abstract. As the worldwide community grapples with the mounting challenges brought on by climate change, a growing concern has emerged among scholars and policymakers alike regarding the continued sustainability of corporate environmental performance. This concern is not baseless, it is incumbent upon the world's corporations, as significant contributors to global emissions and resource consumption, to not just maintain, but also continually improve their environmental stewardship. Therefore, this study explores the role of technological innovation as a mediator between environmental, social and governance (ESG) practices and firms' environmental performance (PE) within companies that had made a public offering. These companies were chosen due to their balance between profit-making and ESG considerations, given their high level of scrutiny and accountability. Using the Partial Least Squares-Structural Equation Modeling (PLS-SEM) approach, the study simultaneously examined multiple relationships, making it well-suited to this exploratory research. The results affirm that the integration of ESG practices spurs technological innovation, subsequently enhancing environmental performance. Technological innovation is crucial in creating environmentally friendly products and processes, improving energy efficiency, and evolving waste management techniques. The findings highlight that strategic emphasis on ESG considerations and technological innovation can significantly uplift corporate environmental performance.

Keywords: ESG practices, Environment, Environmental performance, Morocco, Technological innovation.

1. Introduction

Technological innovation is widely recognized as a crucial driver of economic growth, as noted by [1]. However, in the present context, the economic landscape cannot be properly understood without considering its environmental and social implications. As a result, the emergence of socially responsible investment, with a focus on environmental, social, and governance (ESG) factors, has become increasingly significant [2].

The convergence of technological innovation and ESG practices has opened new avenues for enhancing the environmental performance of businesses, as discussed by [3]. Technological

innovations have the potential to facilitate the development of eco-friendly products and processes, thereby contributing to improved environmental performance.

Numerous studies have highlighted the positive impact of robust ESG practices and technological innovation on environmental performance. For instance, [4] have demonstrated that technological innovation, particularly in the realm of green technologies, can enhance energy efficiency, reduce greenhouse gas emissions, and improve waste management. Similarly, [5] have found that technological innovation plays a central role in improving a company's ESG performance, particularly in relation to the environmental dimension.

However, the interplay between technological innovation and ESG practices, and their combined influence on the environmental performance of companies, remains an underexplored area of research, particularly in the Moroccan context. This is a regrettable knowledge gap, given the pressing environmental challenges faced by Morocco, which necessitate a profound transformation of its economic landscape.

Within this context, our study aims to address this research gap by investigating a fundamental research question: How does technological advancement, as a mediating factor, affect the link between Moroccan companies' ESG policies and their environmental performance?

Our main goal is to discover whether technological advancement mediates the relationship between ESG practices and Moroccan enterprises' environmental performance. We seek to gain insights into how the integration of ESG practices influences the adoption of technological innovation by Moroccan companies, and how this, in turn, impacts environmental outcomes.

To achieve our objectives, we will develop a robust research model based on the existing body of knowledge and formulate hypotheses to address the identified gaps in the literature. To test the validity of these hypotheses, we will design a comprehensive survey questionnaire. The research target population will consist of Moroccan companies that have implemented ESG practices.

Through our study, we aim to contribute to Morocco's efforts in transitioning towards a more sustainable economy. Additionally, we intend to provide practical recommendations for policymakers, business leaders, and investors who are interested in promoting sustainable development in Morocco. Our goal is to advocate for a long-term and responsible approach.

In conclusion, our research is situated at a crucial intersection for the economic and environmental future of Morocco. By shedding light on the intricate relationship between technological innovation, ESG practices, and the environmental performance of companies, we hope to provide valuable insights for public policymakers and corporate strategists. Through concrete and applicable findings, we aspire to contribute to shaping a more sustainable future for the Moroccan economy and its stakeholders.

Considering our research problem, this article will primarily focus on presenting a comprehensive theoretical framework that examines key concepts and addresses the gaps in the existing body of literature. Additionally, we will outline the methodology, including the research model and data collection procedures through a structured survey questionnaire. Furthermore, we will provide in-depth analysis and interpretation of the results, exploring their practical and theoretical implications, discussing the study's limits, and suggesting possible directions for future research.

