
Determinants of Green Finance and Their Influence on Eco-Innovation and Entrepreneurial Performance: An Empirical Study of Lafarge Algeria Using Structural Equation Modeling (SEM)

Adel Gherbi

University Of El Oued (Algeria)

gherbi-adel@univ-eloued.dz

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Boughezala mohammed hamza

University Of Sfax (Tunisia)

boughezalahamza77@gmail.com

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Abstract:

This study examines the effect of green finance on entrepreneurial performance through eco-innovation in Lafarge Algeria using partial least squares structural equation modeling (PLS-SEM). Data were collected through a structured questionnaire administered to 168 managers and employees, of which 150 valid responses were retained (response rate = 89%). The results reveal that green finance has a strong direct effect on entrepreneurial performance ($\beta = 0.677$) and eco-innovation ($\beta = 0.526$). Eco-innovation also exerts a significant effect on entrepreneurial performance ($\beta = 0.195$) and partially mediates the relationship between green finance and entrepreneurial performance ($\beta = 0.103$). Additional findings show that digital and external determinants are among the most influential drivers of green transformation, whereas internal determinants are not statistically significant. The study concludes that sustainable industrial transformation depends primarily on green finance supported by digitalization, eco-innovation, and an enabling institutional environment.

Keywords: Green Finance; Eco-Innovation; Entrepreneurial Performance; Lafarge Algeria; Digital Determinants

Jel Classification Codes: L26, Q56.

1. Introduction :

The world is currently witnessing profound transformations driven by accelerating environmental challenges related to climate change, rising emissions, and the depletion of natural resources. This has prompted governments and institutions to adopt economic models based on the principles of sustainability and the green economy, in response to global trends toward reducing carbon footprints and promoting sustainable growth (Zhang et al., 2021). In this context, green finance has emerged as an effective mechanism for supporting environmentally friendly projects by directing investments toward activities with a positive environmental impact, particularly those related to renewable energy, waste management, clean technologies, and environmental innovation (Li & Wang, 2021; Sun et al., 2021).

Furthermore, interest in environmental innovation has grown as a key driver for improving institutional performance amidst regulatory pressures and increasing consumer awareness of environmental issues. Environmental innovation is viewed as a strategic means to reduce the negative impacts of economic activity and enhance operational efficiency through the development of environmentally friendly products, processes, and technologies (Hojnik & Ruzzier, 2016; Dangelico, 2016). At the same time, entrepreneurial performance is a critical element for the success of organizations, as it is based on the ability to innovate, be proactive, and seize new opportunities, which are increasingly important in light of accelerating environmental and economic transformations (Wales et al., 2013; Rigtering et al., 2012).

Study Problem

Based on the above discussion, the research problem is formulated as follows:

To what extent does green finance influence entrepreneurial performance through eco-innovation in Algerian industrial companies, with particular reference to Lafarge Algeria?

The following sub-questions stem from this main question:

- 1. What is the impact of green finance on eco-innovation?**
- 2. What is the impact of green finance on entrepreneurial performance?**
- 3. What is the impact of eco-innovation on entrepreneurial performance?**
- 4. Does eco-innovation mediate the relationship between green finance and entrepreneurial performance?**

Based on the theoretical framework, the following hypotheses are proposed:

- H1: Green finance has a significant positive effect on eco-innovation.**
- H2: Green finance has a significant positive effect on entrepreneurial performance.**
- H3: Eco-innovation has a significant positive effect on entrepreneurial performance.**

• **H4: Eco-innovation mediates the relationship between green finance and entrepreneurial performance.**

Study Significance

The importance of linking these three concepts is underscored in environmentally sensitive industrial sectors, particularly in developing countries facing the dual challenge of transitioning to sustainability without negatively impacting economic growth. In this context, industrial companies like Lafarge Algeria have emerged as leading models in the region, thanks to their adoption of green financing programs, their implementation of advanced environmental innovations such as low-carbon cement production and circular economy technologies, and their ability to achieve entrepreneurial performance that reflects their resilience and competitiveness in a market gradually moving towards sustainable construction (Albort-Morant et al., 2016; Xie et al., 2023).

Study Objectives

The study aims to:

- Analyze the impact of green finance on eco-innovation.
- Examine the effect of green finance on entrepreneurial performance.
- Evaluate the role of eco-innovation in enhancing entrepreneurial performance.
- Test the mediating role of eco-innovation in the relationship between green finance and entrepreneurial performance.
- Develop and validate a structural model using PLS-SEM to explain the relationships between the study variables.

Study Methodology

The study adopts a quantitative approach using Partial Least Squares Structural Equation Modeling (PLS-SEM) due to its ability to analyze complex causal relationships and its suitability for non-normal data and multidimensional models. SmartPLS 4 software was employed to assess the quality of both the measurement model and the structural model. Data were collected using a structured questionnaire based on validated scales from prior studies and measured through a five-point Likert scale. A pilot test was conducted to ensure clarity, reliability, and content validity before full data collection.

Study Population and Sample

The study population consists of Algerian industrial companies that have adopted or are transitioning toward practices related to green finance and eco-innovation. This research adopts a case study approach focusing on Lafarge Algeria as a representative industrial company with advanced sustainability practices. Data were collected from managers and employees involved in finance, sustainability, and operational activities through a structured questionnaire. The number of distributed questionnaires was 168, of which 150 valid

responses were retained, yielding a response rate of 89%. The study relied on purposive sampling to target respondents who are directly connected to the research variables. The final sample size ($N = 150$) exceeds the minimum threshold generally recommended for PLS-SEM applications and is therefore considered adequate for model estimation and hypothesis testing.

