

EXAMINING THE IMPACT OF SUSTAINABILITY PRACTICES ON THE LIKELIHOOD OF ENVIRONMENTAL PENALTIES: EVIDENCE FROM S&P 500 COMPANIES

DANIELA LO CASCIO ^{*} and MAURO ALIANO [†]

Department of Economics and Management

SEEDS, Sustainability Environmental Economics and Dynamic Studies

University of Ferrara, Ferrara, Italy

**daniela.locascio@unife.it*

†mauro.aliano@unife.it

Received 30 June 2025

Revised 29 September 2025

Accepted 22 October 2025

Published 17 April 2026

This study examines the relationship between corporate sustainability practices and the likelihood of incurring environmental penalties, focusing on S&P 500 firms from 2000 to 2024. As global pressure mounts for businesses to adopt sustainable practices due to stakeholder expectations and stringent regulations, companies face increasing risks of environmental non-compliance. Although environmental penalties serve as a deterrent, limited research has explored whether sustainability practices can predict a firm's likelihood of receiving penalties. This study addresses this gap by analyzing the predictive role of corporate characteristics, including ESG performance, environmental scores, and governance practices, in assessing penalty risks. Utilizing ESG data from LSEG and penalty records from the Violation Tracker database, we employ regression analysis to determine whether high ESG scores and robust governance frameworks correlate with reduced penalty risks, indicating enhanced risk management and regulatory adherence. Our findings offer actionable insights into aligning corporate sustainability with regulatory standards and mitigating environmental risks.

Keywords: Environmental penalties; sustainability; corporate governance; financial markets; financial risks.

JEL Classifications: G, O16.

*Corresponding author.

This is an Open Access article published by World Scientific Publishing Company. It is distributed under the terms of the Creative Commons Attribution 4.0 (CC BY) License which permits use, distribution and reproduction in any medium, provided the original work is properly cited.

1. Introduction

In recent years, the path towards sustainable economic development has become an essential priority for the global market (Barbier 2017, Van Niekerk 2020). The need to adopt sustainable practices is not only an ethical issue (Darsono *et al.* 2024) but also a fundamental condition for the competitiveness and survival of companies (Zheng *et al.* 2024). The urgency to adapt to sustainable business models is driven both by the growing awareness and pressure from stakeholders (Delmas & Burbano 2011, Gaganis *et al.* 2023, Liu *et al.* 2024) and by increasingly stringent regulations that compel companies to reduce their environmental impact (Foulon & Marsat 2023). A relevant example in the context of the United States is the Clean Air Act, a federal law that requires companies to take measures to reduce air pollution and improve air quality (Clean Air Act 2013). However, despite these pressures, many companies do not fully comply with sustainable practices (Habib & Bhuiyan 2017), hindering ecological progress. In some cases, companies thus accept the risk of receiving financial penalties rather than bearing the costs of compliance. Environmental penalties, however, act as an effective deterrent against irresponsible corporate behavior (Xia *et al.* 2024), pushing companies to improve their environmental performance to preserve their reputation (Tian & Yae 2024) and maintain a collaborative relationship with stakeholders (Wang *et al.* 2024, Xu & Zhang 2024).

To the best of our knowledge, literature has mainly analyzed the effects of environmental penalties on aspects such as stock prices (Xia *et al.* 2024) or financing costs (Chen *et al.* 2025, Gu *et al.* 2023). Few studies, nonetheless, have looked at how sustainable practices may be predictive of which businesses are more likely to face penalties than others. For example, Foulon & Marsat (2023) highlighted that companies with a larger environmental footprint tend to incur more significant penalties, while Zhou *et al.* (2024a; 2024b) showed how penalties can incentivize greenwashing strategies without necessarily improving the actual sustainability of firms. Accordingly, this study shifts the perspective from the consequences of penalties to their determinants. It examines whether ESG performance and related indicators can help predict the likelihood of environmental penalties, focusing on business characteristics such as ESG scores, environmental ratings, and governance indicators. While prior research emphasizes *ex-post* outcomes, little is known about the *ex-ante* conditions that shape firms' exposure to penalties. This paper addresses this gap, thereby advancing the ESG–regulation literature.

The theoretical rationale draws on various perspectives suggesting that strong ESG performance enhances alignment with stakeholder expectations, regulatory compliance, and reputational legitimacy, all of which can reduce regulatory risk. Prior research also indicates that larger firms tend to face higher penalties due to their visibility and environmental impact (Romero *et al.* 2018). This is particularly relevant in the U.S. context, where strict environmental regulations and a high concentration of global corporations in emission-intensive sectors make it an ideal

setting to explore the relationship between ESG practices and regulatory exposure. Accordingly, this study focuses on firms listed in the S&P 500 index.

This research is organized as follows. Section 2 reviews the relevant literature and formulates the hypotheses. Section 3 describes the data and methodology used to test these hypotheses. Section 4 presents the results, followed by a robustness test in Sec. 5. Section 6 provides the conclusions, including policy implications and final considerations.

2. Literature Review and Hypotheses Development

2.1. *Environmental penalties*

Environmental penalties are essential to promote environmental protection and foster corporate responsibility (Garcia & Fonseca 2018). Although their main purpose is to penalize non-compliant behaviors, they can also serve as a lever to improve corporate governance and guide companies towards more sustainable practices. Policymakers use financial penalties to regulate firms' behaviors by leveraging their deterrent effect (Xia *et al.* 2024). Fines represent the direct cost of violations, but the consequences can extend to loss of investor confidence, investor withdrawals, and loss of reputation (Tian & Yae 2024, Xia *et al.* 2024).

In recent years, investor interest in environmental performance has grown, and the stock market has started to reflect this awareness (Xu & Zhang 2024). However, market reactions to environmental performance depend on the context. Studies conducted in different countries or sectors have reached conclusions that are not always convergent, often due to institutional differences. For example, while it was believed that stock market reactions were more pronounced in developed countries, recent research shows that even capital markets in emerging economies respond significantly to environmental violations (Xia *et al.* 2024). Zhou *et al.* (2024a,b), however, observe that in developing countries, regulatory policies often fail to achieve the desired results due to structural limits and deviancies in enforcement.

Environmental violations are direct signals of poor corporate performance, often linked to internal governance problems. As noted by Xing *et al.* (2025), managers who prioritize personal gain over environmental protection compromise the long-term interests of the company, generating economic and reputational damage, such as stock price drops. Increased public awareness can amplify these negative consequences, increasing pressure on corporate stakeholders. At the same time, penalties can play an important deterrent role. According to Wang *et al.* (2023), increasing the certainty of punishment strengthens the deterrent effect of regulations, prompting companies to comply. However, penalties can also have undesirable effects. Zhang & Li (2024) highlight how many companies, after being sanctioned, resort to greenwashing to quickly repair their image. By manipulating the information disclosed, these companies mask the lack of substantial progress, taking advantage of the difficulty for external stakeholders to verify actual environmental performance.

This opportunistic behavior, although useful in the short term, can hinder the effectiveness of penalties. Furthermore, companies that persist in greenwashing risk facing more severe penalties and losing investor trust (Gatti *et al.* 2021). Another crucial factor for the success of environmental policies is public participation. Wang *et al.* (2024) emphasize how social pressures and public opinion can push governments to introduce stricter policies, increasing the cost of violations for companies and encouraging them to invest in cleaner technologies. In conclusion, environmental penalties have a complex impact on companies. They serve both as a deterrent tool and as a lever to improve governance and operational efficiency, but their success largely depends on the quality of corporate governance and the pressure exerted by external stakeholders.

