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RESEARCH ARTICLE

Revisiting the Default Risk-ESG Relationship: New Evidence in European Markets

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ABSTRACT

This study investigates the impact of Environmental, Social, and Governance (ESG) initiatives on corporate default risk, utilizing a panel dataset of non-financial firms across 20 European countries from 2008 to 2022. While previous research has predominantly explored the relationship between ESG practices and firm value, the link between ESG dimensions and corporate risk remains underexamined. Using the Generalized Method of Moments (GMM) approach, our findings reveal a statistically significant negative relationship between ESG initiatives and default risk, particularly in industries with low environmental impact. We also uncover a novel non-linear relationship between financial transparency, a key component of governance, and default risk, where moderate levels of transparency minimize insolvency risk. The study provides new empirical insights, highlighting the importance of ESG initiatives in corporate risk management, particularly in enhancing access to capital and fostering long-term financial stability. Additionally, the research carries key policy implications for regulators, investors, and corporate managers, emphasizing the importance of robust sustainability frameworks and transparent governance practices.

JEL Classification: G32, M14

1 | Introduction

In today's global landscape, marked by challenges such as environmental sustainability and social responsibility, business as usual is no longer viable. Companies must adopt responsible management practices (Khan 2022; Vivel-Búa et al. 2024). This responsibility extends beyond sustainability initiatives to include the effective management of corporate risks, which is essential for ensuring long-term firm success and continuity (Agnese et al. 2023; Capelli et al. 2021).

While significant research has explored how ESG (Environmental, Social, and Governance) initiatives affect firm value (Plumlee et al. 2015; Sharma and Song 2018), the link between ESG efforts and corporate default risk remains underexamined, as strongly supported by the recent meta-analysis of Singhania and Gupta (2024). Despite not being directly tied to financial outcomes, ESG dimensions are increasingly influential in business management and investment decisions (Agnese et al. 2023). According to legitimacy theory, ESG disclosures can enhance a company's public image, thereby increasing its value and potentially lowering perceived risk (Cheng et al. 2014; El Ghoul et al. 2011).

A key aspect of this value-creation process is the relationship between ESG initiatives and corporate default risk, which directly impacts the cost of capital (Bansal and Clelland 2004). As corporate risk is a crucial determinant of the cost of capital, understanding how ESG efforts mitigate default risk is essential (Vivel-Búa et al. 2024). This study focuses specifically on default risk, rather than other forms of risk, due to its relevance in waves of corporate defaults and its broader implications for national economic growth and financial stability—key concerns for policymakers and economists (Maquieira et al. 2024).

This study examines the impact of ESG initiatives on corporate risk, using data from European companies in 20 countries between 2008 and 2022. Responding to calls for further research (Khan 2022; Li et al. 2022), it offers several contributions. First, it broadens the scope of existing literature. Unlike prior studies such as Li et al. (2022) and Pistolesi and Teti (2024), which focus on single-country analyses, this study adopts a multi-country approach tailored to the European context. Similarly, earlier studies like Peiró-Signes and Segarra-Oña (2013) for the US or Korinth and Lueg (2022) for Germany, have largely been restricted to single-country analyses. Even studies focused on the Eurozone, such as Sassen et al. (2016), have often failed to contextualize their research hypotheses or to account for critical features of the European regulatory system. These limitations restrict the ability of researchers to establish unidirectional hypotheses and to control for cross-country variations—gaps this study aims to address. Moreover, governments worldwide are increasingly addressing environmental challenges, with the European Union at the forefront through initiatives like the Corporate Sustainability Reporting Directive (Directive (EU) 2024/1760), which mandates companies to disclose their environmental, social, and governance impacts (Oberthür and Dupont 2021; Tao et al. 2022). This makes the European institutional context particularly suitable for a study of this nature, as the availability of information and the EU's prioritization of ESG issues enable practical policy implications to be drawn and implemented more effectively than in regions where ESG matters receive less emphasis.

Second, this study employs the Generalized Method of Moments (GMM) for panel data, incorporating tests for nonlinear and non-monotonic relationships that previous studies (e.g., Li et al. (2022); Pistolesi and Teti (2024); Vivel-Búa et al. (2024)) have overlooked. Third, it addresses the issue of omitted variables found in prior research (Maquieira et al. 2024) by applying a three-way fixed-effects model (individual, time, and country) and rigorously controlling for governance factors.

Fourth, unlike previous literature in the European context (e.g., Sassen et al. 2016) that focuses on the total, systematic, and idiosyncratic risk, this study specifically examines the relationship between ESG investment and default risk, a more direct measure of financial stability. Default risk, reflecting a firm's ability to meet financial obligations, is of particular practical importance to creditors and lenders and carries more immediate implications than other risk types (Capelli et al. 2021; Maquieira et al. 2024). Moreover, default risk is both more measurable and consequential in terms of financial stability than total, systematic, or idiosyncratic risks; in cases of bankruptcy, the repercussions extend beyond the corporate sector to the labor market and broader economy (Löffler 2004). Hence, this study pays attention to a more relevant and contingent source of risk.

Fifth, while previous studies (e.g., Di Tommaso and Thornton (2020); Li et al. (2022); Maquieira et al. (2024); Nirino et al. (2022); Pistolesi and Teti (2024), among others) have demonstrated that the governance pillar of the ESG index typically has a weak or statistically insignificant impact on risk, weak governance practices can also obscure financial reporting, leading to inaccurate risk assessments and a higher likelihood of corporate default. To address this paradox, this study delves deeper into the governance pillar's impact on default risk. By incorporating transparency and earnings quality into the analysis, the study offers a more detailed evaluation of the governance pillar score—an approach that has not yet been explored in the literature.

Finally, this study aligns with global priorities by addressing select United Nations Sustainable Development Goals (SDGs). Specifically, it contributes to SDG 8 on decent work and economic growth by showing how ESG practices mitigate default risk, thereby promoting sustainable economic growth. Similarly, SDG 9 on industry, innovation, and infrastructure is addressed by analyzing how various industries interact with ESG principles to manage risk, highlighting the importance of sustainable operations. Furthermore, this study supports SDG 13 on climate action by showing how low-impact environmental industries can leverage ESG for risk management, while SDG 16 on peace, justice, and strong institutions is addressed through a focus on governance and accountability, underlining their role in stabilizing financial markets.

Our findings provide compelling evidence of a negative relationship between ESG initiatives and firm risk, both statistically and economically. This effect is particularly strong in industries with low environmental impact, where ESG investments more effectively reduce risk. In contrast, in high-impact industries, the relationship between ESG scores and default risk is more complex, with limited evidence of risk mitigation. These results suggest that industry-specific factors significantly influence the effectiveness of ESG practices. Additionally, our findings address specification errors commonly observed in the literature regarding the governance pillar by incorporating financial transparency metrics into the analysis. The results reveal that both insufficient and excessive transparency can elevate insolvency risk—either by obscuring critical risks or by exposing too much sensitive information, which may provoke overreactions from investors and creditors. Different from previous studies (Sassen et al. 2016), ours considers the particularities of the European zone. We do so by controlling for country-level variables related to the regulatory framework and governance structures. Consequently, this research contributes new empirical insights and has important implications for corporate risk management and strategic decision-making.

The rest of the paper is structured as follows: Section 2 exposes the theoretical framework and the hypotheses of the study, Section 3 describes the data and methodology, Section 4 presents the empirical results, and the final section discusses the conclusions and implications of this study.

2 | Theoretical Framework and Research Hypotheses

The study of corporate risk continues to be a critical area within corporate finance, with a particular focus on corporate default risk. Investigating default risk is essential for ensuring financial stability, guiding investment decisions, and preventing systemic crises. It helps investors assess potential losses and enables firms to mitigate insolvency risks (Altman 1968; Boubaker et al. 2020). Moreover, understanding default risk is crucial for informing regulatory frameworks and shaping economic policies.

Sassen et al. (2016) also focus on the European context, but their study examines how corporate social performance influences a company's total risk, systematic risk, and idiosyncratic risk. In their analysis, total risk is measured by the firm's stock volatility, defined as the annualized standard deviation of daily returns over the previous 12 months. Systematic risk, on the other hand, reflects the company's sensitivity to changes in market returns, capturing the portion of risk explained by the stock's responsiveness to market movements (Nirino et al. 2022; Sharpe 1972). Lastly, idiosyncratic risk is driven by firm-specific factors and represents residual risk that cannot be accounted for by fluctuations in the overall market portfolio (Abu-Ghunmi et al. 2015). Examining the determinants of corporate default risk is important for several reasons. First, it identifies key factors that increase or reduce the likelihood of financial distress, allowing companies to take proactive steps in managing these risks. Second, it provides investors, creditors, and regulators with tools to assess the financial health of firms, essential for investment decisions and credit ratings. Finally, it offers insights into broader economic conditions. For example, elevated default risks can signal weaknesses in specific sectors or the economy as a whole, which can guide policymakers in designing preventive measures.

