

Does consistent management of accounting and non-accounting information on environmental risks improve the relevance of environmental performance for investors?

Bruno Ricca

Department of Economics, University of Messina, Messina, Italy

Salvatore Loprevite

Dante Alighieri University of Reggio Calabria, Reggio Calabria, Italy

Domenico Raucci

*Department of Economic Studies,
Gabriele d'Annunzio University of Chieti and Pescara, Chieti, Italy, and*

Stefania Veltri

*Department of Business Administration and Law, University of Calabria,
Rende, Italy*

Abstract

Purpose – The purpose of this paper is to provide a richer theory-based description of why and when environmental performance (EP) affects firms' market performance (MP). Focusing on the indirect path of the EP–MP relationship, we aim to show that it is mediated by financial performance (FP) and varies in strength or sign under two moderating conditions: different combinations of accounting and non-accounting information on environmental risks disclosed by companies and the firm size.

Design/methodology/approach – For the measurement of FP, in a holistic approach, we construct a score by applying the Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) to a set of financial ratios. As for environmental risks, we consider four combinations of financial statement environmental provisions and environmental controversies, ranking them from low to medium-low, medium-high and high investor-perceived risk. We then use Hayes' PROCESS macro to estimate three traditional mediated moderation models based on 10,000 bootstrapped samples with 95% bias-corrected confidence intervals. We conduct the empirical analysis on a sample of 247 European nonfinancial listed companies covering the years 2015–2022.

Findings – Our analysis shows that a weak link between EP and MP exists, but it can be significantly improved by a consistent company disclosure of accounting and non-accounting information on environmental risks. The study also shows that, as firm size increases, environmental risk information loses relevance for investors in exchange for a greater consideration of financial performance.

Practical implications – Our research shows that when the financial and nonfinancial information on environmental risks is consistent, the environmental risk perceived by investors is lower, and this in turn leads to positive effects on MP. Then, managers should consider that to identify pathways that can lead to better investor ratings, it is necessary to manage environmental risk disclosure policies appropriately, as this can bring significant benefits in terms of lower perceived environmental risks by investors, which translates into higher MP.

Originality/value – By responding to the literature's call for a better understanding of the EP–MP relationship through more complex models that include mediating/moderating variables, the study contributes significantly



to the questions of why and when EP affects MP. In addition, it is the first study that adds to the literature on the value relevance of environmental risks by considering investors' assessments of the reliability and appropriateness of accounting and non-accounting information about these risks in association with FP and company size.

Keywords Environmental performance, Market performance, Accounting and non-accounting information, Environmental risks, Moderated mediation models, European listed companies

Paper type Research article

1. Introduction

Companies are facing growing pressure to become greener from various stakeholders as well as policymakers. This pressure pushes them to adopt more advanced triple-bottom-line reporting systems, supporting them with several guidelines, international standards, and regulations aimed at overcoming the limitations of accounting systems and traditional financial performance evaluations (Bruna *et al.*, 2022; Ricca *et al.*, 2022; Veltri, 2020).

The issue of whether the corporate commitment to environmental protection generates additional costs or benefits for financial performance and for raising capital on stock markets has involved scientific debate for many years now (Chowdhury *et al.*, 2023; Clarkson *et al.*, 2011; Dal Maso *et al.*, 2024). In this research field, the *Stakeholder theory* framework (Freeman, 1984) has been more widely shared in the literature to investigate this relationship, starting from the assumption that improving a company's environmental performance can lead to better financial and market performances, and not necessarily to an increase in cost (Ambec and Lanoie, 2008; Horváthová, 2012; Porter and van der Linde, 1995; Talan *et al.*, 2024). The basic idea of this positive link is that the corporate commitment to environmental protection can produce benefits for all stakeholders and, first and foremost, for their investors, who would benefit from improvements in the market value of companies (Chandrapala, 2013; Dal Maso *et al.*, 2024; Yang *et al.*, 2024).

The recent diffusion of ESG measures and the contrasting results by empirical research have further strengthened the broad debate concerning the relationships between corporate environmental performance (EP) and Market Performance (MP), (Chowdhury *et al.*, 2023; Endrikat *et al.*, 2014; Friede *et al.*, 2015). It is emerging that the EP-MP relationship has a complex nature and is not as simple to investigate as it has been assumed. This calls for further studies on the potential mediation-moderation role that some variables could play. Therefore, the current research question requires going beyond the question "Does it pay to be green" to investigate the issue of *why* and *when* EP affects MP. In this perspective, a literature field, based on the stakeholders' theory framework, underlines the need to deepen the *value relevance* of information on environmental risks for investors, that is, to understand whether the investors use this information to value shares and whether this is reflected in the market value of the equity (Barth *et al.*, 2001; Brown *et al.*, 1999; Kothari, 2001; Saji and Akshaykumar, 2025).

Our research adopts the theoretical framework of these studies that examine the value relevance of EP from the perspective of *stakeholder theory*, aiming to investigate some underexplored aspects (Baboukardos, 2018; Bruna and Lahouel, 2021; Dragomir, 2018; Endrikat *et al.*, 2014; Horváthová, 2010) on the role of potential mediators and moderators of the EP-MP relationship (Jollineau and Bowen, 2023), under the following assumptions.

Since investors primarily base their investment decisions on the company's financial performance (FP) as reflected in its financial statements (Barth *et al.*, 2023), we hypothesize that EP affects MP through the mediation of FP. We further hypothesize that the mediated relationship exists or varies in its strength or sign under two conditions, namely the environmental risks perceived by stakeholders and the company size, which gives us insights into the relationships between EP and MP. In other words, we focus on the indirect path, which provides a richer theoretical-empirical analysis of the EP-MP relationship through mediators (FP) and moderators (environmental risks and company size), being the direct path a "black

box” that typically does not specify *why* and *when* EP affects MP. Therefore, rooted in the stakeholder theory framework explored in the research perspective of *value relevance*, our study contributes to the use of more complex analysis models of EP-MP relationship that, going beyond the only direct path, include mediating/moderating variables (Dixon-Fowler *et al.*, 2013; Grewatsch and Kleindienst, 2017; Korankye *et al.*, 2024; Semenova and Hassel, 2016; Zhou *et al.*, 2022). In this way, we add evidence to the value relevance literature by considering investors’ assessments of the reliability and appropriateness of accounting information and non-accounting information on environmental risks (Baboukardos, 2018; Barth *et al.*, 2023). For these purposes, we applied moderated mediation models on a sample of 247 listed European non-financial companies covering the years 2015–2022.