2.2. Theoretical framework

The theoretical foundation of this study rests on signaling theory and stakeholder theory, both of which clarify the mechanisms through which ESG performance and governance can reduce firms' vulnerability to environmental penalties.

From a signaling perspective (Spence 1973), the framework is particularly useful in order to understand how companies reduce information asymmetry with their stakeholders (Kuo *et al.* 2024). In financial markets, characterized by uncertainty and incomplete information, firms send signals to the market through their operational and strategic choices. Strong ESG performance is one such signal, reflecting a company's commitment to sustainability and alignment with environmental regulations (Connelly *et al.* 2011, Wang *et al.* 2023). This signal positively influences the perception of stakeholders — such as investors, customers, and regulators — by increasing trust and facilitating access to strategic resources such as funding and regulatory support (Huang *et al.* 2023, Kuo *et al.* 2024). Additionally, high ESG performance is associated with a reduction in perceived risk, leading to direct effects on financing costs (Chen *et al.* 2025). Companies that signal strong commitment to sustainability tend to be rewarded by the market, through increased investor confidence and easier access to capital (Darsono *et al.* 2024). On the other hand, environmental penalties can send negative signals to the market, communicating regulatory non-compliance, weak sustainability practices, and managerial inefficiencies (Shevchenko 2021).

This viewpoint is also supported by stakeholder theory, which highlights the significance of attending to the expectations of different stakeholders, such as communities, investors, customers, and regulators. ESG scores can be viewed as a gauge of how well a company responds to stakeholder issues around social responsibility and sustainability. Because they are seen as more sensitive to these issues, companies with higher ESG scores might be subject to fewer fines. Furthermore, penalties can be seen as a way for stakeholders to make sure that environmental requirements are followed (Freeman 2010).

Other theoretical perspectives — such as institutional, legitimacy, and agency theories — converge on similar predictions: firms aligned with external norms,

enjoying greater societal legitimacy, and governed by structures that reduce managerial opportunism are generally better equipped to avoid regulatory penalties. While these perspectives are not the main analytical lens of this study, they reinforce the expectation that ESG and governance practices serve as protective factors against penalties.

2.3. Hypotheses development

2.3.1. The role of ESG scores as a sustainable signal

ESG scores are key indicators of corporate commitment to sustainability (Tamimi & Sebastianelli 2017). These scores provide an integrated view of a company's Environmental (E), Social (S), and Governance (G) performance and were developed to support investment decisions based on non-financial criteria (Sun *et al.* 2024, Tamimi & Sebastianelli 2017). In particular, Environmental Score evaluates a company's environmental performance by measuring its commitment to managing risks and opportunities related to climate change, emissions reduction, and waste management (LSEG)^a; and Governance Score, on the other hand, reflects the quality of corporate governance, including aspects such as board structure, the independence of oversight bodies, and ethical management practices (LSEG). While the Environmental Score directly focuses on environmental performance, the Governance Score is essential to support sustainable strategies, monitor high-impact activities, and align with regulations.

Consistent with legitimacy theory, a high ESG score represents a proactive transparency and communication strategy that allows companies to mitigate environmental risks while generating positive impacts on corporate performance metrics such as Tobin's Q and ROA, particularly for large firms (Minutolo *et al.* 2019). This suggests that a high ESG score can prevent costs associated with penalties or reputational damage, while simultaneously enhancing financial performance. Companies that adopt transparent practices and effectively manage environmental risks are less likely to face penalties due to regulatory non-compliance. A high ESG score also acts as a signal of transparency and reliability, fostering stakeholder support (Bualay 2019, Zhang & Lai 2024). Beyond regulatory compliance, strong ESG performance can also play a crucial role in helping organizations navigate periods of uncertainty. By reducing risks and strengthening stakeholder trust, ESG-oriented companies are often more resilient to external shocks, particularly in times of crisis (Sun *et al.* 2025). This support enables companies to access critical resources for the implementation of green initiatives (Zhang & Lai 2024) and helps mitigate risks associated with regulatory or environmental violations. By demonstrating proactive efforts to manage environmental risks, companies with high ESG scores are often better positioned to avoid actions that could lead to non-compliance with environmental laws or standards, thus reducing the likelihood of incurring penalties.

^aLSEG Data & Analytics (2025) *Worldscope database*, <https://www.lseg.com/en/data-analytics>.

Given the extensive benefits associated with improved ESG performance, companies should be incentivized to adopt more sustainable practices to align with environmental regulations, conveying a positive signal to stakeholders. Sustainable corporate management enforces investor confidence, enhances corporate reputation, and facilitates access to strategic resources required for implementing green activities (Zhang & Lai 2024). Transparent communication and responsible governance, in particular, can reduce uncertainties related to environmental risks, which are often a precursor to sanctions. This approach generates long-term corporate value while also limiting potential costs associated with penalties or reputational damage arising from unsustainable behavior (Buallay 2019, Habib & Mourad 2024).

Some studies have analyzed both the overall ESG score and its individual components to evaluate their distinct impacts on corporate financial performance. For example, Habib & Mourad (2024) and Bahadori *et al.* (2021) found a positive relationship between the overall ESG score and corporate financial performance, as well as a significant impact of the Environmental Score on financial outcomes. Similarly, Chouaibi *et al.* (2022) demonstrated that firms disclosing ESG information in a clear and transparent manner gain competitive advantages, such as enhanced corporate value and reduced risks associated with unsustainable practices. These include fewer fines, sanctions, or legal actions resulting from inadequate environmental management. A consistent commitment to sustainable and ethical practices also improves corporate financial performance (CEP), as highlighted by Busch *et al.* (2022), which showed that continuous improvements in CEP are positively correlated with traditional accounting metrics like ROA, further reinforcing the link between sustainability and economic benefits. By integrating environmental considerations into their governance and operations, companies are better equipped to comply with environmental standards and avoid infractions that could result in penalties. This connection between ESG performance and corporate benefits leads to the formulation of the following hypotheses:

H1 The higher the company's ESG score, the lower the probability of receiving an environmental penalty.

This hypothesis is based on findings that the overall ESG score is a strong signal of transparency and responsible management practices (Buallay 2019, Minutolo *et al.* 2019, Zhang & Lai 2024), enhancing stakeholders' trust and proactive risk management (Habib & Mourad 2024).

H2 The higher the company's Environmental Score, the lower the likelihood of incurring an environmental penalty.

This hypothesis is supported by studies emphasizing the critical role of the Environmental Score in reducing risks associated with environmental non-compliance (Bahadori *et al.* 2021, Habib & Mourad 2024).