The financial literature identifies performance ratios as critical determinants of corporate default risk, offering insights into a company's proximity to insolvency. Classic models such as those of Altman (1968); Altman et al. (2013), Ohlson (1980), and Zmijewski (1984) remain foundational in corporate financial management. However, beyond these traditional factors, both internal and external elements influence default risk. Among external factors driven by the regulatory framework, environmental, social, and governance (ESG) considerations have emerged as equally important in recent years.

2.1 | ESG and Default Risk

Companies that adopt ESG practices tend to implement stronger risk management frameworks. Environmental initiatives, such as reducing emissions or increasing energy efficiency, lower exposure to regulatory penalties and litigation, thereby reducing financial uncertainty (Busch and Lewandowski 2018). In the social domain, policies promoting employee welfare, diversity, and equity improve organizational climate and productivity, strengthening operational stability (Turban and Greening 1997). Additionally, strong corporate governance fosters more transparent and responsible decision-making, mitigating risks of fraud or strategic errors that could lead to bankruptcy (Gompers et al. 2003).

Firms with high ESG ratings are often perceived as less risky by investors. Financial markets tend to reward these firms with better financing terms—such as lower interest rates or broader access to capital—because they are considered better equipped to face future challenges (Bansal and DesJardine 2014). This reduces financial burdens and, by extension, the risk of insolvency (Cheng et al. 2014). Legitimacy theory (Suchman 1995) supports this perspective, suggesting that companies embracing ESG practices align more closely with societal expectations, strengthening their institutional legitimacy. This enhanced legitimacy not only mitigates operational and reputational risks but also fosters trust among investors and lenders, significantly lowering default risk (Deegan 2002). Furthermore, ESG initiatives strengthen relationships with key stakeholders, such as customers, employees, and regulators, which are essential to maintaining operational stability. Companies that engage in socially responsible and environmentally sustainable practices are more likely to earn public trust and customer loyalty, reducing the risks associated with reputational damage or consumer boycotts. Moreover, companies that focus on employee well-being and good governance tend to attract and retain top talent, reducing turnover and fostering a productive work environment.

Beyond their perceived lower risk, firms with strong ESG performance often benefit from tangible financial advantages, such as lower borrowing costs and preferential terms from capital providers (Goss and Roberts 2011). This is especially important as many investors, particularly those with a focus on sustainable and responsible investing (SRI), now prioritize companies that demonstrate sound ESG practices. As a result, these companies enjoy improved liquidity and greater financial flexibility, making it easier for them to weather financial downturns and reduce their default risk by maintaining access to capital when needed. Additionally, firms with strong ESG credentials are more likely to receive governmental or community support during periods of financial distress, potentially helping them avoid bankruptcy (Flammer 2015).

While some literature suggests a positive relationship between ESG activities and a company's default risk (Korinth and Lueg 2022), we do not expect this to hold true in the European context. Research shows that country-level characteristics, such as institutional frameworks (e.g., political, labor, and cultural systems), significantly influence a company's ESG practices and risk exposure (Baldini et al. 2018). Another key factor is the regulatory framework and its enforcement. Unlike the developed markets such as the US (Vivel-Búa et al. 2024) or developing economies like China (He et al. 2022), Europe has a more robust regulatory regime for sustainability practices, such as the 2014 Directive 2014/95/EU, which mandates non-financial reporting (La Torre et al. 2018). Camilleri (2015) reviews the EU's regulatory principles for environmental, social, and governance disclosures, detailing various tools for financial and non-financial reporting, including the Non-Financial Reporting Directive (NFRD). Hence, the theoretical arguments as well as this directive that enhances transparency, informs investors, and mitigates market instability, lead to the intuition that ESG initiatives enhance risk management, access to financing, and stakeholder relationships, which significantly reduce a company's default risk, which supports our first hypothesis:

H1. *Better ESG performance significantly reduces a company's default risk*.

2.2 | ESG and Default Risk: Why Does the Industrial Sector Matter?

Companies with strong ESG performance typically attract more investment and experience lower financial risk, as investors increasingly prioritize sustainability (Alareeni and Hamdan 2020; Giese et al. 2019). However, the impact of ESG on bankruptcy risk varies across sectors due to differing environmental and operational challenges (Boubaker et al. 2020).

The primary, secondary, and tertiary sectors face different regulatory and market pressures that influence the effectiveness of ESG initiatives. For example, the primary sector, which deals with stricter environmental regulations and higher operational costs, often experiences greater financial strain due to these factors (Clarkson et al. 2015). In contrast, the tertiary sector benefits from growing consumer demand for sustainable business practices, making ESG initiatives more effective in improving financial stability (Bansal and DesJardine 2014; Hawn et al. 2018). Since the tertiary sector is less burdened by direct environmental challenges, ESG efforts in this sector primarily focus on social and governance improvements, leading to enhanced market perception, regulatory compliance, and financial resilience (Atz et al. 2023).

These findings consistently indicate that default risk is substantially more mitigated in companies operating in less environmentally aggressive industries. Li et al. (2022) suggest that ESG activities have less impact in extractive and manufacturing industries compared to service industries, likely due to heavier regulatory pressure. Consequently, firms seeking access to capital should increasingly consider investors' growing focus on ESG practices when making strategic decisions. So, the tertiary sector activities are less resource-intensive and produce fewer direct environmental externalities compared to those in the primary and secondary sectors. This implies that investments in environmental sustainability generate relatively higher reputational returns and incur lower costs of implementation (Croci and Petmezas 2015). Additionally, institutional investors and sustainability-oriented funds tend to overweight tertiary firms with solid ESG credentials, as these firms offer more predictable returns, lower regulatory risk, and fewer negative externalities (Giese et al. 2019). Finally, firms in the tertiary sector depend more heavily on intangible assets—such as brand equity, reputation, and consumer trust—which are particularly sensitive to perceptions of ethical and sustainable conduct (Eccles et al. 2014; Hawn et al. 2018).

In the tertiary sector, ESG initiatives often include governance reforms that directly address agency issues, improving managerial accountability and reducing the risk of financial mismanagement (Eccles et al. 2014). Governance mechanisms, such as enhanced board oversight and shareholder engagement, are particularly effective in the tertiary sector, where the focus on social and governance dimensions aligns better with shareholder interests. However, these mechanisms are less impactful in the primary sector, where environmental risks dominate. Agency theory supports the argument that ESG initiatives, particularly in governance, are more effective in reducing bankruptcy risk in the tertiary sector, as they align managerial actions with the long-term interests of shareholders.

Additionally, legitimacy theory helps explain how ESG performance impacts financial stability across sectors. In the primary sector, where environmental risks are more pronounced, companies that adopt robust environmental practices gain societal approval, enhancing their reputation and attracting investment despite the higher regulatory and operational costs (Deegan 2002). In the secondary sector, which faces both environmental and social scrutiny, integrating ESG initiatives—particularly in reducing carbon emissions and improving labor conditions—helps mitigate financial risks by aligning with regulatory requirements and consumer expectations (Clarkson et al. 2015). The tertiary sector reaps the greatest benefits from ESG initiatives, as legitimacy gained through improved governance and social responsibility strengthens stakeholder trust, leading to better access to capital and increased financial resilience (Cheng et al. 2014). Across all sectors, companies perceived as socially and environmentally responsible are more likely to receive stakeholder support during crises, reducing the risk of financial distress (Godfrey et al. 2009). This leads to the idea that the impact of ESG initiatives on reducing corporate bankruptcy risk varies across industrial sectors, with a more significant effect in the tertiary sector (less polluting) compared to the primary sector (more polluting), due to greater regulatory and market pressures in environmentally high-impact industries. This idea supports our second hypothesis:

H2. *The impact of ESG performance on reducing corporate bankruptcy risk varies across industrial sectors, with a more significant effect in the tertiary sector (less polluting) compared to the primary sector (more polluting).*

2.3 | ESG and Default Risk. Are All Pillars at the Same Level in Europe?