Study Limitations

The study is subject to a set of limitations related to its scope, spatial coverage, and period of analysis, as outlined below:

- **Subject Matter Limitations:** The study was limited to three main variables (green finance, eco-innovation, and entrepreneurial performance).
- **Spatial Limitations:** Algerian industrial companies, with a focus on Lafarge Algeria as a case study.
- **Temporal Limitations:** This study was conducted from January to October of 2025.

2. Previous Studies:

2.1. Green Finance Studies

Recent literature indicates that green finance is a key driver for promoting sustainability and environmental innovation. A study by Li & Wang (2021) demonstrated that green finance clearly contributes to improving sustainability practices within organizations in emerging markets and encourages the adoption of environmental innovation. Similarly, a study by Zhang et al. (2021) confirmed that government spending and green policies play a significant role in activating green finance instruments to promote innovation and sustainable development. Furthermore, a study by Sun et al. (2020) showed a strong positive relationship between green finance and environmental performance in developing countries, demonstrating the ability of this type of financial instrument to improve organizations' environmental outputs. These studies conclude that green finance is an important avenue for improving environmental performance and fostering green innovation within organizations.

2.2. Eco-Innovation Studies

The literature focuses on the factors influencing environmental innovation and its role in improving organizational performance. Hojnik & Ruzzier (2016) provided a comprehensive review of the drivers of environmental innovation, including legislative pressures and institutional support. Singh et al. (2020) demonstrated that environmental innovation is positively correlated with organizational performance, and that environmental collaboration strengthens this relationship. Similarly, Dangelico (2016) confirmed that innovation in green products positively impacts an organization's financial and competitive performance. These studies concluded that environmental innovation is directly linked to increased organizational performance and

is a strategic element in the modern business environment

2.3. Entrepreneurial Performance Studies

Studies highlight the factors that support entrepreneurial performance within organizations. Wales et al. (2013) examined the characteristics of leaders and their role in fostering entrepreneurial performance, demonstrating that managers' entrepreneurial behavior enhances an organization's ability to achieve better results. Kraus et al. (2012) also demonstrated that entrepreneurial orientation is a key determinant of performance in small and medium-sized enterprises (SMEs), as it is linked to creativity, initiative, and competitiveness. These studies concluded that entrepreneurial performance is strengthened by a strong entrepreneurial orientation within an organization and by leadership capable of supporting initiative and innovation.

2.4. Studies Linking the Three Variables

The study by Albort-Morant et al. (2016) presented an integrative model linking environmental innovation and organizational performance under pressures that drive institutions toward adopting green practices. The study confirmed that combining environmental innovation with an organization's environmental identity leads to improved performance, making it one of the most relevant studies to this topic because it integrates environmental innovation, performance, and the shift toward green practices. These studies concluded that environmental innovation is a crucial mediator between green practices (or environmental pressures) and entrepreneurial performance.

2.5. Summary of Previous Studies

These studies demonstrate that green finance plays a crucial role in fostering environmental innovation, and that environmental innovation, in turn, supports entrepreneurial and institutional performance. The literature also confirms that entrepreneurial performance is influenced by organizational and strategic factors, but improves significantly when institutions are sustainability- and innovation-oriented. Taken together, the findings indicate a strong correlation between the three variables: green finance → environmental innovation → entrepreneurial performance, which supports the theoretical framework of the current study.

2.6. Research Gap

A review of previous studies reveals a clear lack of research that integrates green finance, environmental innovation, and entrepreneurial performance within a single, comprehensive model. Most studies have focused solely on bilateral relationships or on advanced economic contexts that do not resemble developing environments. Furthermore, the role of green finance as a catalyst for environmental innovation, and the mediation role of environmental innovation in the transmission of green finance's impact to entrepreneurial performance, have not been explored in depth. In addition, the contribution of internal and external factors to

explaining green finance adoption remains unexamined within a comprehensive structural framework. Thus, the gap lies in the absence of a model that integrates these variables and analyzes their direct and indirect effects within a research context that has not been adequately explored.

2.7. The company Under Study

Lafarge Algeria is one of the leading industrial players in the Algerian building materials sector. A subsidiary of the global Holcim-Lafarge Group, it boasts a significant presence through its cement plants in M'Sila and Oum El Bouaghi, as well as its partnership with the Cilas plant in Biskra. With a total production capacity of approximately 11.5 million tons per year, the company supports a network of 12 ready-mix concrete plants and three regional research and quality assurance laboratories, employing around 4,200 people. Lafarge has made green finance a strategic pillar for developing its industrial infrastructure by leveraging environmental loans and financing for renewable energy and emissions reduction. This has enabled it to modernize its production lines and adopt highly efficient environmental equipment. Furthermore, Lafarge is a pioneer in eco-innovation through the development of low-carbon cement, the adoption of fuel co-processing technologies, the use of solar energy, and the implementation of advanced environmental management systems. These efforts have enabled the company to reduce its emissions and enhance operational sustainability. As a result, the company achieved strong entrepreneurial performance, demonstrated by its ability to develop innovative products, expand into green markets, and maintain competitiveness through improved efficiency and reduced costs, in addition to its organizational flexibility and ability to adapt to modern environmental requirements, making it an ideal case to illustrate the link between green finance, eco-innovation, and entrepreneurial performance in the Algerian industrial context.