Scholars document that the CEP determinants are closely tied to corporate governance (Zhang & Lai 2024). Governance mechanisms such as board composition, CEO duality, and gender diversity significantly influence a firm's ability to mitigate environmental risks and comply with regulatory standards. A robust governance structure, captured by the Governance Score, facilitates risk monitoring and ensures adherence to environmental norms (Fernández-Torres *et al.* 2025, Taglialatela *et al.* 2024). Specific governance characteristics further emphasize this relationship. For instance, the literature has extensively focused on elements such as CEO duality and gender characteristics when discussing factors influencing corporate governance. CEO duality has been linked to short-term decision-making and reduced attention to environmental priorities (Shahab *et al.* 2022). Research demonstrates that CEO duality limits the board's ability to effectively oversee management, heightening the risk of environmental non-compliance (Gull *et al.* 2023). Furthermore, the lack of independent oversight exacerbates these risks, underscoring the necessity for balanced control mechanisms within corporate governance. Also, gender diversity within boards is another critical aspect of governance that has attracted significant scholarly attention. The inclusion of women on boards correlates with heightened sensitivity to environmental issues and improved CEP. For instance, gender diversity enhances the board's capacity to monitor strategic decisions and fosters greater environmental accountability (Mallidis *et al.* 2024, Park *et al.* 2012, Schoonjans 2024, Zhang *et al.* 2021). Female representation on boards positively influences environmental performance and the presence of board committees dedicated to sustainability, and executive compensation tied to sustainability objectives significantly enhances environmental performance (Bhuiyan *et al.* 2021). This aligns with stakeholder theory, which posits that greater gender diversity reflects broader stakeholder interests and supports sustainability goals. However, companies that place greater emphasis on profit are more likely to engage in less ethical behaviors (Sun *et al.* 2025), often prioritizing profit maximization over environmental sustainability. This tendency can lead to reduced attention to regulatory compliance and weaker environmental risk management. Beyond these elements, board structure — encompassing size, independence, and the presence of environmental experts — plays a pivotal role in advancing sustainability. Larger, more independent boards exert greater pressure on management to maintain transparency and adhere to environmental regulations (Almaqtari *et al.* 2023). In line with these findings, robust board structures prevent misinformation in environmental reporting, while sustainability committees and gender diversity reinforce these outcomes (Velte 2024). Thus, the Governance Score captures the institutional mechanisms behind effective environmental strategies. It enables analysis of both ESG's signaling role and the specific impact of E and G dimensions on penalty risk. Based on this literature, we propose the following hypotheses:

H3a The higher the company's Governance Score, the lower the likelihood of incurring an environmental penalty.

H3b In the presence of CEO duality, there is a higher likelihood of incurring an environmental penalty.

H3c The presence of women on the company's board reduces the likelihood of receiving penalties.

As mentioned, ESG scores are essential tools for assessing companies' commitment to sustainability across environmental, social, and governance domains (Agnese *et al.* 2023, Ford *et al.* 2022). These scores not only guide responsible investment decisions but also play a crucial role in shaping companies' reputational and financial performance. Among these metrics, the ESG Controversies Score plays a central role as it measures companies' exposure to negative events — such as scandals or unethical behaviors — often amplified by media coverage, which can harm their image and stakeholder relationships (Xue *et al.* 2023). Negative events elicit stronger reactions compared to positive ESG initiatives, amplifying stakeholders' risk perception and increasing the pressure on the companies involved (Bang *et al.* 2023). This heightened sensitivity is further fueled by media coverage, which makes ESG controversies particularly relevant indicators of reputational and operational risk. Companies involved in ESG controversies often experience severe reputational damage, leading to significant economic consequences, including product recalls, legal penalties, and difficulties in obtaining external capital. Such impacts raise financing costs, hinder access to financial resources, and undermine a company's competitiveness (Xue *et al.* 2023). For example, Hampl & Vágnerová Linnertová (2024) highlight that, while ESG performance can mitigate perceived risks, ESG controversies significantly increase the risk perception among creditors and investors, negatively affecting a company's financial resilience. The ESG Controversies Score, therefore, emerges as a key indicator for understanding sustainability-related risks, with higher scores indicating fewer controversies. Cicchiello *et al.* (2023) emphasize its importance, showing how it differs from the general ESG score as it reflects negative events reported in the media, significantly increasing reputational and economic risks. Highly visible companies, such as the banks analyzed in their study, are particularly vulnerable. Although these firms adopt stronger ESG practices to protect themselves from reputational risks and maintain a competitive edge, their higher media exposure amplifies the negative impacts of ESG controversies. Additionally, ESG controversies are linked to operational inefficiencies, as demonstrated by Kweh *et al.* (2024) in the context of Chinese energy companies. Firms with higher ESG Controversies scores tend to exhibit lower operational efficiency due to the negative effects of scandals and controversies, which necessitate costly corrective measures and erode stakeholder trust. Despite these risks, in highly competitive contexts or those characterized by high public visibility, ESG controversies can also incentivize companies to improve their practices, reducing reputational damage and preserving stakeholder trust (Chiaramonte *et al.* 2022). However, the inevitability of controversies and their amplification through the media make companies with low ESG Controversies Scores more vulnerable to environmental and economic penalties,

given the link between negative public perception and financial consequences. Based on the literature, the following hypothesis is proposed:

H4 The higher the company's ESG Controversies Score, the lower the likelihood of incurring an environmental penalty.

3. Data and Methodology

3.1. Sample

This study analyzed environmental violations committed by U.S. companies listed in the S&P 500 index. Data was sourced from the Violation Tracker^b public database, focusing on environmental offenses between 2000 and 2024. The search specifically targeted environmental-related offenses for companies within the sample timeframe (2000–2024). For each company, details such as penalty amount, date, and violation description were recorded under “Current Company” to ensure consistency with the database's classification. In total, 4578 penalties were analyzed. Companies were categorized into 11 sectors based on Yahoo Finance's classification: Basic Materials, Communications Services, Consumer Cyclical, Consumer Defensive, Energy, Financial Services, Healthcare, Industrials, Real Estate, Technology, and Utilities. To provide an overview of the distribution of these penalties, descriptive statistics summarizing the number of penalties by sector are reported in Table 1.

To provide further insight into the sample, Table 2 presents descriptive statistics on the key variables used in the analysis, including ESG scores and financial indicators, highlighting patterns and variability across firms. ESG, Environmental, Governance, and Controversies scores are obtained from LSEG and range from 0 (lowest) to 100 (highest).

The mean of the ESG score is 51.429, with a standard deviation of 20.323, reflecting significant variability among firms. This is likely due to the diverse range of sectors included in the sample. Companies in environmentally intensive industries, such as “energy” and “basic materials”, typically face greater environmental challenges and scrutiny, which may negatively impact their scores compared to less impactful sectors like “technology” or “services”. This suggests that the inherent environmental footprint of these industries plays a substantial role in shaping their ESG performance. The Environmental Score has a lower mean of 43.553 but exhibits even greater variability, with a standard deviation of 29.590. This suggests that firms' environmental practices differ substantially, influenced by the nature of their operations. Similarly, the ESG Controversies Score shows an average of 80.726, indicating that most firms have relatively moderate levels of controversies. However, the high standard deviation of 30.754 suggests considerable variation, reflecting differing reputational and operational risks across industries. Governance practices,

^bGood Jobs First (2024) *Violation Tracker Database*, <https://violationtracker.goodjobsfirst.org>.

Table 1. Distribution of environmental penalties by sector.

Sector	N° firms by sector	N° penalties by sector
Basic Materials	22	834
Communication Services	23	29
Consumer Cyclical	57	163
Consumer Defensive	38	271
Energy	23	2228
Financial Services	67	50
Healthcare	67	111
Industrials	70	442
Real Estate	31	46
Technology	76	80
Utilities	30	324

Note: The table reports the classification of firms by industry sector, along with the number of firms and the total environmental sanctions recorded for each sector

Table 2. Descriptive statistics.