Firms that prioritize ESG practices are better equipped to mitigate environmental risks, such as regulatory penalties for emissions violations, which could otherwise lead to severe financial losses (Clarkson et al. 2015). Similarly, effective governance reduces the chances of fraud or managerial mismanagement, issues that can severely damage a company's reputation and investor confidence, ultimately increasing the risk of default (Giese et al. 2019). By integrating ESG into their risk management strategies, companies are better positioned to avoid operational disruptions and financial pitfalls, significantly lowering the probability of default.

Studying ESG practices in European firms is crucial due to the distinct regulatory frameworks that shape sustainability efforts across the region. European Union regulations, such as the European Green Deal[1] and the Sustainable Finance Disclosure Regulation (SFDR)[2], mandate ESG reporting and target setting, making ESG integration a legal requirement rather than a voluntary initiative (European Commission 2019). In contrast, US firms operate in a more fragmented regulatory environment, where ESG reporting remains largely voluntary and guided by frameworks such as the Global Reporting Initiative (GRI) and the Sustainability Accounting Standards Board (SASB) (Eccles et al. 2020). The stricter regulatory pressure in Europe compels companies to engage more deeply with sustainability initiatives, offering valuable insights into how compliance influences financial and operational outcomes.

Investor expectations are another key factor distinguishing European firms from their US counterparts. European institutional investors, guided by the EU taxonomy for sustainable activities, increasingly require companies to meet high ESG standards, and many investment funds are now centered around sustainability criteria (Clark et al. 2015). In contrast, responsible investing in US markets has grown but remains less pervasive. The stronger emphasis on ESG by European investors pushes companies to align with long-term sustainability goals, improving access to financing as firms that excel in ESG often enjoy lower borrowing costs and greater access to capital (Goss and Roberts 2011).

Regarding ESG scores, European firms generally outperform US companies in the environmental and social pillars. However, the governance pillar tends to be stronger in US firms, as noted by Peiró-Signes and Segarra-Oña (2013) and Kaiser (2020). From the scope of this study, the governance pillar requires separate analysis, as it has shown a more limited direct impact on default risk compared to the environmental and social pillars, particularly in areas such as transparency (Gompers et al. 2003) and earnings quality (García Lara et al. 2016). Indeed, as argued by Nirino et al. (2022), most efforts analyzing company risk focus on the social and environmental perspectives of corporate social responsibility. Along these lines, John et al. (2008) and Nirino et al. (2022) suggest that governance mechanisms can align the interests of managers and shareholders by amplifying the positive effect of corporate social responsibility outcomes, resulting in greater shareholder loyalty and lower risk. Our study tests this hypothesis.

From an agency theory perspective, ESG initiatives are key to aligning the interests of managers and shareholders, which can significantly reduce default risk. Without strong governance structures in place and without transparent disclosure of financial reports, managers (agents) may pursue short-term gains at the expense of long-term financial health, which increases risks for shareholders (principals). ESG initiatives, especially those focused on governance, introduce mechanisms like greater transparency, board oversight, and stakeholder engagement, which help align managerial decision-making with the firm's long-term sustainability goals (Hill and Jones 1992; Jensen and Meckling 1976). This alignment reduces agency problems, ensuring that managers prioritize actions that mitigate risk and improve the company's financial resilience, thereby lowering the chances of default. By fostering stronger governance practices that promote financial transparency and earnings quality, ESG initiatives safeguard companies against financial mismanagement and unethical behavior, further reducing the likelihood of financial distress and default risk.

While governance mechanisms like board composition and executive oversight are critical for long-term firm stability, their influence on default risk is often indirect and slower to manifest. Several studies have shown that the governance pillar of the ESG index has a weak or statistically insignificant impact on default risk (e.g., Di Tommaso and Thornton (2020); Li et al. (2022); Maquieira et al. (2024); Pistolesi and Teti (2024), among others). However, aspects of governance, such as financial transparency and high earnings quality, remain crucial. These governance practices reduce information asymmetry, helping stakeholders assess a firm's true financial health. As a result, as stated by Bhojraj and Sengupta (2003), they enhance investor confidence, improve access to capital, and mitigate bankruptcy risk. Conversely, weak governance practices can obscure financial reporting, leading to inaccurate assessments of risk and increasing the likelihood of default. Therefore, the governance pillar, particularly through its influence on transparency and earnings quality, warrants separate examination to understand its nuanced role in reducing default risk. This leads to the idea that greater transparency and higher earnings quality, as key components of the governance pillar of ESG, reduce a firm's default risk by providing clearer financial information, improving investor confidence, and enabling more accurate assessments of a company's financial stability and risk exposure.

While most prior studies have assumed a linear and negative relationship between governance quality—particularly financial transparency—and default risk, both theoretical arguments and our empirical findings suggest that this relationship may be non-linear. At low levels of transparency, poor disclosure and weak financial reporting hinder investors' ability to assess firm performance and risk exposure. This information asymmetry elevates perceived risk, increases the cost of capital, and weakens the firm's ability to access external financing (Bushman et al. 2004; Diamond and Verrecchia 1991). As transparency improves, investors are better able to evaluate firm fundamentals, which reduces uncertainty, strengthens investor confidence, and facilitates access to credit markets under more favorable terms (Bharath et al. 2008; Sengupta 1998). In this intermediate zone, transparency plays a critical risk-mitigating role by improving governance, reducing agency costs, and enhancing market discipline. However, at very high levels of transparency, the relationship may reverse. Excessive disclosure may reveal strategic vulnerabilities or invite scrutiny that increases regulatory pressure or stakeholder activism (Leuz and Wysocki 2016). Moreover, full transparency may limit managerial discretion in responding to crises or adapting strategies in competitive environments, thus constraining operational flexibility (Verrecchia 2001). In such cases, firms may become risk-averse in value-creating activities (e.g., innovation or investment in intangible assets), potentially harming long-term performance and increasing exposure to financial stress. This dynamic can result in an inverted governance effect, where the costs of overexposure outweigh the benefits of transparency (Hermalin and Weisbach 2012). Consequently, there may be an optimal level of transparency that minimizes insolvency risk. This perspective aligns with recent governance theories recognizing the potential costs of over-disclosure and, as we hypothesized, there is a U-shaped relationship between transparency and default risk.

All these ideas support our third hypothesis:

H3. *The is a non-linear, U-shaped relationship between financial transparency and default risk.*

3 | Data, Variables, and Methodology

Our sample includes 3476 firm-year observations from 333 non-financial companies across 20 European countries, covering the period from 2008 to 2022. This provides an average of 10.44 continuous observations per company. The sample includes firms listed in their respective national market indices of the most traded and liquid companies. Specifically, it features companies from Austria (ATX), Belgium (BE20), Czech Republic (PX50), Denmark (OMX Copenhagen 20), Finland (OMX Helsinki 25), France (CAC40), Germany (DAX30), Hungary (BUX), Iceland (ICEX), Ireland (ISEQ20), Italy (IT40), Luxembourg (LUXX), Netherlands (NL25), Norway (OMX Oslo 20), Portugal (PSI), Slovenia (SBITOP), Spain (IBEX35), Sweden (OMX Stockholm 30), Switzerland (SMI), and the United Kingdom (FTSE100). Financial firms (SIC 6000–6999) were excluded due to their regulated status and the distinct nature of their financial statements, which are often incompatible with those of non-financial firms. Additionally, companies in technical bankruptcy or those with missing information for relevant variables were excluded (Saona and San Martín 2016).

The data were sourced from LSEG Workspace, which provides both financial and market-based information as well as multiple ESG scores for each company-year observation used in our analysis. We also employed country-level contextual variables such as the Worldwide Governance Indicators (Kaufmann et al. 2011) from the World Bank,[3] the Index of Economic Freedom,[4] the country Gross National Product as well as a variable that identifies crises periods as country-level drivers of corporate default risk.