3. Conceptual Framework of the Study Variables

3.1 Green Finance

3.1.1 General Concept of Green Finance

Green finance is one of the most important modern economic tools aimed at supporting the transition to a sustainable, low-emission economy. It is defined as a set of financial mechanisms and instruments directed towards financing projects and activities with a positive impact on the environment, such as renewable energy, waste management, environmental innovation, energy efficiency, and low-carbon projects (Li & Wang, 2021; Sun et al., 2021). Green finance includes various instruments such as green bonds, green loans, sustainable investments, and carbon finance, which have become a crucial component of sustainable financial markets globally (Azhgaliyeva et al., 2020).

3.1.2 Conceptual Dimensions of Green Finance

Green finance has three main dimensions addressed in the literature:

- **Environmental Dimension:** This aims to support projects that reduce emissions and mitigate negative environmental impacts. It is the most prominent dimension in definitions of green finance (Zhang et al., 2021).
- **Economic Dimension:** This focuses on improving economic growth through long-term sustainable investments linked to competitiveness and innovation (Taghizadeh-Hesary & Yoshino, 2019).
- **Social Dimension:** This involves improving quality of life, reducing pollution, and achieving overall societal well-being through environmentally friendly activities.

3.1.3 The Importance of Green Finance in Organizations

The literature indicates that green finance has become a strategic element in organizations due to the numerous advantages it offers:

- Stimulating the adoption of clean technologies by providing financial resources for environmental innovation projects (Hojnik & Ruzzier, 2016)
- Enhancing competitiveness by adopting sustainable production models that differentiate the organization in the market (Dangelico, 2016)
- Reducing regulatory risks through early compliance with increasingly stringent environmental legislation (Zhang et al., 2021)
- Supporting the development of a sustainable financial market that aligns with ESG (Environmental, Social, and Governance) principles (Azhgaliyeva et al., 2020).

3.1.4 Green Finance Determinants

• Internal Determinants

Studies confirm that financial capabilities, governance, environmental culture, and the availability of qualified human resources are among the most important drivers of green finance adoption (Li & Wang, 2021; Sun et al., 2021). Research also highlights the importance of environmentally conscious leadership in directing investments toward sustainable projects (Azhgaliyeva et al., 2020).

• Environmental Determinants

Global environmental changes, pollution levels, and climate risks directly influence institutions' shift towards green finance. Studies have indicated that increased environmental pressures incentivize institutions to adopt environmentally friendly financial instruments (Shah et al., 2019).

• External Determinants

These include government policies, environmental laws, institutional support, and the development of a

financial infrastructure that supports green investments. The literature suggests that government incentives and advanced environmental legislation are among the strongest determinants of green finance adoption (Zhang et al., 2021; Taghizadeh-Hesary & Yoshino, 2019).

- **Digital Determinants**

Digitalization has emerged as a new determinant of green finance, with digital technologies, blockchain, and FinTech contributing to improved emissions tracking accuracy and increased transparency in sustainable finance (Xie et al., 2023; Giudici et al., 2020).

3.2 Eco-Innovation

3.2.1 The General Concept of Eco-Innovation

Eco-innovation is a modern strategic concept that combines the principle of innovation with an environmental dimension. It is defined as the production or application of new or improved products, processes, organizational practices, or marketing strategies aimed at reducing environmental impact and improving an organization's environmental performance (Hojnik & Ruzzier, 2016). Eco-innovation goes beyond mere technological development to include administrative and organizational dimensions that contribute to greater resource efficiency, reduced waste and emissions, and enhanced sustainability at various stages of production (Dangelico, 2016).

3.2.2 Areas of Eco-Innovation

The literature has addressed several forms of eco-innovation, the most important of which are:

- **Green Product Innovation**

This includes designing environmentally friendly products characterized by low emissions, recyclability, or the use of less harmful materials. This type of innovation is important in responding to the demands of green markets (Dangelico, 2016).

- **Green Process Innovation**

It focuses on improving production processes to reduce waste and emissions and increase operational efficiency through the adoption of clean technologies or the restructuring of production methods (Hojnik & Ruzzier, 2016).

- **Environmental Organizational Innovation**

It involves introducing structural changes in management methods, such as adopting ISO 14001 environmental management systems or adopting work practices that support sustainability at the organizational level.

- **Green Marketing Innovation**

It involves developing marketing strategies that highlight the environmental characteristics of products and target environmentally conscious consumer segments.

3.2.3 The Role of Environmental Innovation in Organizations

Recent literature confirms that environmental innovation is a key driver in improving organizational and economic performance through:

- Reducing costs resulting from waste and inefficient resource use.
- Enhancing competitiveness by offering products with added environmental value.
- Proactively complying with stringent environmental standards and regulations.
- Enhanced corporate reputation due to increased environmental awareness among consumers.
- Increased opportunities for entrepreneurial growth through entry into new markets based on green products and technologies (Singh et al., 2020)
- Environmental innovation is a central element in the strategies of companies seeking integration into the green economy.