Our findings reveal the existence of a weak EP-MP relationship mediated by FP and moderated by environmental risks and firm size. The analysis shows that this relationship changes significantly as a function of stakeholder perceptions of environmental risk, meaning that when the accounting (balance sheet provisions for environmental risks) and non-accounting information (the existence of information on environmental controversies) concerning environmental risks are consistent, it plays a significant role in improving the EP-MP relationship. Moreover, the findings also show that, as firm size increases, environmental risk information loses relevance for investors in exchange for a greater consideration of financial performance.

The remainder of the article is structured as follows. Section 2 summarizes the relevant literature and presents research hypotheses. Section 3 describes the research framework (sample and observation period, variables, methods, and models). Section 4 reports data processing and findings. Section 5 discusses and concludes.

2. Theoretical framework and hypotheses development

The evolution of studies on the relationships between EP and corporate financial results (MP and/or FP) has been characterized by a lack of consensus among scholars due to the different and often contrasting theoretical frameworks adopted, and the inconclusive results shown by empirical evidence.

As for the most important theoretical frameworks (Del Gesso and Lodhi, 2025), the conventional wisdom concerning environmental protection based on the *Neoclassical theory* and *Agency theory* assumes a negative link, arguing that environmental commitment generates higher costs thus reducing profits and conflicting with the maximization of shareholder value, which is the main objective of the firm (Jensen, 2001; King and Lenox, 2001). On the contrary, *Stakeholder theory* (Freeman, 1984) asserts a positive link, as companies that satisfy stakeholder interests in environmental safeguards improve their reputation and customer loyalty, with a competitive advantage generating economic benefits (Porter and van der Linde, 1995).

The empirical studies aimed at testing the various theoretical frameworks have reached conflicting results, finding the relationship between EP and financial results both positive (Farza *et al.*, 2021; Tzouvanas *et al.*, 2020) and negative (Duque-Grisales and Aguilera-Caracuel, 2021; Horváthová, 2010). This led researchers to investigate more complex interpretative schemes for studying this relationship. For example, based on the trade-off view of the *Neoclassical theory* and *Agency theory*, some empirical studies have evidenced that EP could generate economic disadvantages up to a certain point. Over time, after this point, in line with the *Stakeholder theory*, EP could produce economic benefits that compensate for costs, thus improving financial results (Barnett and Salomon, 2006; Horváthová, 2010, 2012; Nuber *et al.*, 2020; Yang *et al.*, 2024; Zhang *et al.*, 2020). This would suggest a non-linear EP-MP relationship. Other empirical studies instead have hypothesized that the mixed results of prior research can be attributed to the fact that EP is associated with both economic benefits and costs that almost cancel each other, leading to a very weak relationship between EP and MP (Baboukardos, 2018; Rahi *et al.*, 2023).

These different interpretations, *inter alia*, imply that the direct path EP-MP is a *black box* that typically does not specify *why* and *when* EP affects MP, and they highlight a need to focus on more complex models that include the mediating (*why* the relationship exists) and the moderating effects (*when*) by other variables on the EP-MP relationship (Jollineau and Bowen, 2023). In this direction, the *Stakeholder theory* framework (Freeman, 1984; Porter and van der Linde, 1995) from the perspective of studies on the *value relevance* of EP (Clarkson, 2012) and information (Barth *et al.*, 2023; Saji and Akshaykumar, 2025) allows for a better explanation of *why* and *when* corporate commitment to environmental protection can produce benefits for investors through improvements in the MP of companies (Chandrapala, 2013; Dal Maso *et al.*, 2024; Del Gesso and Lodhi, 2025; Saji and Akshaykumar, 2025; Talan *et al.*, 2024; Yang *et al.*, 2024).

Here, assuming this theoretical framework, we investigate the relationship between EP and MP through models that consider the mediated/moderated role played by FP, accounting and non-accounting information on environmental risks, and company size.

2.1 Environmental, financial and market performance

The value relevance literature predominantly found that firms' financial and economic performances are positively associated with their MP (Barth *et al.*, 2023; Dunham and Grandstaff, 2022). Regarding non-financial results, the equity markets reaction to the positive insights on environmental information is controversial (Elsayed and Paton, 2005; Hassel *et al.*, 2005; Miralles-Quirós *et al.*, 2019; Nicolò *et al.*, 2023), reasonably suggesting the existence of a weak EP-MP relationship. From this literature, we derive that investors make their investment choices mainly based on the company's FP as reported in the financial statements (Barth *et al.*, 2023; Kong and Wang, 2024; Nicolò *et al.*, 2023) and, consistently with Zhou *et al.* (2022), we hypothesize a mediation role of FP in the EP-MP direct relationship.

Based on the above considerations, we first test the following hypothesis:

H1. The relationship between EP and MP is weak and mediated by FP.

2.2 Information on environmental risks and market performance

Recently, a further interesting strand of studies has focused on the interpretative perspective of environmental risk perceived by investors, in terms of potential consequences on FP and MP related to environmental damage caused by a company. In this research context, some contributions (Benlemlih, 2017; Chen *et al.*, 2021; Deng *et al.*, 2022; van Leeuwen and Mohnen, 2017; Martin *et al.*, 2012; Palmer and Truong, 2017; Servaes and Tamayo, 2013; Tzouvanas and Mamatzakis, 2021; Wang *et al.*, 2018) aim to enhance the positive influences on risks for investors deriving from future economic costs-and benefits linked to a higher environmental commitment of companies and their pro-environmental investments. From this perspective, Baboukardos (2018) developed an analysis of the weak relationship between EP and FP by deepening the moderating role of the environmental provisions as a proxy for the levels of the environmental risk perceived by investors, calling for further analyses on this issue.

Responding to this call, which to date has not been implemented by scholars, we aim to examine whether the relationship between FP and MP is influenced by the company's approach to managing environmental risk information, and specifically whether a consistent approach positively moderates it. For this purpose, we also consider the environmental risks perceived by investors as a moderator of the EP-MP association. However, differently from Baboukardos (2018), we measure them by crossing both the presence of accounting (environmental provisions) and non-accounting information on environmental risks. For the latter, in line with Aouadi and Marsat (2018) and de Villiers *et al.* (2022), we proxy the non-accounting information on environmental risks with the existence of environmental controversies.

To jointly consider the two variables, we build the matrix presented in Figure 1. In the matrix, the existence of environmental provisions in the financial statement and environmental controversies originate 4 combinations associated with different investor perceptions of environmental risks (EnvRisk), going from low, to medium-low, to medium-high and high environmental risks perceived by investors.