Unlike Sassen et al. (2016), our study focuses on the relationship between ESG investments and a company's default risk, which we argue is a more critical focus than total, systematic, or idiosyncratic risk for several reasons. First, default risk reflects a firm's ability to meet its debt obligations, making it a more direct measure of financial stability than stock volatility (total risk) or market sensitivity (systematic risk). While total risk captures price fluctuations and systematic risk reflects broader market trends, default risk signals whether a company is at risk of failure—an ultimate concern for creditors, investors, and other stakeholders. ESG factors' influence on default risk is closely tied to the firm's solvency, which is crucial for long-term sustainability. Second, from a practical perspective, for creditors and lenders, default risk is the most immediate concern, as it determines the likelihood of a company defaulting on its debt. This is crucial for banks, bondholders, and credit rating agencies, who are more concerned about whether a firm can meet its obligations than with daily fluctuations in stock prices (total risk) or market-related movements (systematic risk). Since ESG factors often influence long-term financial stability—through better governance, environmental risk management, or social reputation—they are particularly relevant to default risk analysis more than idiosyncratic risk, as also suggested by Sassen et al. (2016), that is unique to a company as it is not shared by other firms and is not influenced by broad market conditions. And finally, from an empirical perspective, default risk is far more tangible and measurable in terms of a company's ability to survive financial challenges than the study of total, systematic, or idiosyncratic sources of risk. In the event of bankruptcy or default, the consequences are significant not only for the firm but also for the corporate sector, labor market, and broader economy. Therefore, this study focuses on a company's default risk, which we believe is a more crucial measure in understanding long-term financial sustainability.

The default risk corresponds to the dependent variable measured with the Altman (1968)'s *Z*-score, defined as $Z\text{Score} = 1.2\text{WK} + 1.4\text{RE} + 0.6\text{MKBV} + 0.999\text{SALES} + 3.3\text{EBIT}$ where WK is the company's working capital over total assets, RE is the retained earnings over total assets, MKBV is the market value of equity over the book value of total liabilities, SALES corresponds to the company's sales as a share of total assets, and EBIT is the earnings before interest and taxes over total assets. To align the *Z*score with increasing default risk, we multiplied it by −1, so higher values indicate greater default risk. This metric is widely recognized for its predictive accuracy in assessing bankruptcy risk or financial distress (Abinzano et al. 2020; Altman et al. 2017) and has been employed in prior studies in specific countries like with US or Spanish firms (Habermann and Fischer 2023; Vivel-Búa et al. 2018) as well as in multi-country analysis focused on the European context (Aggarwal and Aung 2009; Tahmid et al. 2024; Vivel-Búa et al. 2024). Additionally, according to the recent study by Abinzano et al. (2023), Altman's *Z*-score provides comparable results to those obtained with market-based metrics such as the Black-Scholes-Merton model, but with the advantage of less data availability constraints. For robustness purpose, we followed the O-Score as second accounting-based model for measuring the output variable proposed by Ohlson (1980). This variable is measured as $\text{OScore} = -1.32 - 0.407\text{SIZE} + 6.03\text{TLTA} - 1.43\text{WCTA} + 0.0757\text{CLCA} - 2.370\text{NITA} - 1.830\text{FUTL} + 0.285\text{INTWO} - 1.720\text{ENEG} - 0.521\text{CHIN}$ where SIZE is the log of the ratio of total assets to the Gross National Product price-level index. The index assumes a base value of 100 for 2007; TLTA is total liabilities over total assets; WCTA measures the working capital as a share of total assets; CLCA are the current liabilities divided by current assets; NITA is the net income over total assets; FUTL is the cash flows from operations over total liabilities; INTWO is a dummy variable that takes value one if net income was negative for the last 2 years and zero otherwise; OENEG also take value one if total liabilities are greater than total assets or zero otherwise; CHIN is $\left(NI_t - NI_{t-1}\right) / \left(|NI_t| + |NI_{t-1}|\right)$, where *NI* is net income.

The independent variables related to our first hypothesis is the overall ESG score (ESGINDEX) along with the individual scores for environmental (ESGEnv),[5] social (ESGSoc),[6] and governance (ESGGov) pillars.[7] The overall ESG score (ESGINDEX) consists of an equally weighted average of the three pillar scores. These scores range from 0 to 1, with higher values indicating greater sustainability. The data are obtained from LSEG Workspace, consistent with prior studies in the Eurozone (Vivel-Búa et al. 2024) and the US (Habermann and Fischer 2023). To test our second hypothesis, we classified companies by industry, first by environmental impact (high vs. low) and second by sector (primary, secondary, tertiary) following Patten (2002) and Saona and Muro (2023). High-impact or sensitive sectors include basic materials, energy, industrials, and utilities, while low-impact non-sensitive sectors include consumer cyclicals, non-cyclicals, healthcare, technology, and telecommunications. The primary sector comprises basic materials, energy, and industrials; the secondary sector includes consumer cyclicals, non-cyclicals, and utilities; and the tertiary sector comprises healthcare, technology, and telecommunications.

For the third hypothesis, we used three alternative earnings quality measures based on the StarMine financial transparency algorithm, available via LSEG Workspace. StarMine defines earnings quality as the reliability and persistence of past earnings, with high-quality earnings accurately reflecting past performance and predicting future performance (Cline et al. 2021; Saona, Muro, et al. 2024). StarMine states that poor earnings quality indicates the likelihood of deteriorating fundamentals, low financial transparency, and low financial reporting quality. We considered three measures of earnings quality based on earnings restatement (EQER) which takes value 1 if the company restated its financial statements, and 0 otherwise; country rank (EQCR) in which a security is compared to all other securities trading in the same region; and cash flows (EQCF). These two last metrics of earnings quality range from 0 to 1, with values increasing as earnings quality and informativeness improve.

We included several control variables commonly used in the default risk literature, such as firm value (FV) proxied by Tobin's Q, calculated as the sum of the firm's market capitalization and total liabilities divided by total assets (Barlett and Partnoy 2020; Perfect and Wiles 1994).[8] As Tobin's Q is typically skewed, we use its logarithmic transformation (LnFV) in our regression models. Firm size (Size) is measured as the natural log of the firm's total assets, while leverage (Lev) is captured as the ratio of total debt to total assets. Capital expenditure (CAPEX) is calculated as the percentage changes in gross property, plant, and equipment (Choi and Park 2022). We also include ownership structure (OWN1), which reflects the concentration of ownership by the largest shareholder, as a corporate governance control (Saona et al. 2020).

Following Saona, San-Martin, et al. (2024), to account for country-level influences, we include the Worldwide Governance Indicator (WGI), the country's Economic Freedom Index (ECONFREE), the Gross National Product price-level index (GNP) with base value of 100 for 2007, and a dummy variable to control for time fixed effects like crises periods (Crisis) such as the 2007–8 financial recession and the COVID19 pandemics. WGI ranges from approximately −2.5 (weak) to 2.5 (strong), and captures institutional dimensions like rule of law, regulatory quality, and corruption control (Kaufmann et al. 2011). ECONFREE, sourced from the Heritage Foundation, reflects a country's economic freedom across dimensions such as trade, investment, and financial freedom, and is scaled from 0 to 100.

To examine the non-linear relationship between CAPEX as well as the various measures of earnings quality and the default risk, we included the quadratic term of CAPEX, EQCR, and EQCF, along with interaction terms between the ESG scores and the sector classifications.

We employed the Generalized Method of Moments system estimator (GMM-SE), as developed by Blundell and Bond (1998), which enhances the Arellano and Bond (1991) estimator. GMM-SE, with adjusted standard errors to account for potential heteroskedasticity, is particularly well-suited to addressing issues such as unobserved firm-specific heterogeneity, endogeneity of explanatory variables, and omitted variable bias (Windmeijer 2005). While Adams (2016) suggests using instrumental variables or quasi-experimental techniques to handle endogeneity issues with variables that are not strictly exogenous—such as various corporate social performance metrics associated with ESG scores or corporate governance metrics like financial transparency (measured through earnings quality)—the primary challenge with these techniques is identifying valid instruments. These instruments must be sufficiently correlated with the endogenous independent variables but uncorrelated with both the dependent variable and the error term (Antonakis et al. 2021). This challenge is further compounded by the unverifiable assumption that the instruments and the endogenous regressors are uncorrelated with the error term (Antonakis et al. 2021). Nevertheless, as supported by Barros et al. (2020), our chosen econometric technique, based on the GMM-SE for panel data, is appropriate as it effectively addresses all sources of endogeneity by removing unobserved heterogeneity and using lags of the independent variables, which are uncorrelated with the error term, as instruments. In their empirical comparison of multiple regression methods, Barros et al. (2020) found that the estimated parameters of GMM-based models were much closer to the true values when compared to other panel data methods. Similar conclusions were reached by Kiviet et al. (2017) and Antonakis et al. (2021), and the approach was empirically applied by Saona, Muro, et al. (2024).