3.3 Entrepreneurial Performance

3.3.1 The General Concept of Entrepreneurial Performance

Entrepreneurial performance is a fundamental concept in entrepreneurship literature, referring to an organization's ability to achieve superior results by adopting entrepreneurial behaviors and practices such as innovation, initiative, boldness, and the continuous pursuit of new opportunities. Entrepreneurial performance differs from traditional performance in its focus on the innovative and strategic dimensions of the organization, being measured by the new projects, new markets, or innovative products it achieves, rather than solely by profits or direct financial indicators (Wales et al., 2013).

This concept is linked to a dynamic approach that views the organization as an entrepreneurial actor constantly striving to exploit opportunities and transform resources into value-added outputs, which is the essence of entrepreneurial activity in small, medium, and large enterprises alike.

3.3.2 Conceptual Dimensions of Entrepreneurial Performance

Entrepreneurial performance comprises several dimensions, which have been addressed in the literature from various perspectives. Among the most prominent of these dimensions are:

- **Entrepreneurial Growth**

This measures an organization's ability to expand, increase its market share, and raise production and sales levels. It is one of the most important indicators of entrepreneurial success.

- **Innovation Output**

This includes the development of new products, services, or processes. It is considered one of the most important criteria for evaluating entrepreneurial performance due to its direct link to competitive advantage (Rigtering et al., 2012)

- **Proactiveness**

This reflects an organization's ability to anticipate competitors and seize new opportunities before others.

- **Risk-taking**

This refers to an organization's willingness to make unconventional decisions or invest resources in projects that involve a degree of risk in order to achieve growth opportunities.

- **Profitability**

This represents the financial results resulting from entrepreneurial behavior, such as increased revenue or improved profitability compared to competitors.

3.3.3 The Importance of Entrepreneurial Performance in Organizations

Entrepreneurial performance receives significant attention in the literature due to its association with numerous strategic benefits, the most important of which are:

- Enhancing the organization's competitiveness in rapidly changing business environments.
- Supporting internal economic growth through the development of new products and innovative production solutions.
- Enabling the organization to adapt more flexibly to environmental and technological changes.
- Achieving sustainable added value through the adoption of innovative and entrepreneurial practices.
- Expanding markets and opportunities by entering new sectors or developing new resources.

Reputable studies (Wales et al., 2013; Rigtering et al., 2012) have confirmed that entrepreneurial performance is a central mechanism for organizational success and strengthening its competitive position in the market.

4. Applied Study

This study aims at providing a comprehensive analysis of both the measurement model and the structural model using Partial Least Squares Structural Equation Modeling (PLS-SEM) with SmartPLS 4 software. This analysis is a crucial step in ensuring the quality of the measures used in the study and the validity of the assumed causal relationships between the variables. The analysis is divided into two main phases:

- **Measurement Model Analysis:** This includes evaluating internal reliability, convergent validity, and discriminant validity.
- **Structural Model Analysis:** This includes testing the model's explanatory and predictive power, effect

size, and direct and indirect relationships.

The same analytical methodology used in the reference I cited was followed, in terms of the depth of interpretation, the scale of the analysis, and the correlation of results with established statistical criteria in the literature.

4.1 Measurement Model Analysis

The measurement model was examined using three main phases, each aimed at verifying the quality of the underlying structures and their suitability for the subsequent structural model analysis.

4.1.1 Internal Reliability and Convergent Validity

Internal reliability is a key indicator of the consistency of respondents' answers to each variable's items. It is measured using Cronbach's alpha and composite reliability (CR), both of which must be ≥ 0.70 , indicating adequate homogeneity among the items (Hair et al., 2022). Convergent validity is achieved when the AVE value exceeds 0.50 according to the Fornell & Larcker criterion (Fornell & Larcker, 1981). Additionally, the factor loads of the items must be ≥ 0.70 to ensure a strong correlation with the measured concept (Sarstedt et al., 2019).

To improve the quality and accuracy of the measurement model, items with weak factor loads were removed, as they did not accurately reflect the dimension to which they belonged. This procedure contributed to increasing internal reliability by enhancing the consistency of the remaining items and raising Cronbach's alpha. It also strengthened convergent validity by reinforcing the correlation between statements and their dimensions and increasing the extracted mean variance (AVE). Consequently, the final version of the model was obtained by retaining only the statements that best represented the conceptual dimensions of the study, and the data are summarized in the following table:

Table N°1: Internal Reliability and Convergent Validity

Main Variable	Dimension	Item	Loading	Alpha	CR	AVE
Eco-Innovation		ECI1	0.810	0.848	0.891	0.621
		ECI2	0.745			
		ECI3	0.839			
		ECI4	0.817			
		ECI5	0.721			
Entrepreneurial Performance		ENP1	0.786	0.732	0.832	0.554
		ENP2	0.768			
		ENP3	0.772			
		ENP4	0.643			
Environmental	Environmental Determinants	END1	0.819	0.758	0.846	0.578

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Determinants		END2	0.708			
		END3	0.746			
		END4	0.766			
	External Determinants	EXD1	0.851	0.753	0.859	0.670
		EXD2	0.847			
		EXD3	0.754			
	Internal Determinants	IND1	0.803	0.770	0.867	0.686
		IND2	0.872			
		IND3	0.808			
	Digital Determinants	DID1	0.833	0.751	0.857	0.666
		DID2	0.834			
		DID3	0.781			

Source : Prepared by researchers based on SMARTPLS outputs.