Details on the use of environmental provisions and environmental controversies in our analysis models are provided in section 3.2 (d).

Each of the four combinations expresses different levels of consistency between the presence of accounting and non-accounting information on environmental risks, which is associated with a different level of perceived risk by investors:

- (1) **Quadrant “EnvRisk 1”**. If the company has no ongoing environmental controversies, the absence of environmental provisions on the balance sheet is consistent with the content of the non-financial disclosure. No environmental risks emerge, and accounting information appears appropriate to investors, who estimate a low reporting risk.
- (2) **Quadrant “EnvRisk 2”**. If the company has no ongoing environmental controversies but recognizes environmental provisions on the balance sheet, the accounting information provided is not consistent with the non-accounting one, while the provisions could be considered as symptomatic of potential environmental risks. The investors perceive a higher risk level than in quadrant 1. However, the perceived risk is not very high because the provisions in the absence of controversies could also be considered as expressive of a prudent attitude in the preparation of the financial statements and for hedging potential environmental risks. The investors may even prize this compared to the situation of the quadrant “Risk 1”.
- (3) **Quadrant “EnvRisk 3”**. If the company has ongoing environmental controversies and recognizes environmental provisions on the balance sheet, the perceived risk by investors is overall medium/high. The accounting information provided is consistent with the non-accounting one, so the perception of the environmental risk tends toward

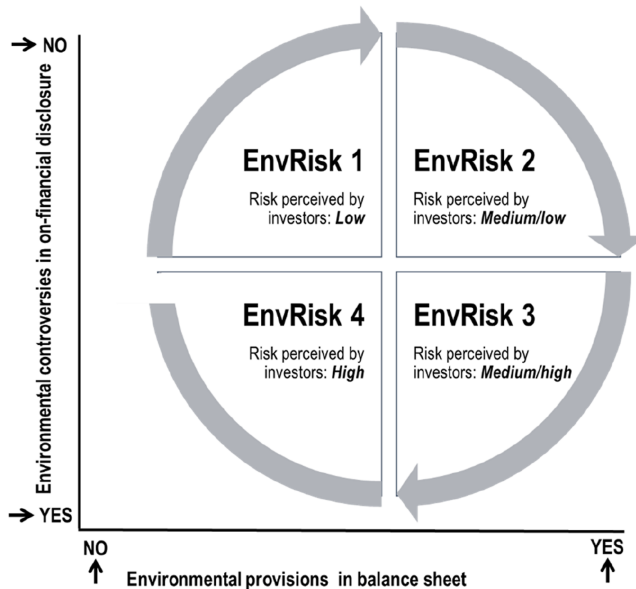


Figure 1. Four-quadrant partition table of the categorical variable EnvRisk. Source: Authors' own work

a medium value. However, the presence of controversies highlights critical issues increasing the perception of environmental risk by investors, leading investors to perceive a medium/high risk.

- (4) **Quadrant “EnvRisk 4”.** If the company has ongoing environmental controversies but does not recognize environmental provisions on the balance sheet, the perceived risk by investors is high. The presence of controversies highlights environmental risks, and the absence of accounting information is inconsistent with the non-accounting information. These two effects amplify each other by making investors perceive a high level of environmental risk.

We point out that our estimation of the above environmental risk levels is based on the consistency of the presence/absence of accounting and non-accounting information, without considering the level of provisions reported within the balance sheet. This assumes that companies have correctly applied the requirements of IAS 37 (“Provisions, Contingent Liabilities and Contingent Assets”) to recognize an amount of provisions that reflects a reliable estimate of the probable amount of the obligation.

Based on the above classification, we hypothesize that the EP positively affects MP (mediated by FP) when the environmental risk is perceived low or medium-low by investors; conversely, if the environmental risk is perceived medium-high or high by investors, EP negatively affects MP. We can thus operationalize the research hypothesis as follows:

- H2. Low or Medium-Low (High or Medium-High) levels of environmental risks perceived by investors positively (negatively) moderate the relationship between EP and MP mediated by FP.

2.3 The role of company size

Previous studies on the value relevance of accounting information found that the positive impact of FP on MP becomes more significant as the size of the company increases (Hodgson and Stevenson-Clarke, 2000; Ispriyahadi and Abdulah, 2021), also finding that larger company size contributes to better performance related to social results (ESG) (Brammer and Millington, 2006; D’Amato and Falivena, 2020). Nevertheless, the majority of studies included firm size as a control variable in the regression equations (Secinaro *et al.*, 2020). Here, consistently with other recent studies, we hypothesize the firm size as a moderator of the investigated relationship, as also suggested by a Meta-Analysis of moderators of the EP–FP relationship (Dixon-Fowler *et al.*, 2013). In the paper, we share the idea that the relationships between EP and FP, FP and MP, and EP and MP exist or vary in strength or sign conditional to the company size, testing the research hypothesis as follows:

- H3. The company size moderates both the direct effect of EP on MP and the indirect effect of EP on MP through FP on both paths.

3. Research design

3.1 Sample

We selected a database from 2015 to 2022 using Refinitiv® Eikon Datastream®. We started with 4,085 listed companies based in countries that have adopted the euro as their single currency, excluding financial companies as their financial statement structure and financial ratios differ significantly from those of other companies. In addition, to obtain a balanced panel, we needed to drop companies with missing data that could not be properly imputed (Table 1). As a result, we have a non-probabilistic sample of 1,729 observations including all companies without missing data for the examined period.

Table 1. Sample selection process

Selection process	
Listed companies based in countries adopting the euro as their single currency	4,085
Financial companies*	580
Firms with missing or inconsistent data	3,248
<i>Resulting sample</i>	257
Source(s): Authors' own work	

The choice of the European context is due to several factors that make it an interesting field of investigation for our topic, as they drive companies to increasingly integrate environmental considerations into their business strategies. Among these, we can recall the presence of various regulatory frameworks (Directive 2014/95/EU-NFI, Directive 2022/2464-CSRD) and sustainability initiatives, as well as a strong tradition of corporate social responsibility (CSR) and stakeholder engagement.

Table 2 shows the sample composition by European geographical area, under the classification proposed by CEMR (2021).

As for the observation period, we started in 2015 due to the large number of companies with missing data in previous years. To compare the pre-COVID period with the COVID period in the robustness analyses (see section 4.1), the last period considered was 2022, omitting 2023.

