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DOI: https://doi.org/10.14195/2183-203X_59_3

Green Investment Strategies and Financial Performance: Evidence from Portuguese Firms

Estratégias de Investimento Verde e Desempenho Financeiro: Evidência das Empresas Portuguesas

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ABSTRACT
This study analyses the relationship between environmental investment strategies and the financial performance of Portuguese companies engaged in the extractive, manufacturing, and utility sectors between 2010 and 2021. According to the results, there is no statistically significant correlation between financial performance and green investment. This outcome is in line with part of the literature suggesting that, in highly regulated sectors, environmental investments are often driven by compliance requirements, acting as risk mitigation measures rather than direct sources of profit. Additionally, short-term metrics like ROA could miss benefits in the long run. On the other hand, eco-innovations have a favourable correlation with both financial performance and, to a lesser extent, green investment.
Keywords: Green Investment, Green Innovation, Financial Performance, Climate Changes.

JEL Classification: G32; Q56; O33; M14; C33

1. Introduction

Climate change is seen as a threat to society, the environment and world economies, both now and in the future, thus threatening sustainable development (Borrego et al., 2010). To answer these challenges, many organizations are actively seeking to adopt new measures (e.g. green investments and green innovations) aimed at environmental protection and promoting an ecological transition (Ye and Dela, 2023).

Several studies have explored the relationship between environmental investments, financial performance, and eco-innovations across various countries, reaching different conclusions. In Indonesia, for example, Chariri et al. (2018) found that green investments enhance firms' reputations and financial performance by demonstrating environmental responsibility. In Italy, Vasileiou et al. (2022) demonstrated that the financial impact of green innovations varies depending on the type of innovation. In Ireland, Siedschlag and Yan (2023) concluded that green investments generally have a positive effect on firm performance, although not all companies benefit equally.

However, to the best of our knowledge, there has been no comparable empirical study focusing on Portuguese firms. This gap is noteworthy given recent indicators (European Commission, Directorate-General for Research and Innovation, 2024) that show Portugal lagging behind European averages in environmental performance and eco-innovation. Additionally, criticism of the National Climate Law's ambition may reflect a broader lack of strategic commitment to environmental issues among Portuguese firms. This context highlights the need to investigate how environmental strategies relate to financial performance in Portugal.

This study employs survey-weighted linear and logistic regression models to explore the relationship between green investment and firms' financial performance, supported by robustness checks based on alternative model specifications. The analysis focuses on Portuguese firms in the extractive, manufacturing, and utilities sectors from 2010 to 2021, using data from the *Enterprises Survey on Environment Protection and Management* (IEGPA).

The paper is organized as follows: Section 2 presents the theoretical framework and research hypotheses; Section 3 describes the dataset, variables, and empirical models; Section 4 reports the main findings; and the final section concludes the study.

2. Theoretical Background and Research Hypothesis

2.1. Green Investment and Financial Performance

According to Eyraud et al. (2013), green investments are those required to lower emissions of air pollutants and greenhouse gases (GHG) without appreciably lowering the production and consumption of non-energy products. On the other hand, financial performance is understood as the way in which a business can generate earnings and growth (Selvarajah et al., 2018).

In line with legitimacy theory, companies actively seek out ways to create and defend their legitimacy by coordinating their policies, goals, and beliefs with those of the community (Chariri et al., 2018), while having the stakeholder interests included in the implementation of strategic decisions, as per stakeholder theory (Indriastuti and Chariri, 2021). Given the importance of environmental preservation in today's society, green investments can be seen as a way for businesses to earn and secure stakeholders' trust and support (Ye and Dela, 2023) as well as legitimacy in the eyes of their communities. Consequently, businesses' willingness to handle climate-related issues can be viewed as a means of enhancing their financial performance.

Although the above-mentioned factors suggest that firms' financial and environmental performance may move in harmony, some research (e.g. Lankoski, 2010) has pointed to the fact that there may be a drawback to the relationship between financial performance and green investment. Among the drawbacks mentioned is the fact that an organization's environmental performance may lead to higher production costs and lower productivity as a result of the implementation of new green technologies and procedures. Consequently, how companies' environmental performance will impact their financial performance is still undetermined and needs additional analysis.