Hence, the baseline model will take the following form:

$$
\begin{aligned}
Z\text{Score}_{itc} = {} & \beta_0 + \beta_1 \text{ESG}_{itc} + \beta_2 \text{LnFV}_{itc} + \beta_3 \text{Size}_{itc} \\
& + \beta_4 \text{Lev}_{itc} + \beta_5 \text{CAPEX}_{itc} + \beta_6 \text{OWN1}_{itc} \\
& + \beta_7 \text{EQ}_{itc} + \beta_8 \text{WGI}_{tc} + \beta_9 \text{ECONFREE}_{tc} + \beta_9 \text{GNP}_{tc} \\
& + \beta_9 \text{Crisis}_t + \sum_{q=1}^{15} \beta_q \text{YEAR}_{qic} + \sum_{h=1}^{20} \text{Country}_{hit} + \varepsilon_{it}
\end{aligned}
\tag{1}
$$

As mentioned above, the dependent variable is ZScore for the company i, in the period t and country c. The independent variables are defined earlier, and as outlined in Equation (1), the models include time and country fixed effects, in addition to individual fixed effects, as well as the stochastic error term, ε_{it}.

For robustness checks, results are also replicated with Arellano and Bond's (1991) difference GMM estimator (GMM-Diff) which allows estimations of models with the lagged dependent variable to capture dynamics and persistence in the data. The major advantages of this technique are that by first-differencing the data, the estimator removes time-invariant individual effects that could bias the results if left in the model; alike the GMM-SE, by using lagged values of the endogenous variables as instruments, this approach helps to deal with simultaneity, measurement error, and omitted variable bias in panel data settings; additionally, this method is particularly suitable for micro-panel structures with a large number of cross sections and a relatively small number of time periods. Validity of instruments is tested with the suitable Sargan and Hansen tests.

4 | Results

4.1 | Descriptive Statistics

Table 1 presents the primary panel data statistics for the variables used in the empirical analysis. To reduce the impact of outliers and mitigate the risk of biased results, variables were winsorized at the 1% or 2% level where appropriate. The results indicate that only a small proportion of companies are exposed to high default risk, as measured by the *Z*Score.[9] The average ESG index (ESGINDEX) is 0.666, which reflects a relatively strong performance in terms of sustainability, particularly when compared to firms in other major economies, such as the US (Pistolesi and Teti 2024), and emerging markets like China (Li et al. 2022). This value is also similar to the ESGINDEX average of 0.6131 reported by Sassen et al. (2016) for European companies. Among the three ESG pillars, the governance score has the lowest average of 0.618, with a maximum value of 0.983.

Regarding the other independent variables, the typical firm finances its assets with approximately 26.2% debt (Lev). Additionally, the gross fixed assets of these firms grow at an average annual rate of 4.7% (CAPEX). In terms of ownership structure (OWN1), around 18.9% of a firm's outstanding shares are held by the largest shareholder. This concentration of ownership is considerably lower than that observed in emerging markets (Chu et al. 2015; Saona et al. 2018), where corporate governance deficiencies and shareholder power concentration are more pronounced.

Consistent with these observations, the transparency measures in the sample are relatively high. The earnings quality metrics based on country rank (EQCR) and cash flows (EQCF) have median values of 0.568 and 0.660, respectively, reflecting a general adherence to financial transparency and quality reporting. As noted by La Torre et al. (2018), financial and non-financial reporting regulations have been strongly promoted in the European Union to improve the comparability of information and enhance corporate accountability. Our findings, therefore, reflect the success of these policies in promoting informative financial statements.

In addition to firm-level variables, we account for country-specific factors such as economic risks, cultural differences, and institutional frameworks. The Economic Freedom Index (ECONFREE) is used to capture the degree of business, trade, and investment freedom among the sampled firms, indicating a relatively high level of economic freedom. The Worldwide Governance Indicator (WGI) is also included to reflect the institutional quality of the country. The mean WGI value in our sample is consistent with previous studies of European firms (Saona and Muro 2023), which is notably higher than what is typically observed in firms operating in developing economies (Saona, San-Martin, et al. 2024).

Table 2 further examines the potential for multicollinearity, which could bias the results. Using the rule of thumb that a correlation above 0.6 indicates potential issues, we find no significant evidence of multicollinearity. The highest observed correlation is between firm size (Size) and the ESGINDEX (0.6), which, while relatively high, is addressed in the regression analysis by employing multiple alternative metrics for ESG ratings, supporting the robustness of the findings as discussed later. Additionally, we calculated the variance inflation factor (VIF) to formally test for multicollinearity. A VIF greater than 10 is typically a signal of this econometric problem. However, in our data the highest VIF was 4.33, suggesting that multicollinearity should not affect our findings.[10]

4.2 | Impact of ESG Scores on Default Risk

Table 3 tests our first hypothesis, which posits a negative impact of ESG ratings on default risk. The table incorporates various metrics for ESG ratings, alongside multiple firm- and country-level control variables. Given that firm-specific characteristics (e.g., state of incorporation, organizational culture, managerial conservatism), time-specific factors (e.g., political or economic events) as well as country-specific features (e.g., cultural differences) may influence both ESG scores and default risk, we employed a three-way fixed-effects model. This includes firm-fixed effects to account for time-invariant firm characteristics, time-fixed effects to control for time-dependent trends, and country-fixed effects, thereby mitigating potential biases arising from firm-, time-, or country-specific heterogeneity. In addition, firm-level as well as country-level control variables enter the models.

The findings indicate a consistent and statistically significant negative relationship between various ESG rating metrics and default risk. This suggests that as European companies invest in ESG activities, their default risk decreases, likely due to mitigating climate-related risks, improving brand equity, or attracting capital from ESG-focused or impact investors, which, in turn, enhances operational efficiency. For instance, by looking at the first model, the estimated coefficient of ESGEnv is −1.943 (p-value = 0.000) and statistically significant. This magnitude indicates that an increase in a firm's environmental performance by one standard deviation (0.216) is associated with a relative decrease in the default risk (*Z*Score) by 3.02% in relation to the mean risk (13.881). Similarly, if the overall corporate social performance index is considered (ESGINDEX) as exhibited in the last model of Table 3, we observe that the estimated coefficient of −0.388 (p-value = 0.008) implies that an increase in the variable by one standard deviation (0.165) is linked with a decrease of the default risk of 0.461% in relation

TABLE 1 | Descriptive statistics.

Variable		Mean	Std. dev.	Min	Max
*Z*Score	Overall	−13.881	12.583	−75.687	−1.926
	Between		12.828	−70.130	−2.524
	Within		5.719	−54.595	20.176
OScore	Overall	−5.672	1.158	−9.726	−2.089
	Between		1.084	−8.638	−3.117
	Within		0.563	−8.599	−2.910
ESGEnv	Overall	0.666	0.216	0.000	0.986
	Between		0.214	0.000	0.972
	Within		0.100	−0.145	1.091
ESGSoc	Overall	0.697	0.194	0.016	0.985
	Between		0.177	0.064	0.960
	Within		0.111	−0.042	1.115
ESGGov	Overall	0.618	0.212	0.035	0.983
	Between		0.176	0.153	0.939
	Within		0.130	0.111	1.141
ESGINDEX	Overall	0.660	0.166	0.032	0.955
	Between		0.158	0.074	0.913
	Within		0.087	−0.025	1.011
LnFV	Overall	0.141	0.552	−1.166	2.021
	Between		0.520	−0.874	2.021
	Within		0.252	−1.063	1.186
Size	Overall	23.198	1.344	18.189	26.994
	Between		1.457	18.189	26.531
	Within		0.315	21.103	25.468
Lev	Overall	0.262	0.134	0.000	0.867
	Between		0.132	0.000	0.867
	Within		0.063	0.004	0.780
CAPEX	Overall	0.047	0.034	0.000	0.217
	Between		0.031	0.000	0.186
	Within		0.017	−0.042	0.201
OWN1	Overall	0.189	0.175	0.000	0.980
	Between		0.173	0.013	0.785
	Within		0.049	−0.360	0.641
ECONFREE	Overall	73.034	5.144	58.800	84.200
	Between		4.798	61.449	81.692
	Within		1.519	67.784	77.477

(Continues)

TABLE 1 | (Continued)

Variable		Mean	Std. dev.	Min	Max
WGI	Overall	0.784	0.061	0.590	0.873
	Between		0.062	0.593	0.868
	Within		0.011	0.752	0.827
EQER	Overall	0.013	0.114	0.000	1.000
	Between		0.028	0.000	0.167
	Within		0.110	−0.153	0.947
EQCR	Overall	0.568	0.260	0.010	1.000
	Between		0.186	0.010	1.000
	Within		0.205	−0.115	1.177
EQCF	Overall	0.660	0.190	0.050	1.000
	Between		0.161	0.050	1.000
	Within		0.124	−0.016	1.193
GNP	Overall	104.955	12.128	80.807	160.407
	Between		10.200	87.380	140.781
	Within		6.399	76.012	160.662
Crisis	Overall	0.139	0.346	0.000	1.000
	Between		0.167	0.000	1.000
	Within		0.339	−0.527	1.062

Note: The table shows panel data statistics for the variables used in the model, including the mean, the overall, between and within standard deviations, minimum and maximum values. Section 3 of the study describes the variables. $N=3479$, $n=333$, and $\overline{T}=10.44$.

to the mean risk. Collectively, the models support the hypothesis that ESG activities have a risk-mitigating effect on default risk, keeping all the other factors constant. Several arguments support this.