Variable	Obs	Mean	Std. Dev.
ESG Score	8260	51.429	20.323
Environmental Score	8260	43.553	29.590
ESG Controversies Score	8260	80.726	30.754
Governance Score	8260	56.037	21.566
Total Asset (ln)	8260	23.585	1.465
Cash to Asset	8260	0.086	0.092
Debt Equity	8260	142.837	939.317
ROA	8260	6.583	7.814

Notes: The table provides an overview of the key variables used in the analysis, highlighting notable patterns and variations across ESG dimensions, financial characteristics, and penalties data. The summary statistics emphasize the diversity of the sample, including firms from various sectors, and set the stage for subsequent analyses that account for these differences.

represented by the Governance Score, have a mean of 56.037 with a standard deviation of 21.566, showing moderate overall performance with room for improvement. As with the other ESG dimensions, sector-specific factors likely play a role, with more regulated industries, such as “finance”, typically scoring higher. Among the financial variables, the data highlight the presence of large firms in the sample, characterized by substantial means and significant variability. This diversity reflects differences in firms’ financial capacity and performance, which may play a role in shaping their approach to sustainability and compliance practices. Descriptions of the variables and their respective data sources are reported in Table 3.

Table 3. Variable definitions and data sources.

Variable name	Description	Role in the model	Data source
PENALTY	Dummy variable associated with penalties. The variable takes the value of 1 if the company has received a penalty and 0 otherwise	Dependent variable	Violation Tracker
ESG	Company's ESG score	Explanatory variable	LSEG
ESG_CONTR	Company's ESG Controversies Score	Explanatory variable	LSEG
ENV	Company's environmental score	Explanatory variable	LSEG
GOV	Company's governance score	Explanatory variable	LSEG
CEO	Dummy variable associated with CEO duality, taking the value 1 if the CEO also acts as the Board Chair, and 0 if the roles are distinct.	Explanatory variable	LSEG
GENDER	Percentage of women in the board's company	Explanatory variable	LSEG
ASSET	Company's total assets (variable defined in <i>ln</i>)	Control variable	LSEG
EQUITY	Company's total debt to equity	Control variable	LSEG
CASH	Company's ratio of cash to total assets	Control variable	LSEG
ROA	Company's Return on Assets	Control variable	LSEG

Notes: This table defines all variables included in the empirical models, specifying their roles (dependent, explanatory, or control variables) and corresponding data sources. ESG and financial variables are obtained from LSEG, while environmental penalties are sourced from Violation Tracker.

3.2. Logistic regression models

To test the proposed hypotheses, logistic regression models were employed to examine the probability of a firm receiving an environmental penalty. The study tested six models with specific configurations. Specifically, four models will be tested to examine the general ESG hypotheses (H1, H2, H3a, and H4), and two models will be tested to examine the specific governance hypotheses (H3b and H3c).

PENALTY_t = α + ESG_{t-1} + ∑ ControlVariables_{t-1} + γ_j (1)

PENALTY_t = α + ENV_{t-1} + ∑ ControlVariables_{t-1} + γ_j (2)

PENALTY_t = α + ENV_CONTR_{t-1} + ∑ ControlVariables_{t-1} + γ_j (3)

PENALTY_t = α + GOV_{t-1} + ∑ ControlVariables_{t-1} + γ_j (4)

PENALTY_t = α + CEO_{t-1} + ∑ ControlVariables_{t-1} + γ_j (5)

PENALTY_t = α + GENDER_{t-1} + ∑ ControlVariables_{t-1} + γ_j (6)

Control variables include total assets, cash to assets, equity and ROA. All explanatory variables are lagged by one year relative to the year in which the firm received the environmental sanction. This approach ensures the correct causal ordering and mitigates potential endogeneity concerns. The sector-specific fixed effect

is denoted by γ_j . These factors were chosen because they can influence the results of the regressions and are essential to isolate the specific impact of ESG, Environmental and Governance scores. Several studies have shown that the number of penalties and their impact vary depending on the size of the company and its financial strength. For example, Xia *et al.* (2024) show that larger companies tend to receive higher penalties, both due to their greater visibility and available resources, which make them more vulnerable to regulatory violations. Furthermore, Romero *et al.* (2018) point out that sanctioned companies suffer negative impacts on profits and earnings due to environmental penalties, thus making it necessary to consider variables that may directly influence company performance.

Furthermore, given the assumptions presented in Sec. 2, we also take into account the interaction between gender and CEO duality factors.

$$\begin{aligned} \text{PENALTY} = & \alpha + \text{CEO}_{t-1} + \text{GENDER}_{t-1} + \text{INTER}_{t-1} \\ & + \sum \text{ControlVariables}_{t-1} + \gamma_j \end{aligned} \quad (7)$$

where the variables CEO and GENDER interact to form INTER.

4. Results and Discussions

4.1. Logistic regression

Table 4 presents the results of the logistic regression models used to analyze the effect of scores on the probability of a company receiving environmental penalties. The models include sector-fixed effects, allowing us to control for sector-specific differences.

In model 1 of Table 4, the ESG score shows a negative and statistically significant coefficient, supporting hypothesis H1. This indicates that a higher ESG score is associated with a lower probability of receiving environmental penalties. Among the control variables, such as cash to assets, are not statistically significant, suggesting a marginal or zero impact of these variables on the probability of penalties. However, firm size (total assets) has a positive and highly significant effect, highlighting that larger firms have a higher probability of receiving penalties. This is consistent with the greater visibility and complexity of large firms, which may attract stricter regulatory scrutiny. Conversely, variables such as debt equity and cash to assets are not statistically significant, implying a marginal or unimportant impact on the likelihood of penalties. Model 2 of Table 4 examines the effect of the Environmental Score. The negative and highly significant coefficient supports hypothesis H2, demonstrating that firms with higher Environmental Scores are less likely to receive penalties. Additionally, the cash-to-assets ratio becomes significant, suggesting that firms with greater liquidity may allocate resources more effectively to environmental compliance. Firm size remains positively significant, reiterating its influence as a determinant of penalty probability. Model 3 results focus on the ESG Controversies Score. The coefficient is negative and marginally significant, indicating that higher

Table 4. Logistic regression results — ESG dimensions and penalty risk.

VARIABLES	(1) PENALTY	(2) PENALTY	(3) PENALTY	(4) PENALTY
ESG _{t-1}	-0.0154*** (0.00380)			
ENV _{t-1}		-0.00737*** (0.00270)		
ESG_CONTR _{t-1}			-0.00338* (0.00205)	
GOV _{t-1}				-0.00559* (0.00296)
ROA _{t-1}	0.0105 (0.00958)	0.0105 (0.00954)	0.00953 (0.00946)	0.00920 (0.00945)
ASSET _{t-1}	0.576*** (0.108)	0.499*** (0.107)	0.313*** (0.0903)	0.383*** (0.0926)
EQUITY _{t-1}	4.58e-05 (4.48e-05)	4.39e-05 (4.51e-05)	3.91e-05 (4.50e-05)	4.42e-05 (4.47e-05)
CASH _{t-1}	-1.746 (1.133)	-2.040* (1.134)	-2.565** (1.120)	-2.337** (1.124)
CONSTANT	-13.57*** (2.500)	-12.21*** (2.528)	-7.921*** (2.239)	-9.519*** (2.216)
Observations	8260	8260	8261	8260
Sector Fixed effect	yes	yes	yes	yes
Wald chi2	129.79	129.99	121.49	121.79
Prob > chi2	0.000	0.000	0.000	0.000
Number of id	502	502	502	502

Notes: This table presents the results of logistic regressions estimating the probability of a firm receiving an environmental penalty as a function of ESG, Environmental, Governance, and ESG Controversies Scores. All models include sector fixed effects and control for firm size, leverage, liquidity, and profitability. Wald chi2 confirms model significance. Standard errors in parentheses *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

controversy scores are associated with a slightly reduced likelihood of penalties, reflecting the expectations of H4. This could reflect a potential signal in the model of how controversies are managed and perceived. Firm size retains its positive and significant relationship with penalties, while cash to assets continues to exhibit significance. Model 4 is consistent with hypothesis H3a. This finding suggests that stronger governance practices reduce the likelihood of receiving environmental penalties. Similar to the previous models, cash gains significance, and total assets continue to positively influence the probability of penalties.