3.2 Variables measurement

Our analysis models (see section 3.3) involve the following variables, which are normalized in the interval 0–100:

- (1) Market Performance (Dependent variable)
- (2) Environmental Performance (Explicative variable)
- (3) Financial Performance (Mediating variable)
- (4) Environmental Risk and Company Size (Moderating variables)

3.2.1 market performance. The literature used many variables as proxies for MP (Dal Maso *et al.*, 2024; Endrikat *et al.*, 2014; Nuber *et al.*, 2020). Among these, “Market Value/Total Assets” (MV/TA), “Market Value/Numbers of shares” (MV/Number of shares), and “Tobin’s Q” are the most used. Here, we, use Tobin’s Q obtained from Refinitiv Eikon Datastream (ID Code: 168E). For the robustness analysis, we use the “Market Value/Numbers of shares”.

3.2.2 Environmental performance. For EP, consistently with Veltri *et al.* (2021), we use the Environment Pillar Score provided by Refinitiv® Eikon Datastream®, which is a

Table 2. Sample by European geographical area

Area	Countries	No. of companies
Northern Europe	Finland, Ireland	27
Central Europe	Austria, Germany	68
Southern Europe	Greece, Italy, Portugal, Spain	52
Western Europe	Belgium, France, Luxembourg, Netherlands	100
<i>Total</i>		247
Source(s): Authors' own work		

comprehensive measure calculated using a subset of 68 metrics referred to as the three categories “Resource use”, “Emissions” and “Innovation” (Refinitiv, 2022).

3.2.3 Financial performance. Previous studies have investigated the relationship between EP and FP by measuring the latter through specific profitability ratios (such as ROA, ROE, etc.), and (more limitedly) also with specific measures of the financial dimension (such as leverage, current ratio, etc.) (Horváthová, 2012; Lahouel *et al.*, 2022; Veltri, 2020). Other studies, responding to the call of scholars for a holistic vision of FP (Bruna *et al.*, 2022), have tried to adopt comprehensive measures for FP, quite often limited to economic efficiency (Liu *et al.*, 2019; Nuber *et al.*, 2020). However, FP should not be considered using just specific financial ratios concerning economic advantages and disadvantages, as the environmental commitment also impacts in terms of the monetary resources required, thus reflecting on the company’s financial structure. Therefore, in measuring FP it is more fruitful to take into consideration the interconnections between the financial structure and profitability (Bruna *et al.*, 2022). To embrace this holistic approach, we construct an FP score by applying to a set of financial ratios the *Technique for Order Preference by Similarity to Ideal Solution* (TOPSIS) (Hwang and Yoon, 1981; Lin and Tsai, 2010), which is a methodology derived from the Multi-Criteria Decision Methods (MCDM) widely used in the last twenty years to obtain a summary of FP (Bulgurcu, 2012, 2013; Demireli, 2010; Roy and Patro, 2021). In particular, in line with the theoretical framework and applications to computing FP through TOPSIS used by Ricca *et al.* (2022), we choose a set of 9 financial ratios able to encompass *profitability* and *operating efficiency, solvency, and liquidity*, which are the main dimensions of FP (Altman, 1968; Damodaran, 2010). The details about the set of financial ratios in TOPSIS are in Table A.1 in the Supplementary material. The data source for the accounting values of the ratios is Refinitiv® Eikon Datastream®. Applying TOPSIS to our set of ratios, we calculate 3 different financial performance scores:

- (1) The first one is the overall score (FP), which considers all 9 financial ratios and we use in the models of the principal analysis;
- (2) The second and third are the *profitability* (FP_pr) and *solvency and liquidity* (FP_sl) scores, which consider only the three relevant ratios in our set for each of the dimensions of financial performance. We use them in the robustness analysis.

3.2.4 Environmental Risk and Company Size. In our moderated mediation models, we use the moderating variables Environmental Risk (EnvRisk) and Company Size (Size). The categorical variable EnvRisk expresses the level of environmental risk perceived by investors based on accounting (environmental provisions) and non-accounting information (environmental controversies) disclosed by the company, as already clarified in section 2.2). It arises from the combination of the dichotomization of the following two variables:

- (1) “Environmental Resource Impact Controversies” (Refinitiv ID code ENRRDP067), which considers the “number of controversies related to the environmental impact of the company’s operations on natural resources or local communities” (Thomson Reuters, 2017);
- (2) “Environmental Provisions” (Refinitiv ID code ENERDP092), i.e. the “environmental provisions as reported within the balance sheet, kept aside to cover possible future environmental liabilities” (Thomson Reuters, 2017).

As for Company Size, the literature used many variables, such as Total Assets, Equity, Market Value, Number of Employees, Revenues, etc. (Baboukardos and Rimmel, 2016; Brammer and Millington, 2006). Between these, Total Assets seems to be the most effective and used. In addition, many empirical papers use the logarithm form of firm size measure to mitigate the high skewness of data (Dang *et al.*, 2018). Therefore, we adopt the natural logarithm of Total Assets as a measure of Company Size (Size).

3.3 Regression equations

Accounting literature highlighted the importance of deepening our understanding of a hypothesized association. For this purpose, it suggested using mediation (to test a causal theory that relates an independent variable and a dependent variable through a mediator), moderation (to understand under what conditions the relationship between X and Y exists or differs in strength or sign) or moderated mediation (to investigate when the mediated effect is conditioned by another variable) (Jollineau and Bowen, 2023). In the last twenty years, researchers began to increasingly develop theories including “moderated mediation”, “mediated moderation”, or “conditional process modeling” (Edwards and Lambert, 2007; Fairchild and MacKinnon, 2009; Hayes, 2009). As a result, some packages or macros have been developed to facilitate the use of these methods.

In this research, we employ the PROCESS macro (Hayes, 2020, 2022) to estimate three traditional models based on 10,000 bootstrapping samples at 95% biased-corrected confidence intervals.

For model (1) (Figure 2), we use a simple mediation model to study the impact of X (EP) on Y (MP) mediated by M (FP) at time *t* (the end of the fiscal year) for June of year *t*+1.

The regression equations of Model (1) are the following:

$$\hat{Y}_{t+1} = \beta_0 + \beta_1 M_t + \tau_1 X_t + \sum_{i=2015}^{2021} \delta_i year_i$$

$$\hat{M}_t = \alpha_0 + \alpha_1 X_t + \sum_{i=2015}^{2021} \delta_i year_i$$

Where:

year = dichotomic variable to control the year-fixed effect

\hat{Y} = MP

X = EP

M = FP

the direct effect of X on Y is equal to $\alpha_1\beta_1$

the indirect effect of X on Y is equal to τ_1

Model (2) (Figure 3) is a moderated mediation model studying the impact of X (EP) on Y (MP) mediated by M (FP) and moderated by Rj (EnvRisk) at time *t* (the end of the fiscal year) for June of year *t*+1. In other words, the indirect effect of EP (X) on MP (Y) through the mediator FP (M) is conditioned by the environmental risk (Rj) as a moderator on both paths.