The table shows that Cronbach's alpha and composite reliability values all exceed 0.70, statistically indicating good internal consistency among the items. AVE also exceeds 0.50 in all dimensions, a clear indicator of convergent validity. Most factor loadings show values higher than 0.70, reflecting a strong correlation between the items and their dimensions, while the ENP4 value (0.643) remains within acceptable limits for behavioral studies. Overall, this confirms that the measurement model possesses sufficient internal reliability and convergent validity to proceed to discriminant validity testing.

4.1.2 Discriminant Validity

Discriminant validity aims to ensure the independence of the underlying constructs, meaning that each variable measures its own concept without interference from other variables. This is a fundamental requirement for the quality of a measurement model (Fornell & Larcker, 1981). To verify this, three main tools were adopted in the PLS-SEM methodology: the Fornell-Larcker criterion for theoretically discriminating variables, the HTMT coefficient, which is considered the most accurate measure for detecting discrimination deficits (Henseler et al., 2015), and cross-loading, which allows examining the correlation of each item with its dimension compared to other dimensions (Hair et al., 2022).

Fornell-Larcker Criterion

Table N°2: Fornell-Larcker Criterion

Variable	DD	EI	EP	END	EXD	IND
DD	0.816					
EI	0.513	0.788				
EP	0.569	0.497	0.744			

END	0.505	0.633	0.449	0.761		
EXD	0.347	0.447	0.386	0.346	0.819	
IND	0.359	0.507	0.389	0.612	0.224	0.828

Source : Prepared by researchers based on SMARTPLS outputs.

The Fornell-Larcker criterion compares the square root of AVE for each variable with the correlation coefficient between that variable and the other variables. The diagonal values in the table show that they are all higher than the inter-variable correlations, which statistically means that each variable has a distinct level of explained variance compared with the other variables, thus confirming discriminant validity.

HTMT Coefficient

Table N°3: HTMT Coefficient

Variable	DD	EI	EP	END	EXD	IND
DD						
EI	0.626					
EP	0.775	0.619				
END	0.662	0.771	0.590			
EXD	0.461	0.546	0.519	0.448		
IND	0.466	0.612	0.511	0.790	0.284	

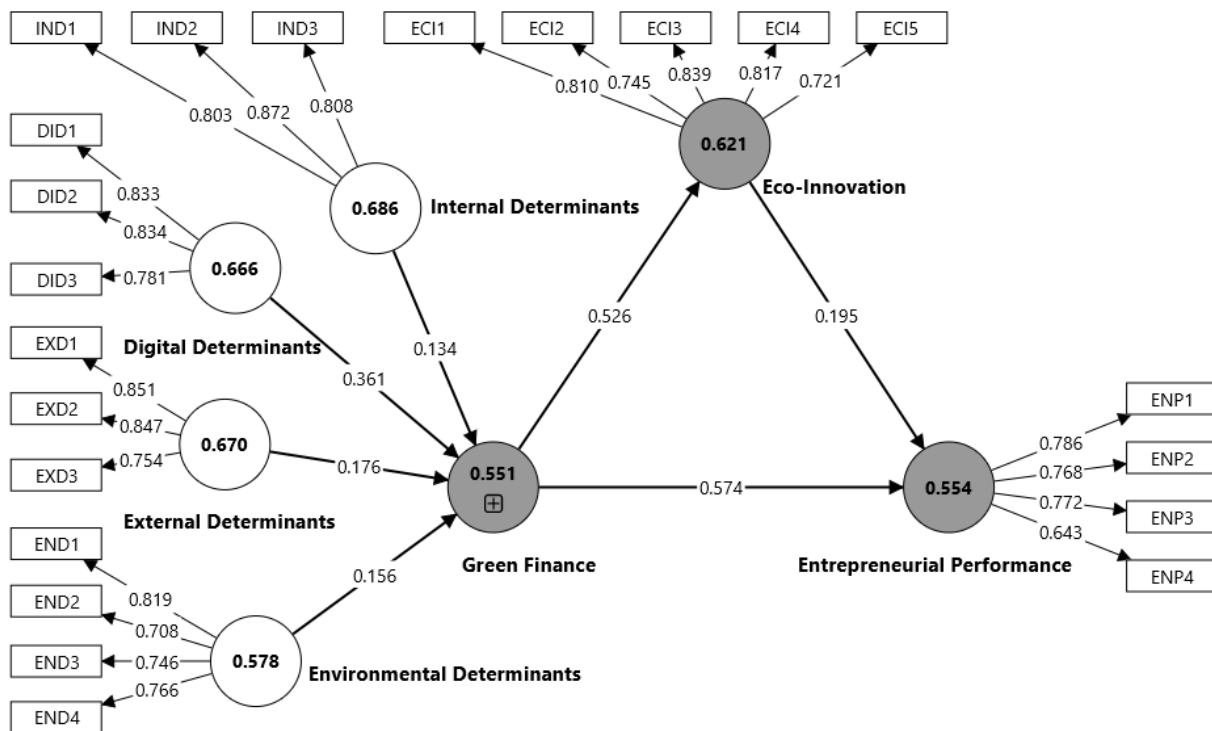
Source : Prepared by researchers based on SMARTPLS outputs.