All results are confirmed by the significant Wald chi2, underscoring the relevance of the explanatory variables in predicting the likelihood of penalties.

The results across all models underscore the importance of ESG dimensions in mitigating regulatory risk. Both environmental and governance scores exhibit negative associations with the likelihood of environmental penalties, highlighting the crucial role of ESG practices. Firm size emerges as a significant predictor, emphasizing the heightened regulatory exposure of larger firms. The cash-to-assets ratio

has emerging significance in Models 2, 3, and 4, which suggests that liquidity potentially facilitates regulatory compliance in order to reduce the risk of penalties. These findings align with theoretical frameworks such as signaling theory, stakeholder theory, and legitimacy theory. Higher ESG scores signal a firm’s commitment to sustainability, improving stakeholder trust and reducing regulatory scrutiny. The results suggest that firms should prioritize improvements in specific ESG dimensions — particularly environmental and governance components — to mitigate penalty risks. Moreover, larger firms, given their visibility, must adopt more robust compliance mechanisms to manage their exposure to regulatory risks.

Table 5 presents a logistic regression on the likelihood of environmental penalties. The models incorporate key variables such as CEO duality, board gender diversity, and their interaction.

In model 1, CEO duality shows a positive and marginally significant coefficient, confirming H3b. This suggests that firms where the CEO also serves as the board chair may face a higher probability of receiving penalties, potentially reflecting weaker governance in such a structure. Among the control variables, total assets are

Table 5. Logistic regression results — governance characteristics and penalties.

VARIABLES	(1) PENALTY	(2) PENALTY	(3) PENALTY
CEO _{<i>t</i>-1}	0.182* (0.110)		0.683*** (0.169)
GENDER _{<i>t</i>-1}		-0.00710 (0.00439)	0.00165 (0.00675)
INTER _{<i>t</i>-1}			-0.0289*** (0.00931)
ROA _{<i>t</i>-1}	0.00627 (0.00755)	0.00695 (0.00757)	0.00585 (0.00759)
ASSET _{<i>t</i>-1}	0.224*** (0.0666)	0.290*** (0.0711)	0.303*** (0.0725)
EQUITY _{<i>t</i>-1}	4.98e-05 (4.01e-05)	4.95e-05 (3.99e-05)	5.41e-05 (3.95e-05)
CASH _{<i>t</i>-1}	-2.404** (0.968)	-2.056** (0.967)	-2.300** (0.986)
CONSTANT	-6.492*** (1.676)	-7.823*** (1.761)	-8.321*** (1.794)
Observations	11,257	11,257	11,257
Sector Fixed Effect	yes	yes	yes
Wald chi2	122.31	122.59	136.70
Prob > chi2	0.0000	0.000	0.0000
Number of id	503	503	503

Notes: This table reports the estimated coefficients from logistic regressions assessing the impact of governance characteristics — namely, CEO duality, board gender diversity, and their interaction — on the likelihood of receiving an environmental penalty. Control variables and sector fixed effects are included in all specifications. Wald chi2 confirms model significance. Standard errors in parentheses *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

positive and highly significant, reiterating that larger firms are more visible and thus subject to greater regulatory scrutiny. The cash is negative and significant, indicating that firms with higher liquidity are better at managing regulatory risks. Other variables, such as ROA and debt equity, are not significant and suggest limited direct influence on the likelihood of penalties. Model 2 examines the role of board gender diversity. While the coefficient for board gender diversity is negative, it is not statistically significant. This indicates that, in isolation, gender diversity on the board doesn't significantly influence the probability of penalties. The results for firm size and cash to assets remain consistent with Model 1, highlighting their impact on penalty risk. Model 3 introduces an interaction variable between CEO duality and board gender diversity. The interaction coefficient is negative and highly significant, suggesting that the presence of gender diverse boards mitigates the adverse effects of CEO duality on penalty likelihood. This finding underscores the importance of diverse governance structures in balancing potential weaknesses associated with concentrated leadership roles. The coefficient for CEO duality becomes significant, while board gender diversity remains non-significant, indicating that the interaction effect is a driver in this model.

In these regression models, the results are also confirmed by the significance of the Wald chi2, highlighting the relevance of the explanatory variables in predicting the likelihood of penalties.

The results highlight the critical role of governance characteristics in shaping regulatory outcomes. CEO duality, which centralizes leadership, appears to increase the probability of receiving penalties, possibly due to reduced independence. However, the mitigating effect of gender diverse boards suggests that inclusive governance structures can balance this risk, reinforcing the value of board diversity as a mechanism to enhance decision-making.

Table 6. Marginal effect — ESG dimensions and penalty risk.

VARIABLES	Marginal effect (%)
ESG _{t-1}	-0.07%
ENV _{t-1}	-0.04%
ESG_CONTR _{t-1}	-0.02%
GOV _{t-1}	-0.03%
CEO _{t-1}	0.8%
INTER _{t-1}	-0.1%

Notes: Average marginal effects of ESG, environmental, controversies, and governance scores (lagged) on the probability of receiving an environmental penalty. Marginal effects are expressed in percentage points; *p*-values are reported for significance. The gender variable is not included in this table as its coefficient in the regression was not statistically significant.

Building on the results in Tables 4 and 5, Table 6 shows the average marginal effects of lagged ESG dimensions on the probability of receiving an environmental penalty. Negative marginal effects suggest that higher ESG or Environmental scores reduce the likelihood of penalties, whereas positive effects indicate an increased probability.

From a theoretical perspective, these findings align with stakeholder and legitimacy theories, emphasizing the importance of governance practices that align with society and regulatory expectations.

5. Robustness Test

To ensure the robustness of our findings, we conducted additional analyses using Generalized Method of Moments (GMM) estimation and instrumental variable (IV) approaches. These methods address potential endogeneity issues that may arise in the relationship between ESG performance and the likelihood of incurring environmental penalties.

One major worry is that, because of omitted variable bias or reverse causality, ESG metrics — which represent a company's governance and environmental practices — may be endogenous. Businesses may deliberately raise their ESG scores in anticipation of future fines, or unanticipated circumstances may have a dual impact on regulatory outcomes and ESG performance. We used a firm's total number of past punishments as an instrumental variable for ESG performance in order to address these problems.

Given their high correlation with a company's current ESG rankings, the number of historical penalties is a believable tool. Businesses that have previously violated regulations frequently respond by enacting better environmental and governance practices, which raise their ESG scores. However, the exclusion restriction condition is satisfied because past fines are unlikely to have a direct impact on present penalties outside their influence on ESG performance. The cumulative number of penalties represents the total number of regulatory violations committed by the firm up to a given point. Firms with a history of frequent violations are often induced to implement more rigorous environmental and governance practices, which eventually enhance their ESG scores.