The regression equations of Model (2) are the following:

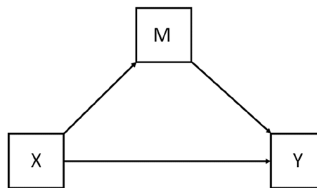


Figure 2. Mediation model (1). Source: Authors' own work

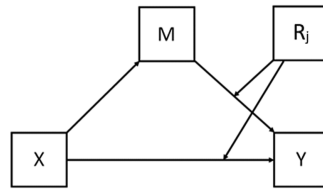


Figure 3. Moderated mediation model (2). Source: Authors' own work

$$\hat{Y}_{t+1} = \beta_0 + \sum_{j=1}^3 \beta_j R_j + \gamma_0 M_t + \sum_{j=1}^3 \gamma_j M_t R_j + \tau_0 X_t + \sum_{j=1}^3 \tau_j X_t R_j + \sum_{i=2015}^{2021} \delta_i \text{year}_i$$

$$\hat{M}_t = \alpha_0 + \alpha_1 X_t + \sum_{i=2015}^{2021} \delta_i \text{year}_i$$

Where:

year = dichotomic variable to control the year-fixed effect

\hat{Y} = MP

X = EP

M = FP

R_j depending on the value of EnvRisk (see Table 3)

Therefore, the direct effects of X on Y, conditional on the value of EnvRisk, encoded as R_j , is $\tau_0 + \sum_{j=1}^3 \tau_j R_j$, and the indirect effects of X on Y, conditional on the value of EnvRisk, encoded as R_j , is $\alpha_1 (\gamma_0 + \sum_{j=1}^3 \gamma_j M_t)$.

Model (3) (Figure 4) is a moderated mediation model studying the impact of X (EP) on Y (MP) mediated by M (FP) and moderated by R_j (EnvRisk) and W (Size) at time t (the end of the fiscal year) for June of year $t+1$. Therefore, in this model, we have two moderators: company size (Size), which is a continuous variable that moderates both the direct and indirect effect of

Table 3. Dummy variables R_j

EnvRisk	R1	R2	R3
1	0	0	0
2	1	0	0
3	0	1	0
4	0	0	1

Note(s): EnvRisk represents the level of reporting risk. It is a categorical moderator with four categories and can take alternating values from 1 to 4. It is represented by three dummy variables R_j (with j from 1 to 3) encoded as above,

Thus, depending on the value of Risk, inserting the values of 0 and 1 for moderator R_j (with j from 1 to 3) gives,

When EnvRisk = 1 then: $R_1 = 0$; $R_2 = 0$ and $R_3 = 0$,

When EnvRisk = 2 then: $R_1 = 1$; $R_2 = 0$ and $R_3 = 0$,

When EnvRisk = 3 then: $R_1 = 0$; $R_2 = 1$ and $R_3 = 0$,

When EnvRisk = 4 then: $R_1 = 0$; $R_2 = 0$ and $R_3 = 1$

Source(s): Authors' own work

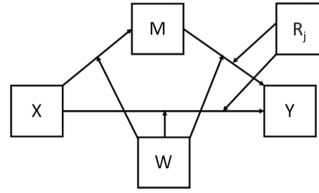


Figure 4. Two-moderated mediation model (3). Source: Authors' own work

EP on MP through FP on both paths; R_j (Environmental Risk), which moderates the indirect effect of EP on MP through FP on both paths.

The regression equations of Model (3) are the following:

$$\hat{Y}_{t+1} = \beta_0 + \sum_{j=1}^3 \beta_j R_j + \beta_4 W_t + \gamma_0 M_t + \sum_{j=1}^3 \gamma_j M_t R_j + \gamma_4 M_t W_t + \tau_0 X_t + \sum_{j=1}^3 \tau_j X_t R_j + \tau_4 X_t W_t + \sum_{i=2015}^{2021} \delta_i year_i$$

$$\hat{M}_t = \alpha_0 + \alpha_1 X_t + \alpha_2 W_t + \alpha_3 X_t W_t + \sum_{i=2015}^{2021} \delta_i year_i$$

Where:

year = dichotomic variable to control the year-fixed effect

\hat{Y} = MP

X = EP

M = FP

W = Natural logarithm of Total Assets as variable for Company Size (Size).

R_j depending on the value of EnvRisk encoded as in model (2) (see Table 3)

In this case, the direct effect of X on Y conditional by W and the value of EnvRisk, encoded as R_j ; when EnvRisk = 1 ($R_1 = 0; R_2 = 0; R_3 = 0$) => $\tau_0 + \tau_4 W$, instead for the other level of EnvRisk (2, 3, 4) => $\tau_0 + \tau_4 W + \sum_{j=1}^3 \tau_j R_j R$. The indirect effects of X on Y, conditional on W and the value of EnvRisk, encoded as R_j ; when EnvRisk = 1 ($R_1 = 0; R_2 = 0; R_3 = 0$) => $(\alpha_1 + \alpha_3 W) (\gamma_0 + \gamma_4 W)$, instead for the other level of EnvRisk (2, 3, 4) => $(\alpha_1 + \alpha_3 W) (\gamma_0 + \gamma_4 W + \sum_{j=1}^3 \gamma_j R_j)$.

4. Data processing and findings

The relationship between EP and MP is not a simple one, meaning that to fully comprehend this association we need to include variables able to explain why EP influences MP, i.e. the mechanism underlying the basic hypothesized EP-MP relationship, and when EP influences MP, that is under what conditions the relationship exists or varies in strength or sign. In the research, we thus hypothesize that the direct and indirect effects of EP on MP are conditioned upon the moderators EnvRisk (level of environmental risks perceived by investors) and Size (Company Size).