First, ESG investments provide downside protection by fostering stronger customer loyalty and higher brand equity, leading to increased sales and market share. Second, credit markets are increasingly sensitive to corporate ESG efforts, which encourage companies to disclose more non-financial information, thus reducing information asymmetry and making their stocks more attractive to investors. These factors ultimately reduce default risk.

Among the control variables, an increase in firm market value (LnFV) is negatively associated with default risk, indicating that as firm value rises, companies become more established in capital markets, which exerts downward pressure on financial distress. Conversely, firm size (Size), measured as the log of total assets, is positively associated with default risk (*Z*Score), suggesting that larger firms may leverage their size and reputation to take on higher levels of risk. Additionally, higher levels of debt (Lev) are positively associated with increased default risk. This finding aligns with Cathcart et al. (2020), particularly due to the magnitude of the estimated parameter. For example, in the first model, the estimated coefficient for Lev is 36.517 (p-value $=0.000$), indicating that an increase in this variable equivalent to one standard deviation (0.133) is associated with a 35.03% increase in default risk (*Z*Score) relative to the mean risk (13.881). This finding supports Traczynski (2017), who argued that financial leverage and market return volatility are the only two risk factors that consistently explain default risk across all industry sectors.

We also examined the non-linear relationship between capital expenditure (CAPEX) and default risk, a relationship commonly discussed in corporate finance theory in general, but barely considered in corporate distress in particular. At lower levels of CAPEX, firms may underinvest, leading to inefficiencies, outdated technologies, and an inability to compete, thus increasing insolvency risk (*Z*Score) (Jensen 1986). However, as supported by Richardson (2006), at high levels of capital expenditure, overinvestment—driven by managerial overconfidence or poor capital allocation—may occur, increasing financial leverage, liquidity constraints, and ultimately default risk. This supports the hypothesis of a U-shaped relationship between CAPEX and *Z*Score, where moderate levels of investment optimize a firm's productivity and competitiveness (Fazzari et al. 1988), ceteris paribus.

Our results confirm these arguments, as evidenced by the negative and statistically significant coefficients for CAPEX, and the positive and significant coefficients for $CAPEX^2$.[11] In all four estimations in Table 3, the level of CAPEX that minimizes default risk was calculated by taking the first derivative of the polynomial regression function and setting it equal to zero. These minimum values, referred to as the Extrema Point in the regression table below $CAPEX^2$ support the U-shaped relationship. For example, in the first column, default risk is minimized

TABLE 2 | Correlation matrix.

Variables	*ZScore*	OScore	ESGEnv	ESGSoc	ESGGov	ESGINDEX	LnFV	Size	Lev	CAPEX	OWN1	EQER	EQCR	EQCF	ECONFREE	WGI	GNP
OScore	0.513***	1.000															
ESGEnv	0.199***	−0.090***	1.000														
ESGSoc	0.082***	−0.078***	0.657***	1.000													
ESGGov	0.109***	−0.062***	0.317***	0.371***	1.000												
ESGINDEX	0.166***	−0.096***	0.828***	0.838***	0.719***	1.000											
LnFV	−0.820***	−0.209***	−0.213***	−0.061***	−0.054**	−0.140***	1.000										
Size	0.394***	−0.112***	0.554***	0.519***	0.360***	0.600***	−0.379***	1.000									
Lev	0.371***	0.518***	0.016	0.011	0.040*	0.029	−0.008	0.145***	1.000								
CAPEX	−0.054**	−0.030	−0.018	−0.026	0.002	−0.017	0.048**	−0.042*	0.077***	1.000							
OWN1	0.038*	0.040*	−0.091***	−0.124***	−0.181***	−0.167***	−0.072***	−0.107***	−0.038*	0.242***	1.000						
EQER	0.028	0.021	0.033	0.028	0.032	0.040*	−0.026	0.050**	−0.012	−0.025	−0.030	1.000					
EQCR	−0.314***	−0.106***	−0.047*	0.016	0.015	−0.008	0.347***	−0.145***	−0.254***	−0.127***	−0.019	0.024	1.000				
EQCF	−0.434***	−0.162***	−0.107***	−0.0182	0.006	−0.051**	0.488***	−0.215***	−0.218***	−0.176***	−0.054**	−0.018	0.739***	1.000			
ECONFREE	−0.210***	−0.102***	−0.099***	−0.061***	0.150***	−0.001	0.265***	−0.140***	−0.030	−0.014	−0.240***	0.023	0.111***	0.117***	1.000		
WGI	−0.176***	−0.104***	−0.065***	−0.088***	0.041*	−0.045*	0.201***	−0.176***	−0.160***	−0.034	−0.196***	0.035	0.102***	0.121***	0.648***	1.000	
GNP	−0.055**	−0.035	0.085***	0.093***	0.055**	0.097***	0.026	0.071***	−0.037*	0.045*	0.118***	−0.001	0.030	0.039*	0.081***	0.300***	1.000
Crisis	−0.038*	0.027	0.039*	0.029	0.046*	0.049**	0.056**	0.012	0.053**	−0.017	−0.020	−0.015	−0.018	−0.015	0.103***	−0.002	−0.053**

Note: The table displays all the pairwise correlation coefficients between the variables. Section 3 of the study describes the variables. $^{*}p<0.05$; $^{**}p<0.01$; $^{***}p<0.001$.

TABLE 3 | Main results.

Variables	*ZScore*	*ZScore*	*ZScore*	*ZScore*
ESGEnv	−1.943***			
	(−4.064)			
ESGSoc		−0.195**		
		(−0.394)		
ESGGov			−0.405**	
			(−2.007)	
ESGINDEX				−0.388***
				(−2.459)
LnFV	−17.852***	−16.824***	−16.826***	−17.415***
	(−65.567)	(−44.408)	(−45.743)	(−46.089)
Size	0.321***	0.345**	0.574***	0.384**
	(2.805)	(2.040)	(3.262)	(2.129)
Lev	36.517***	32.996***	35.674***	34.753***
	(36.359)	(23.023)	(22.988)	(23.287)
CAPEX	−22.488**	−75.357***	−54.517***	−59.689***
	(−2.474)	(−5.658)	(−3.848)	(−4.193)
$CAPEX^2$	149.733***	394.539***	354.633***	359.727***
	(3.053)	(5.178)	(4.357)	(4.461)
Extrema Point	*0.0751*	*0.0955*	*0.0769*	*0.0830*
Lind-Mehlum	*2.47*	*4.45*	*3.85*	*4.19*
p-value	*0.007*	*0.000*	*0.000*	*0.000*
OWN1	−1.235	−2.861**	−2.380*	−2.676**
	(−1.505)	(−2.392)	(−1.924)	(−2.208)
ECONFREE	−0.044***	−0.049**	−0.083***	−0.059***
	(−3.238)	(−2.488)	(−4.127)	(−3.048)
WGI	19.542***	18.055***	21.023***	19.511***
	(13.309)	(8.099)	(9.473)	(9.084)
GNP	−0.050***	−0.040***	−0.040***	−0.039***
	(−14.265)	(−8.216)	(−7.474)	(−7.617)
Crisis	0.906***	0.754***	0.780***	0.793***
	(15.858)	(10.253)	(10.294)	(10.516)
Constant	−29.566***	−23.393***	−29.398***	−29.858***
	(−4.922)	(−3.429)	(−3.990)	(−4.043)
Observations	3476	3476	3476	3476
Cross-sections	333	333	333	333
Country Dummy	YES	YES	YES	YES
Year Dummy	YES	YES	YES	YES
Instruments	160	124	124	124