These robustness tests enhance the credibility of our results by addressing potential endogeneity concerns. The findings reinforce the importance of promoting ESG initiatives as a means of reducing regulatory risks and improving environmental compliance.

5.1. Results

The results from the robustness tests, applied across models in Tables 4 and 5, reinforce the findings of the main analyses, demonstrating the consistency of the relationships between ESG components and environmental penalties. In these tests,

the Governance Score is excluded from analysis to focus more precisely on the specific characteristics of the other ESG dimensions. This approach allows for a more nuanced exploration of the governance dimension, ensuring that its intricate effects are captured and interpreted more effectively.

In Table 7, Model 1 confirms that the ESG score has a negative and highly significant coefficient, suggesting that higher ESG performance reduces the probability of receiving penalties. This finding underscores the long-term protective effect of ESG practices, signaling a firm’s commitment to sustainability and fostering trust among regulators. Similarly, Model 2 shows a significant negative coefficient for the environmental score, reinforcing the importance of environmental initiatives in reducing regulatory risks. This result highlights that environmental scores directly address the concerns of environmental regulators. Model 3 also supports this result, with the ESG Controversies Score showing a significant negative coefficient. Although the effect is marginal, it indicates that managing controversies effectively has a protective effect against penalties. Proactive efforts to address disputes and improve transparency mitigate the likelihood of penalties, though less strongly than overall ESG performance or environmental initiatives. Control variables also provide additional insights into the drivers of environmental penalties. Firm size consistently shows a positive association with penalties, reflecting heightened scrutiny of larger

Table 7. Robustness checks — ESG dimensions using GMM and IV estimation.

VARIABLES	(1) PENALTY	(2) PENALTY	(3) PENALTY
ESG	−0.00408*** (0.000452)		
ENV		−0.00256*** (0.000307)	
ESG_CONTR			−0.000862*** (0.000173)
ROA	0.00580*** (0.00202)	0.00409* (0.00230)	−0.00603*** (0.00192)
ASSET	0.219*** (0.0122)	0.247*** (0.0125)	0.113*** (0.00771)
EQUITY	−0.000135*** (1.90e−05)	−0.000115*** (2.17e−05)	−2.51e−05 (1.56e−05)
CASH	−1.342*** (0.213)	−2.016*** (0.251)	−3.008*** (0.208)
CONSTANT	−4.738*** (0.284)	−5.425*** (0.300)	−2.173*** (0.193)
Observations	8260	8260	8261
Number of id	502	502	502

Notes: This table displays results from robustness tests using Generalized Method of Moments (GMM) and instrumental variable (IV) estimations to address potential endogeneity in the relationship between ESG scores and environmental penalties. Past penalties are used as instruments for ESG performance. Standard errors in parentheses *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

firms. Debt-to-equity ratios are negatively associated with penalties, albeit with a small effect, likely indicating that leveraged firms prioritize compliance to maintain creditor confidence. Lastly, cash-to-assets ratios significantly reduce penalty risks, as firms with greater financial flexibility can allocate resources effectively to ensure compliance.

Turning into a governance-specific model, CEO duality is associated with a positive and significant coefficient, indicating that firms with combined CEO and chairperson roles face higher penalty probabilities due to weaker oversight. By contrast, board gender diversity has a significant negative coefficient, highlighting its role in reducing penalty risks through stronger governance and decision-making (Table 8).

A relevant result is the significant negative coefficient for the interaction term, showing that diverse boards mitigate the adverse effects of CEO duality on regulatory outcomes. This finding underscores the importance of inclusive governance structures in balancing leadership concentration and fostering better compliance outcomes.

Table 8. Robustness checks — governance-specific models with GMM and IV.

VARIABLES	(1) PENALTY	(2) PENALTY	(3) PENALTY
CEO	0.0569*** (0.00708)		0.103*** (0.0142)
GENDER		−0.00239*** (0.000423)	0.000421 (0.000672)
INTER			−0.00648*** (0.000909)
ROA	−0.000492 (0.00168)	−0.00287* (0.00159)	−0.00359** (0.00164)
ASSET	0.102*** (0.00572)	0.0675*** (0.00567)	0.0788*** (0.00584)
EQUITY	−9.17e−05*** (1.46e−05)	−9.26e−05*** (1.46e−05)	−9.37e−05*** (1.46e−05)
CASH	−1.357*** (0.182)	−1.560*** (0.176)	−1.334*** (0.180)
CONSTAT	−2.146*** (0.144)	−1.256*** (0.139)	−1.562*** (0.144)
Observations	11,257	11,257	11,257
Number of id	503	503	503

Notes: This table provides robustness results for governance-specific models using GMM and IV techniques. It evaluates the effect of CEO duality, board gender diversity, and their interaction on penalty likelihood, while addressing possible endogeneity concerns. Standard errors in parentheses *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

The robustness tests confirm the stability of key relationships identified in the main models, while also providing deeper insights into the nuanced effects of ESG and governance variables.

6. Conclusions

In addition to moral issues, adopting sustainable practices has become essential to a business's ability to compete and survive. Reducing environmental impact is crucial, as evidenced by growing stakeholder demand and legislative frameworks like the US Clean Air Act. Notwithstanding the expenses of regulatory compliance, financial penalties for non-compliance serve as powerful deterrents, encouraging businesses to embrace environmentally friendly practices.

The results show that ESG performance has important policy ramifications, especially when it comes to forecasting environmental fines. A company's dedication to sustainable practices and efficient risk management is demonstrated by high ESG scores, particularly in the environmental and governance areas. Using this information, policymakers can create regulatory frameworks that penalize non-compliance and encourage sustainability, for example, by offering tax exemptions or subsidies to businesses with high ESG ratings.

The findings also imply that governance frameworks, such as diverse boards and independent leadership, are essential for reducing regulatory risks. Mandatory gender diversity quotas or improved transparency standards are two examples of initiatives that could strengthen corporate accountability and resilience by promoting inclusive governance.

Due to their visibility and environmental footprint, large corporations face heightened regulatory exposure, necessitating tailored oversight and sector-specific policies. This emphasizes the necessity of customized rules that take into account the intricacies of bigger enterprises. Strict oversight combined with industry-specific rules for high-emission sectors can guarantee adherence while encouraging greener alternatives.

Furthermore, it is clear how crucial stakeholder participation is to promoting company sustainability. In addition to protecting against fines from the government and harm to one's reputation, strong ESG performance frequently improves stakeholder relationships. Promoting public-private partnerships and stakeholder involvement in environmental policy could help businesses and society align their objectives and hasten sustainable economic development.

Although these policy suggestions provide a way forward, structural problems like inconsistent regulatory enforcement and greenwashing need to be addressed. Transparency and accountability should be given top priority in future regulations to guarantee that ESG measures accurately represent sustainable activities rather than being used as a cover for non-compliance.

One of the study's potential limitations is that focusing solely on environmental fines may not adequately capture broader regulatory or reputational repercussions.