In addition to legitimacy and stakeholder support, green investments may also influence firm productivity through multiple channels. On one hand, they can lead to gains in operational efficiency, such as reduced energy consumption, improved resource management, and lower waste generation. On the other hand, these investments often involve high upfront costs, technological uncertainty, and potential disruptions to existing processes, which may temporarily reduce productivity or profitability (Ambec and Lanoie, 2008). This trade-off contributes to the ambiguity in the literature regarding the true financial benefits of green investment and reinforces the need for empirical analysis. Thus, the following hypothesis is proposed:

Hypothesis 1. *Green investment has a positive effect on firms' financial performance.*

The return-on-assets (ROA) value, a financial metric that assesses a firm's profitability in relation to its total assets, will be used to gauge the financial performance of firms (Chariri et al., 2018; Guenster et al., 2011; Khalid et al., 2023). The entire amount of money invested in minimizing environmental impacts will be employed as a proxy for green investments in this study, which will be based on Xie (2020).

2.2. Green Investment and Green Innovation

Green innovation (also known as environmental innovation or eco-innovation) refers to the development or adoption of products, processes, and services that reduce environmental impact or promote sustainability, including measures such as using cleaner energy sources, recycling materials, or reducing emissions (Vasileiou et al., 2022).

As a specific form of technological innovation, green innovation shares the general objective of creating value through the application of new knowledge but distinguishes itself by incorporating environmental concerns into innovation outcomes. According to innovation theory, investment is one of the most influential elements driving a company's capacity to innovate (Solo, 1951). However, innovation is not solely determined by financial input.

As emphasized by the resource-based view (Barney, 1991; Hart, 1995), firms' internal capabilities – such as technical knowledge, managerial routines, and strategic alignment – are crucial to determining innovation potential and implementation.

Although some authors (e.g., Ahuja et al., 2008; Brown et al., 2009) argue that green innovation is often perceived as risky, costly, and uncertain – making it less attractive to investors – others observe a growing alignment between environmental and economic goals, with firms increasingly viewing green innovation as part of their long-term strategy (Zhang et al., 2023). Moreover, green innovation is not a uniform or necessarily capital-intensive endeavour. As Triguero et al. (2013) highlight, many firms engage in eco-innovation through incremental or low-cost organizational and process improvements – such as energy-saving routines or improved environmental management systems – without the need for substantial capital expenditure.

This perspective suggests that the relationship between green innovation and green investment is not automatic or linear. Some firms may innovate with limited financial resources, while others may invest in green technologies for compliance or signalling purposes without developing innovation capabilities. This theoretical ambiguity justifies the need to test the relationship empirically.

Hypothesis 2. *Firms' green investment is influenced by their level of green innovation.*

2.3. Green Innovation and Financial Performance

The discussion of whether it pays for a company to "go green" is something that has become an essential point, especially given the growing concerns surrounding climate change. One of the processes at the core of this discussion is green innovations, as presented above, since, according to Triguero et al. (2013), these are playing an increasingly important role in the green transition of firms so that environmental and financial objectives can be mutually achieved.

Although eco-innovations are an essential tool for firms to establish strategies that lead to sustainable development, the way in which they contribute to firms' financial performance is still uncertain. Thus, with a view to achieving a win-win situation in which green innovations improve financial performance, firms tend to need to evaluate how the adoption of certain innovations can have a positive effect on the financial area (Vasileiou et al., 2022).

Therefore, to ascertain how green innovations affect companies' financial performance, the following hypothesis is suggested:

Hypothesis 3. *Green innovations influence firms' financial performance.*

3. Methodology and Empirical Analysis

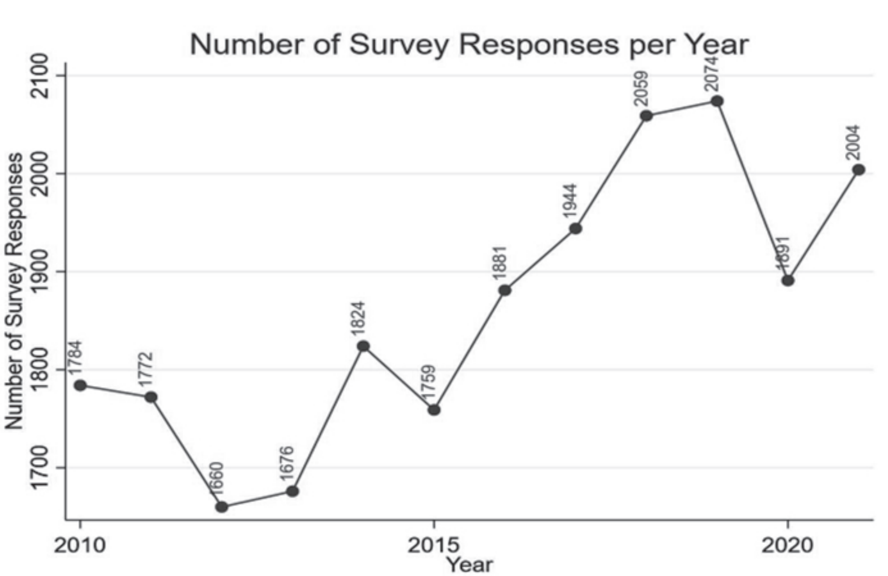
3.1. Dataset

To carry out the empirical analysis in this study, data was used from the *Enterprises Survey on Environment Protection and Management* (IEGPA), conducted annually by Statistics Portugal (INE). This survey contains detailed information on environmental practices, certifications, and investments of Portuguese firms in the extractive industries, manufacturing industries, and electricity, gas, and water production/distribution sectors (according to CAE Rev. 3), covering the period from 2010 to 2021.

To analyse the financial dimension, the dataset was merged with firm-level accounting and financial data from the Integrated Business Accounts System (SCIE), also managed by INE. The linkage was performed using a unique firm identifier common to both datasets, ensuring consistency across years and allowing the construction of a firm-level panel dataset. Our final sample comprises a panel of 6,849 firms with a total of 22,328 firm-year observations. Table A1 in the appendix lists the industries covered by this study and the corresponding summary statistics.

Given the complex stratified sampling design of the IEGPA – based on sector, region, firm size, and turnover class, with exhaustive strata for the largest firms – all estimations were performed using survey-weighted regression methods. The survey's probabilistic and nationally representative nature, along with the calibrated elevation weights provided by INE, ensures that results can be validly extrapolated to the population of Portuguese firms. These standards were employed to weigh each observation, and Stata's svy: module, which appropriately accounts for survey design when estimating coefficients and standard errors, was applied for all regressions. Fixed-effects or random-effects estimators were considered unsuitable due to the cross-sectional nature of the dataset, which only had partial firm rotation. Moreover, traditional panel methods are not directly compatible with design-based weights or the variance structure inherent to complex surveys. Consequently, the most reliable and statistically consistent method for examining the correlations of interest is to employ survey-weighted regressions. Figure 1 presents the number of answers to the survey during the above-mentioned time window.

Figure 1 – Number of survey responses per year



Source: By the author using STATA software based on data from IEGPA, Statistics Portugal.

3.2. Variables

The variables used for the empirical model are described in Table 1:

Table 1 – Description of the variables

Variable	Variable Description
YEAR	Data reference year
NPC	Firm's fictional identification number
CAE	Economic activity (CAE Rev. 3)
ISO14001	Existence of plant with environmental certification according to ISO 14001 standard in the enterprise
EMAS	Existence of plant with EMAS register by Portuguese Environment Agency of the enterprise
GUARANTEE	Existence of financial guarantee of environmental responsibility of the enterprise
GREENHOUSE	Adoption of strategies to reduce emissions of GHG by the enterprise
CARBON	Existence of measures to reduce carbon emissions caused by information and communication technologies (ICT) in the enterprise

OTHERGREEN	Adoption of environmental measures in regular activity of the enterprise
GREENINVEST	Investments in technologies and/or equipment with the purpose of reducing environmental impacts
GRInv	Green investment dummy
RatioInvst	Ratio of green investment to total assets
EBITDA	Earnings before interest, taxes, depreciation, and amortization
ROA	Return on assets
LABOUR	Number of employees
lnTFP	log (total factor productivity)
RLP	Real labour productivity given by the GVA (gross value added) per worker
lnRLP	Log deviation from the industry average RLP for the year
ASSETS	Total assets

The selected productivity measure is the total factor productivity (TFP) at the firm level. The lnTFP is the residual of log production function (i.e. the log difference between firms' output and the weighted sum of inputs). The Levinsohn and Petrin (2003) method was used to estimate the three inputs Cobb-Douglas production function. Labour productivity (LP) was also used to confirm the reliability of the results.