The literature review indicates that the acceptable value for the HTMT coefficient should not exceed 0.90 to ensure discrimination between variables. Referring to the results in the table, it is clear that all values fell below this limit, demonstrating the absence of conceptual overlap between the variables and the independence of the underlying structures. Furthermore, the highest recorded value (0.891) remains within acceptable limits, which strengthens the discriminatory validity and confirms the soundness of the measurement model.

Cross Loadings

The results of the cross-loadings in this study clearly demonstrate discriminant validity, as each indicator recorded the highest loading on its respective dimension compared to the other dimensions. For example, the DID1 indicator had a high loading of 0.833 on the digital determinants compared to lower values on the other dimensions. Similarly, ECI1 recorded a high loading on eco-innovation (0.810) and lower values on the other dimensions. The same applies to ENP3, EXD1, and IND2, which showed high loadings on their respective original dimensions. This pattern reflects a strong correlation between each indicator and its respective dimension, with no overlap with other dimensions, thus confirming the discriminant validity of the measurement model. After conducting these tests, this model can be adopted for the study:

Fig N° 1: Study Model



Source : Prepared by researchers based on SMARTPLS outputs.

4.2 Structural Model Analysis

After confirming its quality, we move on to testing causal relationships:

Coefficients of Determination R^2 and Q^2

The coefficient of determination R^2 is a key indicator of how well a model can explain the variance in dependent variables. Average or high values indicate acceptable explanatory power (Hair et al., 2022; Chin, 1998). The coefficient Q^2 measures the predictive power of the model using blindfolding techniques. Any positive value indicates significant and effective prediction (Fornell & Larcker, 1981; Henseler et al., 2015). Therefore, using R^2 and Q^2 together allows for a comprehensive evaluation of the model's quality in terms of both explanation and prediction.

Table N°4: Coefficients of Determination R^2 and Q^2

Variable	R^2	Interpretation	Q^2	Interpretation
Eco-Innovation	0.277	Explanatorily significant	0.341	Predictively Significant
Green Finance	0.394	Explanatorily significant	0.357	Predictively Significant
Entrepreneurial Performance	0.486	Strongly significant	0.342	Strongly significant

Source : Prepared by researchers based on SMARTPLS outputs.

The R^2 values indicate that the model possesses considerable explanatory power, explaining entrepreneurial performance at a relatively strong 48.6%, while green finance and environmental innovation

explain 39.4% and 27.7%, respectively—moderate percentages consistent with what the literature suggests. Furthermore, all Q^2 values were greater than zero, demonstrating the model's significant predictive power according to the PLS methodology. This reinforces the structural model's strength and its validity in explaining the relationships between variables.

Effect Size F^2

The effect size F^2 is used to measure the contribution of each independent variable to explaining the dependent variable when it is included or excluded from the model. It is a key indicator in assessing the strength of relationships within PLS-SEM. Cohen (1988) suggests that the F^2 value is interpreted as follows: weak (0.02), moderate (0.15), and strong (0.35). This classification is also supported by Hair et al. (2022) and Henseler et al. (2015).

Table N°5: Effect size F^2

Relationship	F^2	Interpretation
GF → Performance	0.464	Strong and significant
GF → EI	0.383	Strong and significant
Digital → GF	0.152	Medium and significant
External → GF	0.043	Weak but significant
Environmental → GF	0.021	Weak but significant
Internal → GF	0.018	Weak and not significant

Source : Prepared by researchers based on SMARTPLS outputs.

The F^2 values show that green finance has the largest effect size in the model, scoring 0.464 for entrepreneurial performance and 0.383 for environmental innovation, the highest values in the table. The digital dimension also had a moderate effect on green finance, with a value of 0.152, while the external (0.043) and environmental (0.021) determinants had weak but significant effects. The internal determinants had the lowest effect value of 0.018 and were not significant.

Path Coefficients

Table N°6: Path Coefficients

Relationship	β	T	P	Significance
Digital → EI	0.190	4.754	0.000	Significant
Digital → Performance	0.244	4.630	0.000	Significant
EI → Performance	0.195	2.871	0.004	Significant
END → EI	0.082	1.967	0.041	Significant (at threshold)
END → Performance	0.106	2.121	0.034	Significant

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EXD → EI	0.092	2.582	0.010	Significant
EXD → Performance	0.119	2.766	0.006	Significant
GF → EI	0.526	8.803	0.000	Strongly significant
GF → Performance	0.677	15.063	0.000	Highly significant
Internal → EI	0.070	1.639	0.101	Not significant
Internal → Performance	0.091	1.707	0.088	Not significant

Source : Prepared by researchers based on SMARTPLS outputs.

The table shows that the structural model results support the main paths associated with the study hypotheses. In particular, green finance has significant direct effects on eco-innovation and entrepreneurial performance, and eco-innovation also has a significant positive effect on entrepreneurial performance. The table further shows that digital, environmental, and external determinants exert significant direct effects, whereas the relationships associated with internal determinants are not statistically significant.