In addition, the analysis does not distinguish between penalties of different magnitudes, treating minor infractions and large sanctions in the same way. This simplification may obscure the true impact of regulatory exposure. Future research could refine this approach by incorporating measures that reflect the relative weight of violations, thereby offering a more nuanced picture of how ESG practices relate to regulatory outcomes. Further studies should look at how governance characteristics and ESG practices affect a company's success over the long run in various regulatory contexts. By verifying that the results are consistent, robustness tests increase the credibility of the findings.

ORCID

Daniela Lo Cascio  <https://orcid.org/0009-0002-8846-2260>

Mauro Aliano  <https://orcid.org/0000-0002-7917-1405>

References

- P. Agnese, F. Battaglia, F. Busato & S. Taddeo (2023) ESG controversies and governance: Evidence from the banking industry, *Finance Research Letters* **53**, 103397, doi: 10.1016/j.frl.2022.103397.
- F. A. Almaqtari, T. Elsheikh, H. M. Al-Hattami & N. Mishra (2023) The impact of board characteristics on environmentally friendly production: A cross country study in Asia and Europe, *Journal of Cleaner Production* **392**, 136257, doi: 10.1016/j.jclepro.2023.136257.
- N. Bahadori, T. Kaymak & M. Seraj (2021) Environmental, social, and governance factors in emerging markets: The impact on firm performance, *Business Strategy & Development* **4**(4), 411–422, doi: 10.1002/bsd2.167.
- J. Bang, D. Ryu & R. I. Webb (2023) ESG controversy as a potential asset-pricing factor, *Finance Research Letters* **58**, 104315, doi: 10.1016/j.frl.2023.104315.
- E. B. Barbier (2017) *The Economics of Sustainability*. Routledge.
- Md. B. U. Bhuiyan, H. J. Huang & C. De Villiers (2021) Determinants of environmental investment: Evidence from Europe, *Journal of Cleaner Production* **292**, 125990, doi: 10.1016/j.jclepro.2021.125990.
- A. Buallay (2019) Is sustainability reporting (ESG) associated with performance? Evidence from the European banking sector, *Management of Environmental Quality: An International Journal* **30**(1), 98–115, doi: 10.1108/MEQ-12-2017-0149.
- T. Busch, M. P. Johnson & M. Schnippering (2022) A change will do you good: Does continuous environmental improvement matter?, *Organization & Environment* **35**(4), 551–578, doi: 10.1177/10860266221107648.
- X. Chen, X. Huang & H. Yan (2025) Environmental penalties and financing punishment: Evidence from incremental bank loans, *Emerging Markets Finance and Trade* **61**(1), 94–109, doi: 10.1080/1540496X.2024.2377994.
- L. Chiamonte, A. Dreassi, C. Girardone & S. Piserà (2022) Do ESG strategies enhance bank stability during financial turmoil? Evidence from Europe, *The European Journal of Finance* **28**(12), 1173–1211, doi: 10.1080/1351847X.2021.1964556.
- S. Chouaibi, J. Chouaibi & M. Rossi (2022) ESG and corporate financial performance: The mediating role of green innovation: UK common law versus Germany civil law, *Euro-Med Journal of Business* **17**(1), 46–71, doi: 10.1108/EMJB-09-2020-0101.

- A. F. Cicchiello, M. Cotugno & C. Foroni (2023) Does competition affect ESG controversies? Evidence from the banking industry, *Finance Research Letters* **55**, 103972, doi: 10.1016/j.frl.2023.103972.
- Clean Air Act (2013) 42 U.S.C. §7401. <https://www.congress.gov/crs-product/RL30853>.
- B. L. Connelly, D. J. Ketchen & S. F. Slater (2011) Toward a “theoretical toolbox” for sustainability research in marketing, *Journal of the Academy of Marketing Science* **39**(1), 86–100, doi: 10.1007/s11747-010-0199-0.
- D. Darsono, D. Ratmono, S. Lee, N. Cahyonowati & L. Lianawati (2024) ESG and environmental performance: Multiple mediation models of green accounting and CSR disclosure, *International Journal of Energy Economics and Policy* **14**(5), 365–371, doi: 10.32479/ijeeep.16682.
- M. A. Delmas & V. C. Burbano (2011) The drivers of greenwashing, *California Management Review* **54**(1), 64–87, doi: 10.1525/cmr.2011.54.1.64.
- Y. Fernández-Torres, C. Gallego-Sosa & M. Gutiérrez-Fernández (2025) Do women board members contribute to companies’ superior environmental performance? A literature review, *Review of Managerial Science* **19**(5), 1513–1565, doi: 10.1007/s11846-024-00800-x.
- J. M. Ford, S. A. Gehricke & J. E. Zhang (2022) Option traders are concerned about climate risks: ESG ratings and short-term sentiment, *Journal of Behavioral and Experimental Finance* **35**, 100687, doi: 10.1016/j.jbef.2022.100687.
- B. Foulon & S. Marsat (2023) Does environmental footprint influence the resilience of firms facing environmental penalties?, *Business Strategy and the Environment* **32**(8), 6154–6168, doi: 10.1002/bse.3478.
- R. E. Freeman (2010) *Strategic Management: A Stakeholder Approach*, first edition. Cambridge University Press, doi: 10.1017/CBO9781139192675.
- C. Gaganis, E. Galariotis, F. Pasiouras & M. Tasiou (2023) Managerial ability and corporate greenhouse gas emissions, *Journal of Economic Behavior & Organization* **212**, 438–453, doi: 10.1016/j.jebo.2023.05.044.
- L. C. Garcia & A. Fonseca (2018) The use of administrative sanctions to prevent environmental damage in impact assessment follow-ups, *Journal of Environmental Management* **219**, 46–55, doi: 10.1016/j.jenvman.2018.04.112.
- L. Gatti, M. Pizzetti & P. Seele (2021) Green lies and their effect on intention to invest, *Journal of Business Research* **127**, 228–240, doi: 10.1016/j.jbusres.2021.01.028.
- L. Gu, Y. Peng, S. A. Vigne & Y. Wang (2023) Hidden costs of non-green performance? The impact of air pollution awareness on loan rates for Chinese firms, *Journal of Economic Behavior & Organization* **213**, 233–250, doi: 10.1016/j.jebo.2023.07.014.
- A. A. Gull, M. Atif & N. Hussain (2023) Board gender composition and waste management: Cross-country evidence, *The British Accounting Review* **55**(1), 101097, doi: 10.1016/j.bar.2022.101097.
- A. Habib & M. B. U. Bhuiyan (2017) Determinants of monetary penalties for environmental violations, *Business Strategy and the Environment* **26**(6), 754–775, doi: 10.1002/bse.1947.
- A. M. Habib & N. Mourad (2024) The influence of environmental, social, and governance (ESG) practices on US firms’ performance: Evidence from the coronavirus crisis, *Journal of the Knowledge Economy* **15**(1), 2549–2570, doi: 10.1007/s13132-023-01278-w.
- F. Hampl & D. Vágnerová Linnertová (2024) How do ESG controversies moderate the nexus between ESG performance and cost of capital? Evidence from European listed companies, *Managerial Finance* **50**(10), 1727–1746, doi: 10.1108/MF-12-2023-0762.