3.3. Models

The first objective of this work is to test the impact of environmental investments on firms' financial performance. To test Hypothesis 1, the following model was created:

$$FP_{it} = \beta_0 + \beta_1 \cdot GREENINVEST_{it} + \gamma \sum ControlVar_{it} + \varepsilon_{it}, \quad (1)$$

where the dependent variable FP_{it} represents the financial performance of the *i*-th firm in year *t* using ROA (ratio of EBITDA to total assets) as a proxy (Chariri et al., 2018). The independent variable $GREENINVEST_{it}$ represents green investment of firm *i* in the year *t*; $\sum ControlVar_{it}$ represents control variables such as productivity measure and year dummy; and ε_{it} is the error term. To avoid inconsistent results due to the order of magnitude of the variables, the green investment ratio (i.e. the ratio of green investment to total assets, *RatioInvst*) was used. Furthermore, in order to check the robustness of results, two variants of Model 1 are presented: one with TFP, the selected productivity measure, and another with LP.

To check how green investments relate to green innovations, the following logistic regression will be used:

$$P(GRInv = 1) = \frac{1}{1 + e^{-(\beta_0 + \beta_1 \cdot greeninov_{it} + \gamma \cdot \sum ControlVar_{it} + \varepsilon_{it})}}, \quad (2)$$

where *GRInv* is a binary variable that takes the value of 1 when the observation encompasses an environmental investment or 0 otherwise, and *greeninov* is an explanatory vector with the variables ISO14001, EMAS, GUARANTEE, GREENHOUSE, CARBON and OTHERGREEN (a description of the variables can be seen in Table 1).

To verify the robustness of the results obtained, the dependent variable was changed from binary one (i.e. GRInv) to a continuous one, the log of *GREENINVEST*, estimating the following model:

$$GREENINVEST_{it} = \beta_0 + \beta_1 \cdot greeninov_{it} + \gamma \cdot \sum ControlVar_{it} + \varepsilon_{it}. \quad (3)$$

Lastly, to assess the effect of the indicators selected to represent green innovations on financial performance, the following model will be employed:

$$FP_{it} = \beta_0 + \beta_1 \cdot greeninov_{it} + \gamma \cdot \sum ControlVar_{it} + \varepsilon_{it}, \quad (4)$$

where the dependent variable FP_{it} represents the financial performance of the *i-th* firm in year t. *greeninov* is an explanatory vector with the variables ISO14001, EMAS, GUARANTEE, GREENHOUSE, CARBON and OTHERGREEN and $\sum ControlVar_{it}$ representing control variables such as the productivity measure and the year dummy.

3.4. Empirical Analysis

According to Siedschlag and Yan (2023), and based on the definition provided in the questionnaire, green investments are defined as the sum of investment (capital expenditures) made in the plant and equipment that enable reductions in pollution or are designed to properly treat waste, noise, wastewater, gas emissions, and other pollutants produced and emitted on firm property. This also covers investments for the enhancement, modification, and adaptation of already-existing equipment and facilities with the goal of preventing, reducing, and minimizing pollution. Taking the previous definition into account, and based on Xie (2020), the value of environmental investment will be used as a measure for the level of green investment.

Three proxies for green investment will be used in this empirical analysis, depending on the models: a continuous variable designated as Investments that encompasses the value of the investment made, a continuous variable designated as RatioInvst that takes the value of the ratio of green investment to total assets and a dummy variable known as GRInv that takes a value of 1 when the observation includes an environmental investment or 0 otherwise. As per Zhang et al. (2023), the natural logarithm of green investment plus one (i.e. $\ln(GREENINVEST + 1)$) is used when employing the continuous variable, in order to ensure the robustness of the empirical findings.