2. Literature Review and Hypothesis Development

The increasing prominence of ESG (Environmental, Social, and Governance) practices and sustainable development in corporate strategies reflects growing investor and consumer demands for more sustainability [6]. In addition to cost reductions and better product quality, ESG practices are also associated with enhanced customer satisfaction and potential performance boosts [7]. Companies' commitment to ESG primarily originates from stakeholder pressure and an escalating demand for environmentally friendly products and provides crucial data for waste management [10].

The broader impact of ESG practices includes supporting sustainable development, enhancing corporate performance, fortifying corporate governance, and augmenting environmental performance [10]. ESG practices are also seen as a significant avenue for gaining competitive advantage and creating positive impacts on both the environment and the economy ([11]; [12]; [13]).

However, the connection between ESG performance and innovation, specifically technological innovation, needs further investigation ([8]; [9]). Technological innovation, as defined by the OECD, comprises product innovation, process innovation, organizational innovation, and marketing innovation, with product and process innovation constituting the primary components of technological innovation [14]. These forms of innovation aim to reduce environmental impact by creating products that use fewer polluting resources, are energy-efficient, or can be easily recycled [16], and by implementing innovative production methods and equipment [17].

In this context, the role of technological innovation as a mediator between ESG practices and environmental performance becomes crucial. Porter's hypothesis suggests that stringent environmental regulations can stimulate innovation, which could offset compliance costs and improve organizational performance ([18]; [19]). Studies have shown that environmental regulations indirectly foster technological innovation, thereby improving competitiveness and productivity within companies ([20];[21]). The relationship between ESG practices and improved environmental performance via technological innovation has also been recognized in some research [22]. Therefore, based on the discussion above, the following hypotheses are proposed:

Hypothesis 1 (H1): *ESG practices enhance corporate technology innovation.*

Hypothesis 2 (H2): *The environmental performance of companies and ESG practices are positively correlated.*

Hypothesis 3 (H3): *Technological innovation has a favorable impact on the environmental performance of businesses.*

Hypothesis 4 (H4): *Technological innovation mediates the effect of ESG practices on the environmental performance of companies.*

3. Methodology

3.1. Sample and Data collection

As part of this research work, a quantitative approach was implemented, involving the distribution of structured questionnaires via email to Moroccan companies making a public offering. The primary objective was to obtain responses from managers and executives who possess a deep understanding of the environmental and social issues concerning their company's environmental performance, including ESG practices and technological innovation in their production processes.

Data collection was carried out over a two-month period, spanning from March to May 2023. A total of 95 companies were contacted via email and invited to participate in the study.

Subsequently, 76 questionnaires were returned, resulting in an 80% response rate. Eleven responses were subsequently excluded due to inconsistencies or inadequate information. Therefore, the analysis was based on a final dataset consisting of 65 valid questionnaires.

Among these companies, a significant majority, accounting for 82.3%, were listed, while the remaining 17.7% were unlisted. The distribution of these companies across sectors varied, with the industrial sector being the most prominent, encompassing 51.4% of the sampled companies.

Regarding the size of the companies, it was found that most of the surveyed companies employed between 500 and 2000 individuals. In summary, the survey sample predominantly comprised publicly traded companies, predominantly from the industrial sector, and exhibited a larger scale, with the majority employing between 500 and 2000 individuals.

Table 1. Descriptive Results

ELEMENT	ITEMS	FREQUENCY
Type of company	Listed Company	82,30%
	Unlisted Company	17,70%
Industry sector	Service	4,10%
	Commerce	2,80%
	Industry	51,40%
	Energy	6,90%
	Real estate	11,10%
	HealthCare	1,40%
	Finance	16,70%
	Insurance	5,60%
Employee's number	100 or less than	11,10%
	100-500	30,60%
	500-2000	45,80%
	2000 and more	12,50%

3.2. Measurement Instrument

Participants in the study were required to answer a single-choice questionnaire that measured the study's variables. The assessment tool employed was a 5-point Likert scale, with a range of 1 (total disagreement) to 5 (perfect agreement).

The items in the questionnaire were modified based on previous research regarding ESG practices, technological innovation, and environmental performance [23],[24]. The questionnaire was split in two parts: the first part provided demographic data, while the second section contained the specific questions. Specifically, the study comprised 17 questions.

3.3. Data Analysis Tools

Using the SmartPLS 4.0 software, a causal model was created through the PLS-SEM analysis. The complex connections between predictor factors and dependent variables were clarified in this work using a variety of statistical methods, including measurement models and structural models.