- G. Huang, F. Ye, Y. Li, L. Chen & M. Zhang (2023) Corporate social responsibility and bank credit loans: Exploring the moderating effect of the institutional environment in China, *Asia Pacific Journal of Management* **40**(2), 707–742, doi: 10.1007/s10490-021-09800-x.
- A. Kuo, D. Chien & M. Kao (2024) Interplay of national and firm environmental, social, and governance performances: Reshaping multinational enterprises' employer attractiveness across home and host countries, *Corporate Social Responsibility and Environmental Management* **31**(6), 5938–5953, doi: 10.1002/csr.2899.
- Q. L. Kweh, I. W. K. Ting, C. Ren & J. Asif (2024) How do environmental, social and governance initiatives and controversies explain the firm efficiency of Chinese energy companies?, *Kybernetes*, **53**, 103397, doi: 10.1108/K-12-2023-2704.
- J.-Y. Liu, Q. Lei, R. Li & Y.-J. Zhang (2024) Resistance or motivation? Impact of climate risk on corporate greenwashing: An empirical study of Chinese enterprises, *Global Finance Journal* **62**, 101030, doi: 10.1016/j.gfj.2024.101030.
- I. Mallidis, G. Giannarakis & N. Sariannidis (2024) Impact of board gender diversity on environmental, social, and ESG controversies performance: The moderating role of United Nations Global Compact and ISO, *Journal of Cleaner Production* **444**, 141047, doi: 10.1016/j.jclepro.2024.141047.
- M. C. Minutolo, W. D. Kristjanpoller & J. Stakeley (2019) Exploring environmental, social, and governance disclosure effects on the S&P 500 financial performance, *Business Strategy and the Environment* **28**(6), 1083–1095, doi: 10.1002/bse.2303.
- S. Park, S. Choi & E. Kim (2012) The relationships between socio-demographic variables and concerns about environmental sustainability, *Corporate Social Responsibility and Environmental Management* **19**(6), 343–354, doi: 10.1002/csr.284.
- J. A. Romero, M. Freedman & N. G. O'Connor (2018) The impact of Environmental Protection Agency penalties on financial performance, *Business Strategy and the Environment* **27**(8), 1733–1740, doi: 10.1002/bse.2239.
- E. Schoonjans (2024) From diversity to sustainability: Environmental and social spillover effects of board gender quotas, *Journal of Economic Behavior & Organization* **222**, 314–331, doi: 10.1016/j.jebo.2024.04.026.
- Y. Shahab, A. A. Gull, A. A. Rind, A. A. Alias Sarang & T. Ahsan (2022) Do corporate governance mechanisms curb the anti-environmental behavior of firms worldwide? An illustration through waste management, *Journal of Environmental Management* **310**, 114707, doi: 10.1016/j.jenvman.2022.114707.
- A. Shevchenko (2021) Do financial penalties for environmental violations facilitate improvements in corporate environmental performance? An empirical investigation, *Business Strategy and the Environment* **30**(4), 1723–1734, doi: 10.1002/bse.2711.
- M. Spence (1973) Job market signaling, *The Quarterly Journal of Economics* **87**(3), 355, doi: 10.2307/1882010.
- Y. Sun, J. Gao, W. Wu & S. Liu (2025) ESG performance and corporate fraud: Evidence based on the MOE framework, *International Review of Financial Analysis* **97**, 103807, doi: 10.1016/j.irfa.2024.103807.
- W. Sun, Y. Luo, S.-M. Yiu, L. Yu & W. Ding (2024) ESG scores, scandal probability, and event returns, *Financial Innovation* **10**(1), 121, doi: 10.1186/s40854-024-00635-1.
- J. Tagliatalata, I. Miroshnychenko, R. Barontini & F. Testa (2024) Talk or walk? The board of directors and firm environmental strategies, *Business Strategy and the Environment* **33**(4), 2890–2910, doi: 10.1002/bse.3628.
- N. Tamimi & R. Sebastianelli (2017) Transparency among S&P 500 companies: An analysis of ESG disclosure scores, *Management Decision* **55**(8), 1660–1680, doi: 10.1108/MD-01-2017-0018.

- G. Z. Tian & J. Yae (2024) Unintended consequences of punishment: Adverse effects of environmental penalties on green patents, *Research in International Business and Finance* **70**, 102281, doi: 10.1016/j.ribaf.2024.102281.
- A. Van Niekerk (2020) Inclusive economic sustainability: SDGs and global inequality, *Sustainability* **12**(13), 5427, doi: 10.3390/su12135427.
- P. Velte (2024) Sustainable board governance and environmental performance: European evidence, *Business Strategy and the Environment* **33**(4), 3397–3421, doi: 10.1002/bse.3654.
- A. Wang, L. Si & S. Hu (2023) Can the penalty mechanism of mandatory environmental regulations promote green innovation? Evidence from China's enterprise data, *Energy Economics* **125**, 106856, doi: 10.1016/j.eneco.2023.106856.
- Z. Wang, H. Sun, C. Ding & X. Zhang (2024) Does public environmental concern cause pollution transfer? Evidence from Chinese firms' off-site investments, *Journal of Cleaner Production* **466**, 142825, doi: 10.1016/j.jclepro.2024.142825.
- F. Xia, Y. Hua & B. Zhang (2024) Does non-compliance pay? Environmental violations and share prices in China, *Corporate Social Responsibility and Environmental Management* **31**(3), 1886–1904, doi: 10.1002/csr.2672.
- K. Xing, F. Yang, P. Liu, J. Wang & J. Wu (2025) Environmental violations and financial distress risk: Evidence from Chinese listed heavily polluting companies, *Pacific-Basin Finance Journal* **89**, 102583, doi: 10.1016/j.pacfin.2024.102583.
- X. Xu & C. Zhang (2024) How does stock market react to environmental penalty announcements?, *Environmental Science and Pollution Research* **31**(29), 41873–41892, doi: 10.1007/s11356-024-33805-w.
- R. Xue, H. Wang, Y. Yang, M. K. Linnenluecke, K. Jin & C. W. Cai (2023) The adverse impact of corporate ESG controversies on sustainable investment, *Journal of Cleaner Production* **427**, 139237, doi: 10.1016/j.jclepro.2023.139237.
- H. Zhang & J. Lai (2024) Greening through ESG: Do ESG ratings improve corporate environmental performance in China?, *International Review of Economics & Finance* **96**, 103726, doi: 10.1016/j.iref.2024.103726.
- K. Zhang & W. Li (2024) Environmental regulations and charitable donations made by polluting companies: Evidence from China, *International Review of Economics & Finance* **93**, 1248–1267, doi: 10.1016/j.iref.2024.03.055.
- D. Zhang, Z. Zhang, Q. Ji, B. Lucey & J. Liu (2021) Board characteristics, external governance and the use of renewable energy: International evidence, *Journal of International Financial Markets, Institutions and Money* **72**, 101317, doi: 10.1016/j.intfin.2021.101317.
- J. Zheng, M. Ghorbani, Y. Yan & Y. Cao (2024) Signals from CSR competition: The influence of relative CSR performance on analysts' recommendations, *The British Accounting Review* **56**(5), 101298, doi: 10.1016/j.bar.2023.101298.
- P. Zhou, X. Huang & F. M. Song (2024a) The deterrent effect of environmental judicature on firms' pollution emissions: Evidence from a quasi-natural experiment in China, *China Economic Review* **88**, 102291, doi: 10.1016/j.chieco.2024.102291.
- K. Zhou, Z. Qu, J. Liang, Y. Tao & M. Zhu (2024b) Threat or shield: Environmental administrative penalties and corporate greenwashing, *Finance Research Letters* **61**, 105031, doi: 10.1016/j.frl.2024.105031.