After calculating a comprehensive score of financial performance (FP) using TOPSIS (see section 3.2), we verified the existence of a direct EP-MP relationship and whether, and to what extent, the effect of EP on MP is mediated by FP [model (1)]. Furthermore, we expanded the

first model to consider the impact of the moderation of the environmental risk (EnvRisk) on the direct and indirect effects of EP on MP [model (2)]. Finally, in model (3) we added Company Size (Size) as an additional moderating variable of direct and indirect relationships of EP on MP. In all models, we used EP as the independent variable (X), MP as the dependent variable (Y), and FP as the mediating variable (M). Furthermore, in models (2) and (3), we considered EnvRisk (R_i) and Size (W) – whose values in the conditional tables are the 16th, 50th, and 84th percentiles – as moderating variables (see section 3.3). All variables are normalized in the range 0–100. Descriptive statistics are in Tables A.2 and A.3 in the Supplementary material.

In the three equations composing the model (1) (Table 4), the *F*-test points out that the R^2 values are highly significant ($p < 0.001$). The first two equations show that EP has a weak and negative but significant impact on FP and MP. The R^2 of the first equation (EP → FP) confirms the mediating effects. In addition, the second equation (EP → MP) shows that the total effect of EP on MP (−0.067) is negative. In the third equation (EP → FP → MP), we can see that FP has a sizable positive impact (0.70) while EP has a weak negative impact (−0.027). Hence, an increase in the level of EP produces a decrease in MP. Accordingly, the incidence of EP on MP (direct effect = −0.026) negatively affects about 39,43% of the total effect. The indirect effect is negative (−0.041) and statistically significant (BootLLCI and BootULCI did not straddle between zero), and however weak, results in approximately double the direct effect. This means that the remaining 60.57% of the negative effect of EP on MP is due to the mediating effect of FP. The above shows that the impact of EP on MP is negative, very weak, and depends more on FP mediation. Therefore, our hypothesis H1 is confirmed.

In model (2), we investigate if the negative weak impact of EP on MP changes depending on how investors perceive environmental risks, based on accounting and non-accounting information disclosed by firms (H2). For this purpose, we introduced the variable EnvRisk (see section 3.2 and 3.3) as moderator of the relationships FP → MP and EP → MP. The findings (Table 5) allow us to highlight differences in the direct path of EP on MP. The “direct

Table 4. Summary of mediation model (1)

Model (1)			
Variables	Y: MP X: EP Mediator: FP	MP	MP
Outcome	FP Coeff.	Coeff.	Coeff.
constant	15.426 ⁺	21.4563 ⁺	10.573 ⁺
EP	−0.058 ⁺	−0.0676 ⁺	−0.027 ^{**}
FP			0.706 ⁺
Year 2016	0.303	−2.3973 ^{**}	−2.611 ^{**}
Year 2017	10.201 ⁺	−2.1441 [*]	−9.341 ⁺
Year 2018	2.440 ⁺	−2.4418 ^{**}	−4.163 ⁺
Year 2019	4.799	−3.9948 ⁺	−7.381 ⁺
Year 2020	9.132 ⁺	−5.3625 ⁺	−11.805 ⁺
Year 2021	16.382 ⁺	−1.814	−13.372 ⁺
R-sq	0.2854 ⁺	0.2524 ⁺	0.2950 ⁺
Effect of EP on MP			
Total			−0.0676 ⁺
Direct			−0.0266 ^{**}
Indirect EP → FP → MP			−0.0410 ^{oo}
Note(s): [*] $p < 0.10$; ^{**} $p < 0.05$; ^{***} $p < 0.01$; ⁺ $p < 0.001$			
Source(s): Authors' own work			

Table 5. Summary of moderate mediation model (2)

Variables	Y: MP X: EP Mediator: FP Moderator: EnvRisk FP Coeff.	MP Coeff.
constant	15.4255 ⁺	9.8227 ⁺
EP	-0.0581 ⁺	0.0161 ^{**}
FP		0.7017 ⁺
R1		-4.4836 [*]
R2		-2.5934 [†]
R3		20.4878 [*]
EP × R1		0.0053 [†]
EP × R2		-0.0413 [*]
EP × R3		-0.2781 [*]
FP × R1		-0.1877 [*]
FP × R2		0.0136 [†]
FP × R3		-0.0946 [*]
Year 2016	0.3031	-2.586 ^{**}
Year 2017	10.2007 ⁺	-9.4136 ⁺
Year 2018	2.4401 ⁺	-4.3985 ⁺
Year 2019	4.799 ⁺	-7.5138 ⁺
Year 2020	9.1318 ⁺	-11.8731 ⁺
Year 2021	16.3821 ⁺	-13.2179 ⁺
R-sq	0.2858 ⁺	0.2883 ⁺

Conditional effects at a value of the moderator EnvRisk			
Conditional direct effects of EP on MP	EnvRisk	Effect	
	1	0.0161 [*]	
	2	0.0214 [*]	
	3	-0.0252 [*]	
	4	-0.262 [*]	

	EnvRisk	Effect	BootLLCI	BootULCI
Conditional indirect effects of EP (mediated by FP) on MP				
	1	-0.0208	-0.057	-0.026
	2	-0.0299	-0.0506	-0.0169
	3	-0.0416	-0.0746	-0.0197
	4	-0.0353	-0.0678	-0.0148

Note(s): * $p < 0.10$; ** $p < 0.05$; *** $p < 0.01$; ⁺ $p < 0.001$
Source(s): Authors' own work

effect” of EP on MP is slightly significant and positively moderated by environmental risk when it is perceived as low EnvRisk = 1 (0.016) and medium-low EnvRisk = 2 (0.021), whilst it is negatively moderated by environmental risk when it is perceived as medium-high EnvRisk = 3 (-0.025) and high EnvRisk = 4 (-0.26). Moreover, the worst direct negative effect is the prerogative of class 4 (expressing the highest-risk class). Instead, the “indirect effect” (EP → FP → MP) is significantly and negatively moderated whatever the level of environmental risk perceived by investors. Once again, the worst negative impact coincides with classes EnvRisk = 3 (-0.041) and EnvRisk = 4 (-0.035), which are the highest classes

of risk levels. So, we can conclude that the conditional effects of environmental risks for both the direct (EP → MP) and indirect (EP → FP → MP) show that the worst impact of EP on MP is for the companies that present environmental controversies and have not provided environmental provisions in the balance sheet (EnvRisk = 4), therefore with the presence of environmental risks and inconsistency of accounting and non-accounting information. In addition, the direct negative influence of EP on MP for firms in the class EnvRisk = 4 is almost eight times greater than the incidence of the indirect effect mediated by FP. The above results confirm our hypothesis H2.