(Continues)

TABLE 3 | (Continued)

Variables	*ZScore*	*ZScore*	*ZScore*	*ZScore*
Avrg. Obs. per Group	10.44	10.44	10.44	10.44
AR(1)	−2.544	−2.680	−2.647	−2.647
p-value	0.010	0.006	0.008	0.004
AR(2)	−2.918	−2.713	−2.770	−2.847
p-value	0.301	0.207	0.155	0.108
Hansen	237.0	192.7	188.5	195.0
F-test	574.9	246.0	248.7	276.3

Note: The table displays the results to test the first research hypothesis. The results considered *ZScore* as the dependent variable, and sustainability measured through ESGEnv, ESGSoc, ESGGov, and ESGINDEX. Section 3 of the study describes the variables. Below the coefficients, the table reports the standard errors robust to heteroskedasticity following the method proposed by Windmeijer (2005). Nonlinearity of CAPEX is assessed with the Lind-Mehlum test that provides the exact test of the presence of a U shaped (or inverse U shaped) relationship on an interval. Although not reported in the table, the option based on Fieller (1954) was used to find the interval for the extreme point. Arellano-Bond AR(1) and AR(2) is an autocorrelation test of first and second order, respectively, using residuals in differences, asymptotically distributes as an N(0.1) and under the null hypothesis of no autocorrelation. Although AR(1) is expected in first differences, it does not invalidate the results. Instruments refer to the number of instruments used in the system GMM. Hansen test is a test of overidentifying restrictions or whether the instruments, as a group, appear exogenous, asymptotically distributed as a X^2 and robust to heteroskedasticity. Endogenous variables were instrumentalized with up to 3 years lagged according to Jara-Bertin et al. (2008), and the number of instruments were kept blow the number of cross-sections as suggested by Roodman (2009). *F* test contrasts the joint nullity of the estimated parameters. *$p<0.05$; **$p<0.01$; ***$p<0.001$.

when capital expenditure is approximately 7.51% of total assets, and as confirmed by the Lind-Mehlum test, there is evidence to reject the null hypothesis and support the existence of a U-shaped relationship between CAPEX and *ZScore*. Although not reported in the table, following Saona, Muro, et al. (2024), the 95% Fieller (1954) confidence interval for the Extrema Point was estimated and it ranges from 3.68% to 9.63%, providing further robustness to our findings. The average Extrema Point across Table 3, at which bankruptcy risk is minimized, corresponds to a capital expenditure of 8.26% of total assets.

In addition to controlling for investment decisions via CAPEX, we also considered corporate governance through ownership structure (OWN1), specifically focusing on monitoring. Risk-ownership concentration relationship is particularly relevant, as shareholders may have incentives to take on higher risk. As Jensen and Meckling (1976) suggest, the separation between shareholders and managers can increase information asymmetry, leading to a divergence in incentives and higher default risk. Similarly, Shleifer and Vishny (1986) argue that concentrated ownership improves firm performance by enhancing monitoring and alleviating the free-rider problem in takeovers. Our findings align with these governance arguments, as the estimated coefficients for OWN1 are negative and statistically significant in three out of the four regressions shown in Table 3.

Additionally, country-level control variables were included to account for institutional factors such as governance quality (WGI) and the degree of economic freedom (ECONFREE). The WGI variable is positive and statistically significant. While this might seem counterintuitive, companies operating in countries with stronger governance frameworks, such as those in the EU, may face heightened scrutiny from regulators and markets. This increased oversight could lead to greater transparency, making potential default risks more apparent. Similarly, companies in highly integrated markets may be more exposed to global financial volatility, which can positively affect default risk, as argued by Bekaert et al. (2014). Djankov et al. (2002) also discuss how high compliance costs and regulatory burdens can make firms more vulnerable to financial distress, reducing their distance to default. These arguments highlight the external influence of European institutional frameworks on a firm's risk profile. However, in well-governed environments, regulatory quality and strong rule of law may also incentivize firms to engage in riskier activities in pursuit of short-term gains (Laeven and Levine 2009).

In contrast to WGI, the ECONFREE variable, which reflects a country's economic freedom, is negatively and statistically significant in relation to default risk. This suggests that when a country promotes business and trade freedom, supported by the rule of law and property rights, corporate default risk decreases. According to Kılcı (2019), economic freedom is associated with the development of capital markets and financial stability, which reduces default risk. Greater economic liberty allows companies to access advanced financial products and manage risks more effectively. Empirically, Chen and Huang (2009) found that economic freedom is correlated with lower stock market volatility, further stabilizing firms and reducing corporate defaults.

Finally, the growth of the Gross National Product (GNP) and a dummy variable that controls for crises periods (Crisis) were introduced in the models. As also observed in previous literature, the default risk is counter cyclical as lower risk is observed in periods of economic expansion, but such risk increased during the crises like the financial recession of 2007-8 and the COVID19 pandemic of 2020.

4.3 | Heterogeneity by Industry Sector

As noted by Pistolesi and Teti (2024), a company's environmental commitment and systematic risk are inherently tied to the industry sector in which it operates. This section addresses our second hypothesis, which examines the heterogeneous impact of ESG ratings on default risk across different industry sectors. First, we analyzed this by generating interaction

TABLE 4 | Main results for heterogeneity by industry sector.

	Panel A				Panel B			
Variables	***Z*Score**	***Z*Score**	***Z*Score**	***Z*Score**	***Z*Score**	***Z*Score**	***Z*Score**	***Z*Score**
ESGEnv	−0.988*				3.240***			
	(−1.726)				(20.368)			
High * ESGEnv	0.613*							
	(1.946)							
ESGEnv + High * ESGEnv	*−0.375*							
t-test	*(−1.035)*							
Secondary * ESGEnv					−2.327***			
					(−9.359)			
Tertiary * ESGEnv					−3.392***			
					(−13.587)			
ESGSoc		−2.855**				3.235***		
		(−2.147)				(9.585)		
High * ESGSoc		1.828**						
		(2.021)						
ESGSoc + High * ESGSoc		*−1.027**						
t-test		*(−1.920)*						
Secondary * ESGSoc						−3.419***		
						(−5.651)		
Tertiary * ESGSoc						−7.355***		
						(−12.078)		
ESGGov			−0.610				2.296***	
			(−0.912)				(4.372)	
High * ESGGov			1.871*					
			(1.859)					
ESGGov + High * ESGGov			*−1.261**					
t-test			*(−0.910)*					
Secondary * ESGGov							−2.710***	
							(−3.328)	

(Continues)

TABLE 4 | (Continued)

Variables	Panel A				Panel B			
	*Z*Score	*Z*Score	*Z*Score	*Z*Score	*Z*Score	*Z*Score	*Z*Score	*Z*Score
Tertiary * ESGGov							−5.500***	
							(−6.207)	
ESGINDEX				−1.754*				3.640***
				(−1.703)				(5.512)
High *ESGINDEX				0.429**				
				(2.379)				
ESGINDEX + High * ESGINDEX				*−1.325**				
t-test				*(−1.560)*				
Secondary * ESGINDEX								−3.577***
								(−4.307)
Tertiary * ESGINDEX								−6.318***
								(−6.028)
LnFV	−17.818***	−16.753***	−16.815***	−17.367***	−18.223***	−17.891***	−17.540***	−18.056***
	(−65.488)	(−44.724)	(−45.271)	(−46.081)	(−207.497)	(−92.728)	(−67.779)	(−64.435)
Size	0.408***	0.458***	0.631***	0.595***	0.477***	0.494***	0.829***	0.568***
	(3.635)	(2.782)	(3.508)	(3.217)	(9.290)	(5.676)	(6.038)	(4.158)
Lev	36.231***	32.633***	35.206***	34.710***	38.695***	38.396***	39.347***	38.232***
	(36.405)	(23.090)	(21.854)	(23.370)	(154.911)	(76.062)	(38.946)	(39.159)
CAPEX	−23.363**	−82.460***	−51.285***	−61.160***	0.467	−8.894	−4.572	−9.916
	(−2.393)	(−5.985)	(−3.620)	(−4.022)	(0.204)	(−1.588)	(−0.475)	(−0.940)
$CAPEX^2$	155.057***	426.004***	326.991***	361.911***	5.263	10.460	76.618	94.902*
	(2.910)	(5.268)	(3.977)	(4.186)	(0.510)	(0.380)	(1.448)	(1.671)
Extrema Point	*0.075*	*0.096*	*0.078*	*0.084*	*−0.044*	*0.425*	*0.029*	*0.052*
Lind-Mehlum	*2.39*	*4.45*	*3.62*	*4.02*	—	—	*0.47*	*0.94*
p-value	*0.009*	*0.000*	*0.000*	*0.000*	—	—	*0.318*	*0.174*
OWN1	−1.507*	−2.574**	−1.887	−2.599**	−1.848***	−1.601***	−1.387*	−1.652**
	(−1.687)	(−2.079)	(−1.507)	(−2.113)	(−6.198)	(−2.919)	(−1.670)	(−1.978)
ECONFREE	−0.049***	−0.049**	−0.088***	−0.064***	−0.066***	−0.069***	−0.077***	−0.066***