Indirect Effects (Mediation)

Table N°7: Indirect Effects (Mediation)

Relationship	O (Original Sample)	M (Sample Mean)	STDEV	T Statistic	P Value	Significance
Green Finance → Eco-Innovation → Entrepreneurial Performance	0.103	0.103	0.038	2.705	0.007	Significant
Digital Determinants → Eco-Innovation → Entrepreneurial Performance	0.037	0.037	0.014	2.597	0.009	Significant
Environmental Determinants → Eco-Innovation → Entrepreneurial Performance	0.016	0.017	0.010	1.573	0.116	Not Significant
External Determinants → Eco-Innovation → Entrepreneurial Performance	0.018	0.018	0.009	1.985	0.047	Significant
Internal Determinants → Eco-Innovation → Entrepreneurial Performance	0.014	0.014	0.011	1.271	0.204	Not Significant

Source : Prepared by researchers based on SMARTPLS outputs.

The results show that the first mediation path reported in the table—Green Finance → Eco-Innovation → Entrepreneurial Performance—is statistically significant, with an effect size of 0.103 and a t-value of 2.705 at a significance level of 0.007, thereby directly supporting H4. The mediation of digital determinants through eco-innovation was also significant (O = 0.037; T = 2.597; P = 0.009). In contrast, environmental determinants had a

low and non-significant indirect effect ($O = 0.016$; $T = 1.573$; $P = 0.116$), while the mediation of external determinants was significant ($T = 1.985$; $P = 0.047$). Internal determinants showed a non-significant indirect effect ($O = 0.014$; $T = 1.271$; $P = 0.204$).

5. Discussion of Hypotheses and Additional Findings on Green Finance Determinants

5.1 Discussion of the First Hypothesis (H1)

Green Finance $\rightarrow$ Eco-Innovation ($\beta = 0.526$, $T = 8.803$, $P = 0.000$)

The results reveal a strong and statistically significant positive effect of green finance on eco-innovation, which supports H1. This indicates that access to green financial mechanisms enables firms to invest in cleaner technologies, low-carbon products, and environmentally responsible processes. This finding is consistent with Li & Wang (2021) and Zhang et al. (2021), who argue that green finance acts as a catalyst for eco-innovation in industrial organizations.

5.2 Discussion of the Second Hypothesis (H2)

Green Finance $\rightarrow$ Entrepreneurial Performance ($\beta = 0.677$, $T = 15.063$, $P = 0.000$)

The results confirm a strong positive effect of green finance on entrepreneurial performance, thereby supporting H2. Green finance appears to strengthen the organization's ability to modernize production, improve efficiency, expand into new markets, and develop competitive sustainable offerings. This result is in line with Taghizadeh-Hesary & Yoshino (2019) and Dangelico (2016), who concluded that green finance improves both organizational competitiveness and entrepreneurial outcomes.

5.3 Discussion of the Third Hypothesis (H3)

Eco-Innovation $\rightarrow$ Entrepreneurial Performance ($\beta = 0.195$, $T = 2.871$, $P = 0.004$)

The findings indicate that eco-innovation has a significant positive effect on entrepreneurial performance, which supports H3. In practical terms, the adoption of environmentally friendly products and cleaner production processes contributes to stronger market positioning, operational flexibility, and innovation-driven growth. This is consistent with Singh et al. (2020) and Hojnik & Ruzzier (2016).

5.4 Discussion of the Fourth Hypothesis (H4)

Eco-Innovation Mediates the Relationship between Green Finance and Entrepreneurial Performance ($\beta = 0.103$, $T = 2.705$, $P = 0.007$)

The mediation analysis confirms that eco-innovation significantly transmits part of the effect of green finance to entrepreneurial performance, thereby supporting H4. In other words, green finance does not enhance entrepreneurial performance only through direct investment capacity; it also does so indirectly by enabling eco-innovative products, processes, and managerial practices. This result reinforces the central role of eco-innovation in the proposed model.

5.5 Additional Analysis of Green Finance Determinants

Beyond the four core hypotheses, the model also examined the direct effects of green finance determinants on eco-innovation and entrepreneurial performance. These results help explain which contextual factors most strongly support green transformation in the case of Lafarge Algeria.

Digital Determinants → Eco-Innovation ($\beta = 0.190$, $T = 4.754$, $P = 0.000$)

Digital determinants exerted a positive and statistically significant effect on eco-innovation. This suggests that digital monitoring systems, data analytics, and smart production technologies enhance the firm's capacity to adopt environmentally friendly solutions and improve emissions control.

Environmental Determinants → Eco-Innovation ($\beta = 0.082$, $T = 1.967$, $P = 0.041$)

Environmental determinants also had a positive effect on eco-innovation, although at a threshold level of significance. This indicates that pollution pressures, emissions reduction requirements, and environmental risks can motivate firms to develop greener products and cleaner processes.

External Determinants → Eco-Innovation ($\beta = 0.092$, $T = 2.582$, $P = 0.010$)

External determinants, including government incentives, environmental regulation, and institutional support, had a significant positive effect on eco-innovation. In the Lafarge Algeria case, the regulatory environment appears to have encouraged the adoption of cleaner technologies and sustainability-oriented investments.

Internal Determinants → Eco-Innovation ($\beta = 0.070$, $T = 1.639$, $P = 0.101$)

In contrast, internal determinants did not have a statistically significant effect on eco-innovation. This suggests that internal resources alone were not sufficient to drive eco-innovation without complementary external support and a favorable regulatory context.