By analysing the survey sample of 6,849 firms, totalling 22,328 observations spanning the period between 2010 and 2021, it is possible to conclude that only 22.13% of the firms made green investments at some point during the period under study (Table 2). While this percentage may appear modest, it reflects structural characteristics of the Portuguese industrial sector, where environmental investment is often driven by regulatory compliance and is not yet widespread across firms. Additionally, the low prevalence underscores the relevance of investigating which factors influence the adoption of such investments.

It is also worth noting that green investment is not evenly distributed over time or across firms. In particular, the year 2011 saw a noticeable spike in the average value of green investments. Upon closer examination, this was driven by three firms with exceptionally large investments. Although these cases are statistical outliers, they were retained in the analysis to preserve the representativeness of the dataset and reflect real-world variation in investment behaviour.

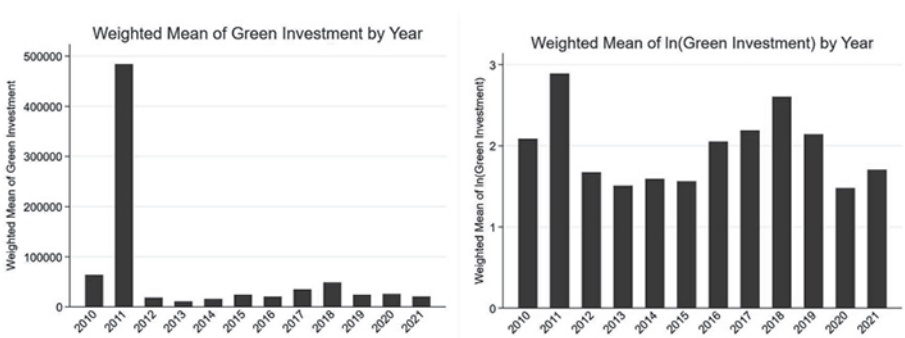
Table 2 – Percentage of green investment

Green Investment (GRInv)	Number of Observations	Weighted Count	Percentage
No (GRInv = 0)	4,835	36,179	77.87%
Yes (GRInv = 1)	2,014	10,281	22.13%

Source: Authors' calculations using STATA software.

The means of the green investments made, and the natural logarithm previously discussed, are shown in Figure 2, appropriately weighted based on the weighting factor. As can be seen in Figures 2a and 2b, green investments peaked in 2011, suggesting that investments were not just substantial overall but also more evenly distributed among the firms under observation. It is also feasible to verify that both average values under review tend to decline after 2018, paying particular attention to 2020 and 2021 as these years display comparatively low values that could potentially be a reflection of the COVID-19 pandemic's effects on green investments, with businesses shifting their financial resources to other domains as a result of financial uncertainty.

Figure 2 – Weighted means of green investment per year



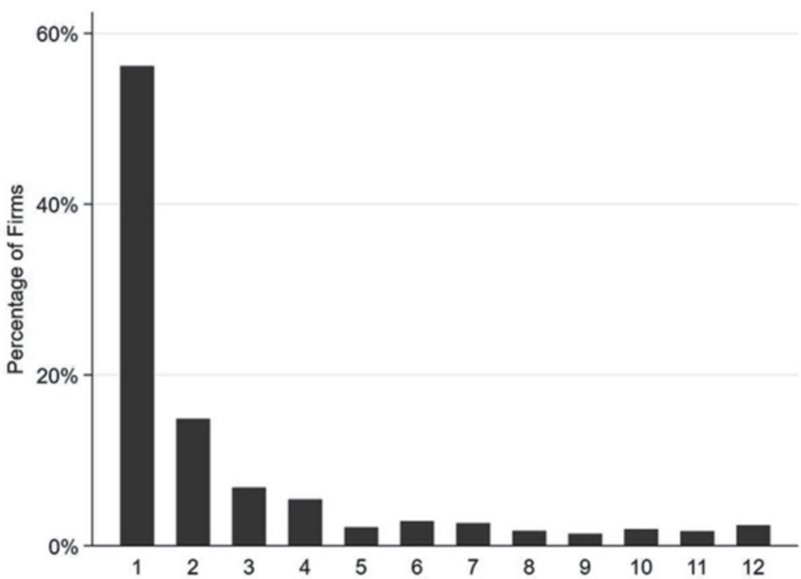
Source: Authors' calculations using STATA software.