Model (3) introduces corporate size as a moderator on direct and indirect paths beyond the environmental risks. The results (Table 6) show further differences from the model (2) due to the introduction of this moderator. The direct path (EP → MP) is positively moderated by corporate size and environmental risks, except for the highest risk class (EnvRisk = 4), which negatively moderates the relationship. In contrast, for firms with higher size, the indirect effects (EP → FP → MP) are negatively moderated by corporate size and environmental risks, except for the companies characterized by a higher size, regardless of risk class. The above results confirm our hypothesis H3.

4.1 Robustness analysis

This section presents the results of the robustness analysis we conducted to verify the validity of the results obtained with model (3).

To test whether the choices made in the construction of the proposed model affected not only the magnitude and statistical significance of the total effect but also the estimated direct and indirect effects, we performed a robustness analysis of the traditional mediation model using the protocol defined by Rijnhart *et al.* (2022). To do this, we implemented five models (4, 5, 6, 7, and 8), alternately substituting the dependent variable Y, the mediator M, and the independent variable X (Table A.5 in the Supplementary material), and adding three categorical confounding variables (Table A.8 in the Supplementary material):

- (1) in the model (4) we substituted the dependent variable Tobin's Q (MP) with the Market Value per share (MV);
- (2) in model (5), we changed the continuous independent variable EP to an ordinal polychotomous variable (RAT_EP). For this purpose, we used the Refinitiv® Eikon Datastream® ESG Rating Methodology, in which EP scores are transformed into ratings (D-to A+) by a simple percentile sorting according to the correspondence made explicit in Table A.4 in the Supplementary material. Subsequently, the ratings, expressed as an ordinal variable, were transformed into conventional non-equidistant real numbers by the inverse of the standardized normal distribution function, using Torgerson's psychometric method (Torgerson, 1958). This methodology allows the ratings expressed in categorical form to be replaced by continuous values so that the differences between rating categories correspond to the true distances between them (Delvecchio, 2000);
- (3) in models (6) and (7) we substituted the moderator FP with two different scores of financial performances – profitability (FP_pr) and solvency and liquidity (FP_sl) scores – calculated always by TOPSIS (see sections 3.2);
- (4) in the model (8), considering that a financial or other crisis could affect the mediator (FP) and the dependent variable (MP) as a first confounding factor, we created a variable (COVID) that distinguishes the years before and during COVID-19. At the same time, since the available data matrix shows differences in financial and market performance according to product sector and European country, we have included two other categorical variables related to the sector (SECTOR) and the geographical area (GA).

Table 6. Summary of mediation model (3)

Model (3) (EP→FP _{ov} →MP)		Y: MP X: EP Mediator: FP Moderators: Size and EnvRisk	
Variables	FP	FP	MP
Outcome	Coeff.	Coeff.	Coeff.
constant	25.7376 ⁺		20.9254 ⁺
EP	-0.1256 ⁺		0.0520 [*]
FP			0.3417 ⁺
Size	-0.2776 ⁺		-0.3047 ⁺
EP*Size	0.0023 ^{***}		0.0001 [*]
FP *Size			0.0106 ⁺
R1			2.5786 [*]
R2			-1.0835 [*]
R3			29.7188 [*]
EP × R1			0.0227 [*]
EP × R2			-0.0224 [*]
EP × R3			-0.2332 [*]
FP × R1			-0.5120 ^{**}
FP × R2			-0.1207 ^{**}
FP × R3			-0.6405 ^{**}
Year 2016	0.4504 ⁺		-2.7040 ^{***}
Year 2017	10.4116 ^{***}		-10.7328 ⁺
Year 2018	2.9786 ⁺		-4.1893 ⁺
Year 2019	4.5266 ⁺		-8.6669 ⁺
Year 2020	8.9471 ⁺		-13.4169 ⁺
Year 2021	16.1740 ⁺		-15.1714 ⁺
R-sq	0.3174 ⁺		0.3244 ⁺

Conditional direct effects of EP on MP at the values of size and EnvRisk

SZ	EnvRisk	Effect	T
33.974	1	0.0509	2.9422 ^{***}
33.974	2	0.0736	1.7995 [*]
33.974	3	0.0285	2.4153 ^{**}
33.974	4	-0.1823	-2.4082 ^{**}
50.1521	1	0.0504	3.0180 ^{***}
50.1521	2	0.0731	2.5470 ^{**}
50.1521	3	0.028	3.6842 ⁺
50.1521	4	-0.1828	-2.5007 ^{**}
69.6819	1	0.0497	1.8139 [*]
69.6819	2	0.0725	1.8638 [*]
69.6819	3	0.0274	2.4909 ^{**}
69.6819	4	-0.1835	-2.5700 [∞]

Conditional indirect effects of EP (mediated by FP) on MP at the values of size and EnvRisk

Size	EnvRisk	Effect	BootLLCI	BootULCI
33.974	1	-0.0321	-0.0591	-0.0092
33.974	2	-0.0087	-0.0265	-0.0023
33.974	3	-0.0266	-0.0615	-0.0059
33.974	4	-0.0028	-0.0308	-0.0017

(continued)

Table 6. Continued

Conditional indirect effects of EP (mediated by FP) on MP at the values of size and EnvRisk				
Size	EnvRisk	Effect	BootLLCI	BootULCI
50.1521	1	−0.0069	−0.0228	−0.0057
50.1521	2	−0.0028	−0.0105	−0.0014
50.1521	3	−0.0059	−0.024	−0.004
50.1521	4	−0.0018	−0.0111	−0.0002
69.6819	1	0.0409	0.0026	0.0895
69.6819	2	0.0215	0.0013	0.0469
69.6819	3	0.0363	0.0022	0.077
69.6819	4	0.0166	0.0006	0.0446

Note(s): * $p < 0.10$; ** $p < 0.05$; *** $p < 0.01$; + $p < 0.001$

Source(s): Authors' own work

The results (Tables A.6, A.7, A.9, and A.10 in the Supplementary material) show that the direct and indirect effects are significant and have the same polarity of the coefficients of the model (3) (Table 6).

5. Discussion and conclusions

Framed in the value relevance research of EP developed in *stakeholder theory*, our study aimed to investigate the EP-MP relationship through models that explore the mediated/moderated effects of FP, accounting and non-accounting information on environmental risks, and firm size on a sample of 1,729 observations related to 247 European non-financial listed firms over the period 2015–2022.