3.3.1. Reliability and Convergent Validity

In practice, if the estimated model has loadings below 0.707, it is advisable to eliminate a particular item, especially when new items or scales are developed. In our case, all loadings exceed the recommended threshold. The validity test revealed that the composite reliability ranged from 0.889 to 0.933, indicating that all questionnaire items aimed at measuring the variables are valid. The table below summarizes the details.

Table 2. Reliability and Convergent Validity Analysis

Variables	Items	Loadings	Alpha Cronbach	Composite Reliability	AVE
ESG Practices	ESG1	0.717	0.876	0.906	0.616
	ESG2	0.825			
	ESG3	0.769			
	ESG4	0.811			
	ESG5	0.811			
	ESG6	0.771			
Technological innovation	INN1	0.829	0.813	0.889	0.727
	INN2	0.876			
	INN3	0.852			
	PF4	0.836			
Environmental Performance	PE1	0.836	0.910	0.933	0.736
	PE2	0.870			
	PE3	0.863			
	PE4	0.933			
	PE5	0.781			

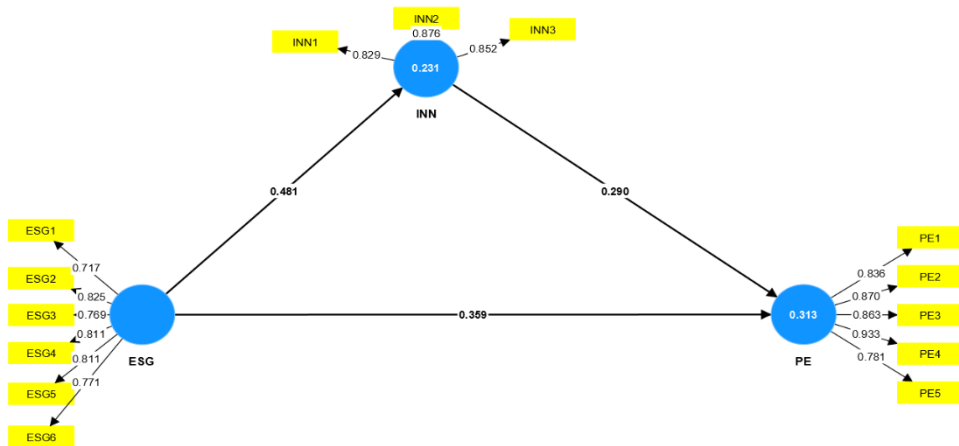


Fig.1. Measurement Model

3.3.2. Discriminant Validity

The findings of the discriminant validity study, as shown in the table below, revealed that each set of variable correlations did not exceed the square root of the AVE. Additionally, none of the HTMT (Heterotrait-Monotrait) values were above 0.90, showing that the discriminant validity was not affected.

Table 3. Discriminant Validity

FORNELL-LACKER CRITERION			
	ESG	INN	PE
ESG	0.785		
INN	0.481	0.853	
PE	0.495	0.463	0.858
HTMT APPROCH			
ESG			
INN	0.550		
PE	0.545	0.530	

4. Results

The results of this study suggest several interconnected relationships between Environmental, Social, and Governance (ESG) practices, technological innovation (INN), and environmental performance (PE).

First, it reveals a significant positive impact of ESG practices on technological innovation (beta coefficient of 0.481, p-value 0.000). In simpler terms, this means that companies with stronger ESG practices are more likely to innovate technologically. This could be due to the fact that good ESG practices often involve keeping abreast of technological advances, particularly those that can reduce a company's environmental footprint or enhance its social responsibility.

Second, the results indicate a direct positive impact of ESG practices on environmental performance (beta coefficient of 0.365, p-value 0.001). This suggests that companies with better ESG practices have improved environmental outcomes. This isn't surprising, as the 'E' in ESG stands for 'environmental,' and companies with strong ESG practices typically focus on reducing their environmental impact.

The third finding shows a positive correlation between technological innovation and environmental performance (beta coefficient of 0.290, p-value 0.007). Companies that are more technologically innovative tend to have better environmental performance. This might be because many technological innovations help companies operate more efficiently, which often results in less environmental impact.