As can be seen from Figure 2a, the mean value of green investments peaked in 2011. This is due to the existence of three outliers, that is, three companies made large investments, causing the average in that year to reach a higher investment value compared to the other years under study.

Figure 3 illustrates how frequently green investments occur. Of the firms with green investments included in the analysis, 56% made a single investment over the 12-year span under review, while 15% made two, 7% made three, and 5% made four green investments. This raises a relevant question about whether the frequency or the magnitude of green investments plays a more decisive role in influencing financial performance. From a theoretical perspective, regular investment may reflect a sustained environmental strategy embedded in the firm's operations, while high unique investments may indicate compliance with specific regulations or exceptional innovation efforts.

In the context of this dataset, the majority of green investment activity appears sporadic and concentrated in a small subset of firms. This suggests that, in Portugal, environmental investment is still not a continuous strategic priority for most companies.

Figure 3 – Frequency of firms' green investments, 2010–2021



Source: Authors' calculations using STATA software.

3.4.1. *The Effect of Green Investment on Financial Performance*

The regression results for Model 1, which is used to test Hypothesis 1, are shown in Table 3. As the data on productivity and profitability is only available for the period from 2010 to 2020, the number of observations is reduced in the hypotheses that incorporate financial variables. At the same time, since lnRLP is used as a measure of productivity, we end up with fewer observations because, for some, real labour productivity is less than or equal to zero.

Table 3 – Linear regression for Model 1

Variables	Dependent Variable: ROA	
	Coefficients	
	Model 1: TFP	Model 2: Labour Productivity
Green investment ratio	0.0002 (0.0018)	0.0015 (0.0009)
lnTFP	0.0713*** (0.0110)	——
lnRLP	——	0.1186*** (0.0232)
Constant	0.0939*** (0.0060)	-0.9375*** (0.1949)
Year dummy	YES	YES
No. of observations	20,001	19,717
R^2	0.0184	0.2206

Notes: Standard errors are reported in parentheses. Stars indicate *** p < 0.01, ** p < 0.05, * p < 0.1. (Source: Authors' calculations using STATA software).

The results of the regression for both model specifications suggest that ROA and green investment (RatioInvst) do not display a statistically significant relationship, which does not confirm the hypothesis formulated given that the evidence is not strong enough to draw a definitive conclusion. However, when restricting the analysis to firms that responded to the survey across all years, the results become more statistically significant.

Table 4 – Linear regression for Model 1 with a narrow sample of firms

Variables	Dependent Variable: ROA	
	Coefficients	
	Model 1: TFP	Model 2: Labour Productivity
Green investment ratio	0.4259** (0.1884)	0.2652*** (0.1064)
lnTFP	0.0505*** (0.0027)	——
lnRLP	——	0.0645*** (0.0232)
Constant	0.1369*** (0.0040)	0.0463*** (0.0019)
Year dummy	YES	YES
No. of observations	5,632	5,606
R^2	0.0532	0.2344

Notes: Standard errors are reported in parentheses. Stars indicate *** p < 0.01, ** p < 0.05, * p < 0.1. (Source: Authors' calculations using STATA software).

Looking at Table 4, it can be seen that green investment has a positive and statistically significant influence on the company's financial performance. More precisely, a one-unit increase in the green investment ratio leads to a 43% increase (27% when using LP as a productivity measure) in ROA. This suggests that companies that invest more in environmental initiatives tend to have higher profitability, which is in line with the first hypothesis formulated.

One possible economic explanation for the weak relationship observed between green investment and financial performance lies in the time lag between investment and return. Many environmental investments, particularly in high-impact sectors, involve long-term benefits that may not be reflected in short-term financial indicators such as ROA. Additionally, firms may undertake green investments primarily to comply with environmental regulation or to reduce reputational risk, rather than to increase profitability. In such cases, the investment acts more as a protective measure than a growth strategy.

The R^2 values observed are relatively low, which is not uncommon in firm-level panel data analyses involving highly heterogeneous companies across industries and years. The dependent variable – ROA – is influenced by a wide range of operational, strategic, and market-specific factors, many of which are unobserved or difficult to capture in a survey-based dataset. As a result, explanatory power measured by R^2 tends to be limited in models of this nature. To address potential concerns about model specification, robustness checks were conducted using alternative productivity measures (TFP and LP) and a restricted sample of firms with complete data across the entire period.