Digital Determinants → Entrepreneurial Performance ($\beta = 0.244$, $T = 4.630$, $P = 0.000$)

The digital determinant also showed a significant positive effect on entrepreneurial performance. This indicates that digitalization strengthens operational responsiveness, decision-making speed, and proactive market behavior, all of which support stronger entrepreneurial outcomes.

Environmental Determinants → Entrepreneurial Performance ($\beta = 0.106$, $T = 2.121$, $P = 0.034$)

Environmental determinants had a significant positive effect on entrepreneurial performance, suggesting that regulatory pressure and environmental competition can stimulate firms to improve sustainable offerings and strengthen their market positioning.

External Determinants → Entrepreneurial Performance ($\beta = 0.119$, $T = 2.766$, $P = 0.006$)

External determinants also contributed positively to entrepreneurial performance. This highlights the

role of legislation, incentives, and institutional support in helping firms scale sustainable initiatives and enter greener market segments.

Internal Determinants → Entrepreneurial Performance ($\beta = 0.091$, $T = 1.707$, $P = 0.088$)

The effect of internal determinants on entrepreneurial performance was not statistically significant. This result suggests that managerial and organizational capabilities, while important, did not independently explain entrepreneurial outcomes in the present model.

Determinants → Eco-Innovation → Entrepreneurial Performance

With respect to indirect effects, the mediation results show that digital determinants ($\beta = 0.037$, $T = 2.597$, $P = 0.009$) and external determinants ($\beta = 0.018$, $T = 1.985$, $P = 0.047$) influenced entrepreneurial performance through eco-innovation. By contrast, the indirect effects of environmental determinants ($\beta = 0.016$, $T = 1.573$, $P = 0.116$) and internal determinants ($\beta = 0.014$, $T = 1.271$, $P = 0.204$) were not statistically significant.

These additional findings indicate that digitalization and external support constitute the most influential drivers of eco-innovation and entrepreneurial performance in Lafarge Algeria, while internal determinants played a comparatively limited role within the tested model.

Overall, the results confirm that the proposed model is best interpreted around four formal hypotheses; green finance, eco-innovation, entrepreneurial performance, and mediation. While the determinants provide complementary explanatory power regarding the conditions that strengthen green transformation.

In this respect, Lafarge Algeria illustrates how green finance, supported by digital capabilities and an enabling external environment, can translate into stronger eco-innovation and better entrepreneurial performance within the Algerian industrial context.

Accordingly, the empirical evidence supports the research problem and its sub-questions by showing that sustainable industrial transformation depends not only on financing itself, but also on the innovative and institutional mechanisms through which that financing is activated.

6. Conclusion

This study represents a significant scientific contribution to understanding the mechanisms of transition to a green economy within industrial institutions. It analyzes the relationship between green finance, environmental innovation, and entrepreneurial performance, and examines the pivotal role of green finance determinants in shaping these relationships. The statistical and analytical results demonstrate that green finance is a crucial strategic element that enables institutions to enhance their technological and innovative capabilities and strengthens their ability to create added value aligned with global environmental trends.

The study reveals that environmental innovation not only emerges as a byproduct of green finance but also serves as a primary driver for improving entrepreneurial performance. This is achieved through the development

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of products, technologies, and production processes with a low environmental footprint. The success of institutions in adopting environmental innovation depends largely on the nature of the regulatory and supervisory environment in which they operate, as well as their ability to leverage technological advancements and digital transformation.

Furthermore, the study reveals that green finance determinants play a varying role in stimulating environmental innovation and enhancing entrepreneurial performance. While internal determinants such as internal resources and managerial capabilities did not demonstrate a clear impact, environmental, external, and digital determinants proved crucial in driving organizations toward adopting innovative practices and enhancing their entrepreneurial performance. This illustrates that the success of green finance depends not only on securing funding but also on a supportive legislative environment, appropriate economic incentives, and the effective adoption of digital technology.

The Lafarge Algeria experience serves as a prime example of how financial, environmental, regulatory, and technological factors interact to guide an organization toward a sustainable production model. The company leveraged green financing programs, national and international environmental pressures, legislative support, and digital transformation to develop innovative products, most notably low-carbon cement, and to modernize its production processes to reduce emissions and increase energy efficiency. This approach has clearly impacted its entrepreneurial performance and its ability to respond to the demands of the contemporary market, which is strongly moving toward sustainable construction.

Taken together, these findings directly answer the main research problem and its sub-questions. The results demonstrate that green finance positively affects both eco-innovation and entrepreneurial performance, while eco-innovation itself contributes significantly to entrepreneurial performance and mediates part of the effect of green finance. Therefore, the transition toward a sustainable industrial model in Algerian companies, particularly Lafarge Algeria, is best understood as the outcome of an integrated relationship between financing, innovation, and performance within a supportive digital and institutional environment.

Recommendations

- Strengthen green finance mechanisms.
- Develop the legislative framework.
- Promote digitalization within industrial enterprises.
- Activate public-private partnerships to support environmental innovation and the development of sustainability projects.
- Improve the administrative and internal capacities of enterprises through training programs.

- Disseminate successful experiences.

Future Research Prospects

- Study the impact of advanced digital factors.
- Expand the model to include other industrial sectors in Algeria or neighboring countries.
- Test other mediating variables such as organizational culture, social responsibility, or green leadership.
- Analyze the long-term impact of green finance on the sustainability and financial and environmental performance of enterprises.
- Integrate the social dimension of sustainability into the model.

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