The fourth and final result reveals an interesting indirect pathway from ESG to environmental performance via technological innovation. It suggests that ESG practices can lead to increased environmental performance by way of promoting technological innovation. The beta coefficient of 0.142 and p-value of 0.017 strengthen this finding. In practice, this could mean that a company's effort to improve its ESG rating could lead to increased innovation, which in turn would improve environmental performance.

Table 4. Estimation of Model Parameters in the Causal Model using Bootstrap Method

Hypothesis	Paths	Beta value	Std. Error	T-value	P-value	Signification
H1	ESG → INN	0.481	0.083	5.784	0.000	Supported
H2	ESG → PE	0.365	0.105	3.407	0.001	Supported
H3	INN → PE	0.290	0.107	2.704	0.007	Supported
H4	ESG → INN → PE	0.142	0.059	2.384	0.017	Mediated

5. Discussions

This study focused on the mediating role of technological innovation to examine the relationship between environmental, social, and governance (ESG) practices and the environmental performance of Moroccan companies. Existing literature has already suggested that ESG practices and technological innovation, considered as organizational resources, can significantly contribute to improving companies' environmental performance [18],[19],[20],[21]. The findings of our research confirm these claims.

Indeed, in the Moroccan context, the country's commitment to an innovation and technology-driven economic transformation underscores the importance of integrating ESG practices into this process. By adopting ESG practices, Moroccan companies can not only address environmental and social challenges but also seize new business and growth opportunities.

The incorporation of ESG practices into technological innovation fosters creativity and entrepreneurship by encouraging companies to develop technologies that address social and environmental needs. For example, Moroccan companies can focus on developing energy-efficient solutions to tackle energy consumption and dependence on fossil fuels. Additionally, they can work on clean technologies aimed at reducing carbon footprint, air pollution, and waste management.

The integration of ESG practices into technological innovation also promotes collaboration among different actors in the Moroccan innovation system. Companies can collaborate with research institutions, universities, and other stakeholders to develop innovative and sustainable technologies. This collaboration facilitates knowledge transfer, joint research, and the emergence of technology clusters oriented towards sustainable development.

6. Conclusion

In summary, the integration of ESG practices into technological innovation within the Moroccan business context promises a wealth of benefits. This strategy encourages creativity, fostering an environment where fresh ideas can emerge and be implemented. As ESG practices inherently value sustainable and socially responsible approaches, this creative drive is geared towards solutions that serve not just immediate business needs, but also the broader societal and environmental context.

Moreover, the inclusion of ESG practices strengthens competitiveness. In a business world that increasingly values sustainability, companies embracing ESG are better positioned to meet stakeholder expectations and adapt to evolving regulatory landscapes. These businesses also tend to attract more investments, as investors are progressively recognizing the value of sustainable business practices. By serving the triple bottom line: people, planet, and profit - these companies are securing their long-term success while contributing to the larger goal of sustainable development.

Collaboration is another significant benefit of integrating ESG practices into business operations. By their nature, ESG principles promote teamwork, both within the company and with external stakeholders. This cooperation can lead to synergistic solutions that deliver more significant impact than isolated efforts.

By adopting this sustainable approach to technological innovation, Morocco can position its companies as key players in the transition towards a green and socially responsible economy. In an era where climate change and social equity are pressing global issues, taking a leadership role in this transition offers tremendous potential for growth and international recognition.

From a theoretical perspective, this study has contributed to our understanding of the interplay between innovation, environmental performance, and ESG practices. It has shed light on the pivotal role of technological innovation in maximizing the positive impact of ESG practices on environmental performance. These insights can guide future studies, opening new avenues for research in this exciting and impactful field.

From a practical standpoint, this study highlights the importance of ESG practices in stimulating innovation and improving environmental performance. This should encourage more companies to invest in environmentally friendly technologies and other innovative solutions that align with ESG principles.

However, it's important to acknowledge the limitations of this study. The specific focus on the Moroccan context may limit the broad applicability of its findings, and there may be other influencing factors not considered in the study. As we move forward, it will be important to replicate this research in different cultural and economic contexts and explore other variables such as company size or industry sector.

In conclusion, the integration of ESG practices into technological innovation is not just a good business strategy; it's a vital step towards creating a more sustainable and equitable world. As this study shows, when businesses embrace sustainability, they're investing in their future success and contributing to the greater good.

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