3.4.2. *Green Investment and Green Innovation*

To test Hypothesis 2, Model 2 was implemented, and the outcomes are presented in Table 5.

Table 5 – Logistic regression for Model 2

Variables	Dependent Variable: GRInv
	Coefficients
ISO14001	0.273** (0.131)
EMAS	0.776*** (0.307)
GUARANTEE	0.358*** (0.122)
GREENHOUSE	1.389*** (0.165)
CARBON	0.236* (0.136)
OTHERGREEN	0.746*** (0.386)
Constant	-2.811*** (0.393)
Year dummy	YES
No. of observations	22,328
Likelihood ratio chi-square	2470.56
Log pseudolikelihood	-34943.435
Pseudo R^2	0.0341

Notes: Standard errors are reported in parentheses. Stars indicate *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. (Source: Authors' calculations using STATA software).

All the indicators, or independent variables, have positive, statistically significant coefficients, as indicated by the data in Table 5. This suggests that the predictors used as proxies for green innovations represent an increased likelihood of green investments being made. Looking at column (2), it can be said that factors such as owning an EMAS[1]-registered facility granted by the APA-Portuguese Environment Agency (EMAS), having a financial guarantee that allows them to assume the environmental responsibility inherent in their business in accordance with Decreto-Lei nº 147/2008[2] (GUARANTEE), and adopting a strategy to reduce GHG emissions from their business (GREENHOUSE) are powerful arguments for green investment (β_2 = 0.776, β_3 = 0.358 *and* β_4 = 1.389, respectively). More specifically, when firms decide to adopt the green innovation measures, the probability of implementing green investments increases by 117.3% ($e^{0.776}$ – 1), 43.0% ($e^{0.358}$ – 1) and 301.1% ($e^{1.389}$ – 1), respectively.

To confirm the results obtained (Table 5) and ensure the robustness of the data, the dependent variable was changed from GRInv, a binary variable, to lnGI, a continuous variable already presented. The results of the ordinary least squares linear regression with the abovementioned modification are presented in Table 6.

Table 6 – Robustness check

Variable	Dependent Variable: lnGI
	Coefficients
ISO14001	0.480* (0.287)
EMAS	1.314** (0.608)
GUARANTEE	0.439* (0.232)
GREENHOUSE	2.440*** (0.334)
CARBON	0.044 (0.238)
OTHERGREEN	0.642** (0.264)
Constant	0.667 (0.423)
Year dummy	YES
No. of observations	22,326
R^2	0.1215

Notes: Standard errors are reported in parentheses. Stars indicate *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. (Source: Authors' calculations using STATA software).

[1] The Community Eco-management and Audit Scheme (EMAS) is a voluntary mechanism that aims to promote the continuous improvement of the environmental performance of organizations through the establishment and implementation of environmental management systems, as well as the provision of relevant information to the public and other interested parties, as per Commission and for Environment (2007).

[2] This decree establishes the Legal Regime of Environmental Responsibility in Portugal, aligning national law with the Environmental Liability Directive (Directive 2004/35/EC) of the European Parliament and the Council. Its aim is to prevent and remedy environmental damage, reinforcing the "polluter pays" principle.

In the robustness check, the only indicator that presents as statistically non-significant is the firm's adoption of measures to reduce carbon emissions caused by information and communication technologies (ICT) which is also the indicator that has the least influence on the decision to go green in the original model.

Therefore, it was found that the indicators associated with green innovations are statistically significant at the usual levels of significance, so the empirical data supports Hypothesis 2.

3.4.3. *Green Investment and Green Innovation*

Table 7 presents the results of Model 3.

Table 7 – Linear regression for Model 3

Variable	Dependent Variable: lnGI	
	Coefficients	
	Model 1: TFP	Model 2: Labour Productivity
ISO14001	-0.0142 (0.0402)	-0.0556* (0.0333)
EMAS	-0.0338 (0.0400)	0.0139 (0.0195)
GUARANTEE	0.0370 (0.0102)	-0.0275** (0.0124)
GREENHOUSE	0.0016 (0.0144)	-0.0035 (0.0107)
CARBON	0.0048 (0.0135)	-0.0124 (0.0109)
OTHERGREEN	-0.0054 (0.0141)	-0.0200* (0.0106)
lnTFP	0.0789 (0.0145)	——
lnRLP	——	0.1186*** (0.0264)
Constant	0.0958*** (0.0129)	0.0539*** (0.0104)
Year dummy	YES	YES
No. of observations	20,000	19,716
R^2	0.0218	0.2439

Notes: Standard errors are reported in parentheses. Stars indicate*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. (Source: Authors' calculations using STATA software).