The study fits into the current debate concerning the convenience for companies to be green, going beyond the question “Does it pay to be green”. Starting from the hypothesis that it exists a weak relationship between EP and MP, as environmental corporate strategies generate not only future advantages but also possible disadvantages that cancel each other out (Ambec and Lanoie, 2008; Baboukardos, 2018; Horváthová, 2012), our paper relies on literature that investigates the EP-MP relationship as a complex issue by the use of variables able to open the black box of the direct path EP-MP. We need to understand *why* (that is the mechanism under the hypothesized relationship) and *when* (under what conditions) EP affects MP, exploring the potential role played by some mediating-moderating variables. In these perspectives, our research adds evidence to these studies using more complex analysis models of the EP-MP relationships, which include both mediating variables, able to explain why EP affects MP, and moderating variables, able to explain under which conditions EP affects MP. This use of moderated mediation models allows for testing complex hypotheses that incorporate indirect effects, so addresses the call of literature on going beyond the “does it pay to be green?” question (Dal Maso *et al.*, 2024; Dixon-Fowler *et al.*, 2013; Grewatsch and Kleindienst, 2017; Semenova and Hassel, 2016). From this perspective, we examined FP’s mediating role in the EP-MP relationship and the moderating role of the environmental risks perceived by investors and the company size.

Our findings show a weak negative EP-MP direct relationship, and a more significant indirect effect of EP on MP through FP, meaning that FP mediates the relationship [model (1)]. This finding corroborates previous research (Dixon-Fowler *et al.*, 2013; Jollineau and Bowen, 2023; Korankye *et al.*, 2024; Semenova and Hassel, 2016) suggesting the increased use of moderated mediation models for a more effective study of the EP-MP relationship. It also highlights the appropriateness of considering FP (by using accounting variables) separately from MP (by using market variables), as emphasized by some strands of research (Bruna and Lahouel, 2021; Loprevite *et al.*, 2020; Zhou *et al.*, 2022). Furthermore, by our moderated

mediation models, we contribute to the literature on the value relevance of the information provided to the market (Barth *et al.*, 2023; Saji and Akshaykumar, 2025), adding evidence on the role of environmental risk information (Baboukardos, 2018; Clarkson, 2012). We demonstrate that low levels of environmental risks perceived by investors moderate the EP-MP relationship making the association between the two performances positive, whilst high levels of environmental risks perceived by investors moderate in the opposite direction making that association more negative [model (2)]. Finally, including the company size as a moderator beyond the environmental risks [model (3)], we found that the conditional indirect effects of EP (mediated by FP) on MP are positive for high firm size regardless of risk class. This relevant role played by firm size on the EP-MP relationship is consistent with the findings of previous studies on ESG performance and links to MP (Bowen, 2002; Bruna *et al.*, 2022).

Our findings show that companies' commitment to the environment and the EP achieved, other things being equal, have a positive valuation in the capital market only when the investors perceive environmental risks as low or medium-low, based on a consistent set of accounting and non-accounting information on these risks. This evidence confirms the relevance of this information to investors (Barth *et al.*, 2001; Brown *et al.*, 1999; Kothari, 2001), further explaining a factor conditioning its impact on the market value of stocks. However, the analysis conducted by using company size as an additional moderating variable also showed that for larger listed companies the environmental risk perceived by the investors loses its relevance in moderating the EP-MP association. These two results suggest that the consistency of accounting and non-accounting information on environmental risks is a relevant factor available to the company to improve the capital market's assessment of EP. At the same time, they also show that this consistency loses relevance to investors in larger firms, for whom FP becomes more important than the disclosure of environmental risks.

Contributing to the literature framed in stakeholder theory, our evidence on European listed companies supports the recent studies on the existence of a weak relationship between EP and MP (and between EP and FP) (Ambec and Lanoie, 2008; Baboukardos, 2018; Horváthová, 2010, 2012; Rahi *et al.*, 2023). Deepening the relationship, we add the current research (Chowdhury *et al.*, 2023; Clarkson *et al.*, 2011; Dal Maso *et al.*, 2024; Grewatsch and Kleindienst, 2017; Jollineau and Bowen, 2023) that aims to overcome the issue of whether "it pays to be green" by deepening the *why* and *when* EP affects MP in the studies of the value relevance of information (Barth *et al.*, 2001, 2023; Nicolò *et al.*, 2023; Talan *et al.*, 2024). In particular, our results provide further insight into the relevance, for investors' assessments, of the consistency of accounting and non-accounting information on environmental risks (Baboukardos, 2018; Baboukardos and Rimmel, 2016).

As for the managerial implications, companies should consider that, to identify paths that can lead to better evaluations from investors, it is necessary to appropriately manage environmental risk disclosure policies because it can bring significant benefits in terms of lower perceived environmental risks by investors, which translates into a higher MP. Our research shows that when the financial and non-financial information on environmental risks is consistent, the environmental risk perceived by investors is lower, and this in turn leads to positive effects on MP. Through consistent management of accounting and non-accounting information on environmental risks, thus, companies disclose to investors reliable information concerning the risks, making them perceived as lower. Based on our evidence, this seems especially true for relatively smaller listed companies.

As for policy implications, policymakers need to be mindful that the relationships between accounting and non-accounting information on environmental issues are becoming increasingly relevant, and then they should use regulations to promote the correct integration of the information on environmental risks. This is the direction toward which the European Union has moved with the Corporate Sustainability Reporting Directive 2022/2464 (CSRD), which has just come into force and is expected to strengthen this consistent integration of accounting and non-accounting information by companies in the coming years.

Although our study makes contributions to literature, it has several limitations. First, it should be highlighted that our analysis is focused on the European context, and the relationships identified, given the sample selection process limited by missing data, are not of causality but more strictly associative. As a result, our findings should not be generalizable to other international contexts, particularly for countries in emerging economies having differences in regulations and governance structure. Second, we have not examined whether the different combinations of environmental risk perceived by investors are connected to other factors, such as possible environmental risk management policies adopted by companies and/or other business characteristics, including variables of corporate governance. Therefore, future research, based on our methodological framework, could corroborate our findings concerning listed companies in other international contexts, also adding other business characteristics and/or other non-financial performance measures such as Social and Governance. Finally, it should be noted that our estimated level of environmental risk perceived by investors assumes that companies, to recognize provisions, have correctly applied the requirements of IAS 37. Therefore, the presence of company accounting policies could bias our findings. Furthermore, it should be investigated whether the market reacts differently depending on the amount of provisions, regardless of their consistency with the associated level of risk. Future research could therefore explore these aspects as well.

Supplementary material

The supplementary material for this article can be found online.

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Corresponding author

Domenico Raucci can be contacted at: domenico.raucci@unich.it