Upon analysis, it appears that most of the green innovation indicators considered are not statistically significant, and the only one that is statistically relevant has a minimal effect on ROA, our dependent variable (β_3 = -0.037 for the first specification of the model and β_3 = -0.0275 for the second), which shows that the adoption of specific measures to mitigate environmental problems does not seem to benefit the profitability of Portuguese companies.

The lack of a clear impact of green innovation on financial performance may stem from several structural and contextual factors. First, many green innovations in the dataset are likely to be incremental or compliance-driven, rather than strategic or market-oriented. Such innovations may improve environmental outcomes but are less likely to translate into competitive advantages or revenue growth. Second, in the Portuguese context, limited access to green financing or insufficient scale of innovation activities may reduce the likelihood that such efforts lead to measurable financial returns. Lastly, it is possible that the benefits of these innovations – such as cost savings or enhanced brand value – take longer to materialize and are therefore not captured within the timeframe or financial indicators used in this analysis.

Therefore, it can be concluded that although one of the measures considered demonstrates some influence on firm profitability, the effect is not strong enough to unequivocally support the hypothesis being tested.

4. **Conclusion**

Understanding the link between environmental and financial performance in Portuguese firms offers valuable insights into how companies can pursue green strategies without compromising profitability. This study examined the relationships between green investment, green innovation, and financial performance in a sample of 6,849 firms from 2010 to 2021.

It was first noted that of the sample only 22.13% of firms made any environmental investment over the 12-year period, and that more than half of the firms (precisely, 56%) made only one green investment over the period. The econometric analysis yielded mixed results. While no statistically significant effect of green investment on financial performance was observed across the full sample, a more focused subsample of consistently surveyed firms revealed a positive and significant relationship. This suggests that sustained environmental investment may be more impactful than occasional efforts.

Regarding green innovation, the study found strong evidence that environmental innovations increase the likelihood of green investment. Among the six innovation indicators, EMAS certification, financial guarantees, and greenhouse gas reduction strategies were the most influential. This confirms that internal environmental capabilities and commitments shape firms' investment behavior.

However, when examining the impact of green innovation on financial performance, results were weak. Only the presence of a financial guarantee showed a minimal effect, with contradictory signs depending on the productivity measure used. This implies that green innovations, particularly those oriented toward compliance, may not immediately translate into improved profitability.

Future research should incorporate additional variables such as environmental regulatory costs, R&D intensity, participation in environmental partnerships or innovation networks, and perceptions of environmental risk. These may clarify the mechanisms through which environmental strategies influence firm performance.

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Appendix

Table A1 – Number of firms by industry, 2010–2021

NACE	Industry	Mean	S.D.	Min	Max
05–09	Mining and quarrying	53.5	4.93	45	63
10–12	Food products, beverages and tobacco products	274.92	21.43	245	313
13–14	Textiles and wearing apparel	211.25	21.41	172	242
15	Leather and leather products	86.00	9.31	72	100
16	Wood and wood products	67.25	7.36	55	77
17–18	Pulp, paper, paper products and publishing	123.67	8.42	111	144
19–21	Chemical and chemical products	117.5	8.02	107	136
22	Rubber and plastic products	98.33	10.39	83	124
23	Other non-metallic products	124.08	15.01	104	143
24	Basic metals	47.5	5.90	39	56
25	Fabricated metal products	164.67	23.62	130	212
26–27	Electronic and electrical equipment	93.17	11.44	74	111
29–30	Motor vehicles, trailers and other transport equip.	120.75	11.62	105	138
28–31–33	Other manufacturing industries	205.58	22.93	174	237
35–36	Electricity, gas and water	72.5	13.77	45	98

Source: Authors' calculations using STATA software.