(Continues)

TABLE 4 | (Continued)

Variables	Panel A				Panel B			
	*Z*Score	*Z*Score	*Z*Score	*Z*Score	*Z*Score	*Z*Score	*Z*Score	*Z*Score
	(−3.576)	(−2.495)	(−4.184)	(−3.248)	(−13.465)	(−7.205)	(−5.039)	(−4.876)
WGI	19.371***	18.190***	21.324***	19.948***	18.177***	17.676***	18.346***	17.298***
	(13.285)	(7.835)	(9.259)	(8.865)	(34.155)	(19.161)	(10.586)	(9.818)
GNP	−0.049***	−0.038***	−0.038***	−0.038***	−0.047***	−0.034***	−0.044***	−0.043***
	(−13.882)	(−7.692)	(−7.142)	(−7.408)	(−62.431)	(−20.008)	(−11.316)	(−11.660)
Crisis	0.867***	0.725***	0.761***	0.774***	0.944***	0.934***	0.975***	0.937***
	(15.341)	(10.074)	(9.876)	(10.369)	(71.560)	(28.044)	(17.738)	(17.966)
Constant	−36.706***	−33.392***	−39.747***	−38.363***	−37.653***	−37.594***	−44.563***	−38.562***
	(−12.557)	(−7.392)	(−7.979)	(−8.136)	(−31.359)	(−15.890)	(−12.227)	(−11.253)
Observations	3476	3476	3476	3476	3476	3476	3476	3476
Cross-sections	333	333	333	333	333	333	333	333
Country Dummy	YES	YES	YES	YES	YES	YES	YES	YES
Year Dummy	YES	YES	YES	YES	YES	YES	YES	YES
Instruments	160	124	124	124	246	193	160	160
Avrg. Obs. per Group	10.44	10.44	10.44	10.44	10.44	10.44	10.44	10.44
AR(1)	−2.670	−2.892	−2.817	−2.835	−2.561	−2.625	−2.757	−2.664
p-value	0.008	0.014	0.005	0.005	0.010	0.003	0.002	0.002
AR(2)	−0.938	−0.457	−0.669	−0.614	−0.428	−0.990	−0.071	−0.092
p-value	0.330	0.383	0.760	0.894	0.609	0.866	0.583	0.772
Hansen	181.5	140.3	140.1	136.5	260.7	218.6	179.4	189.7
F-test	206.2	122.8	119.4	120.8	1264	278.5	158.7	182.6

Note: The table displays the results to test the second research hypothesis. Results in Panel A are used to assess the heterogeneous effect of ESG scores on listed firms in industry sectors separated by high (basic materials, energy, industrials, and utilities) and low (consumer cyclicals and non-cyclicals, healthcare, technology, and telecommunication services) environmental impact. Results in Panel B are used to assess the heterogenous effect of ESG scores on listed firms in industry sectors classified in primary (basic materials, energy, and industrials), secondary (consumer cyclicals and non-cyclicals, and utilities), and tertiary (healthcare, technology, and telecommunication services). The results considered *Z*Score as the dependent variable, and sustainability measured through ESGEnv, ESGSoc, ESGGov, and ESGINDEX. Section 3 of the study describes the variables. Below the coefficients, the table reports the standard errors robust to heteroskedasticity following the method proposed by Windmeijer (2005). The suitable t test of linear combination of coefficients was used to test the significance of the interacted variables. Nonlinearity of CAPEX is assessed with the Lind-Mehlum test that provides the exact test of the presence of a U shaped (or inverse U shaped) relationship on an interval. Although not reported in the table, the option based on Fieller (1954) was used to find the interval for the extreme point. The nonlinearity of CAPEX is trivially rejected in Model 5 as the extremum is outside the interval of the variable. Arellano-Bond AR(1) and AR(2) is an autocorrelation test of first and second order, respectively, using residuals in differences, asymptotically distributes as an N(0.1) and under the null hypothesis of no autocorrelation. Although AR(1) is expected in first differences, it does not invalidate the results. Instruments refer to the number of instruments used in the system GMM. Hansen test is a test of overidentifying restrictions or whether the instruments, as a group, appear exogenous, asymptotically distributed as a X^2 and robust to heteroskedasticity. Endogenous variables were instrumentalized with up to 3 years lagged according to Jara-Bertin et al. (2008), and the number of instruments were kept blow the number of cross-sections as suggested by Roodman (2009). *F* test contrasts the joint nullity of the estimated parameters. *$p < 0.05$; **$p < 0.01$; ***$p < 0.001$. The monotone relationship for CAPEX is trivially rejected in Model 5 as the extremum is outside the interval of the variable.

TABLE 5 | Main results for heterogeneity by earnings quality.

Variables	*Z*Score	*Z*Score	*Z*Score	*Z*Score	*Z*Score	*Z*Score	*Z*Score	*Z*Score	*Z*Score	*Z*Score	*Z*Score	*Z*Score
ESGEnv	−1.135***				−1.745***				−1.580***			
	(−3.205)				(−5.496)				(−5.359)			
ESGSoc		−0.247*				−0.826				−1.207**		
		(−0.881)				(−1.538)				(−2.214)		
ESGGov			−0.162**				0.388				0.487	
			(−1.440)				(0.939)				(1.481)	
ESGINDEX				−0.326*				−0.109*				−0.014
				(−0.892)				(−0.939)				(−0.020)
EQER	0.797***	0.674***	0.798***	0.809***								
	(18.779)	(7.187)	(9.137)	(8.987)								
EQCR					2.705***	−5.927***	−10.568***	−10.579***				
					(5.670)	(−4.974)	(−9.151)	(−9.002)				
$EQCR^2$					−1.612***	6.506***	10.953***	10.852***				
					(−3.488)	(5.702)	(9.756)	(9.705)				
Extrema Point					*0.839*	*0.455*	*0.482*	*0.487*				
Lind-Mehlum					*1.12*	*4.97*	*9.15*	*9.00*				
p-value					*0.131*	*0.000*	*0.000*	*0.000*				
EQCF									−5.708***	−18.719***	−8.297***	−8.289***
									(−5.201)	(−8.665)	(−4.257)	(−4.219)
$EQCF^2$									5.281***	16.488***	7.415***	7.221***
									(5.364)	(8.686)	(4.335)	(4.153)
Extrema Point									*0.540*	*0.567*	*0.559*	*0.574*
Lind-Mehlum									*5.20*	*8.55*	*4.26*	*3.99*
p-value									*0.000*	*0.000*	*0.000*	*0.000*
LnFV	−17.484***	−16.577***	−16.810***	−17.164***	−18.064***	−17.119***	−17.290***	−17.748***	−17.941***	−16.509***	−16.779***	−16.955***
	(−100.793)	(−51.490)	(−51.424)	(−49.538)	(−117.440)	(−54.152)	(−55.092)	(−53.099)	(−108.444)	(−56.005)	(−58.375)	(−52.956)
Size	0.350***	0.266**	0.401***	0.243**	0.376***	0.637***	0.615***	0.494***	0.426***	0.735***	0.608***	0.619***

(Continues)

TABLE 5 | (Continued)

Variables	ZScore	ZScore	ZScore	ZScore	ZScore	ZScore	ZScore	ZScore	ZScore	ZScore	ZScore	ZScore
	(4.042)	(2.364)	(3.270)	(1.986)	(4.265)	(4.208)	(4.451)	(3.052)	(5.899)	(5.470)	(4.985)	(4.375)
Lev	35.164***	32.683***	34.806***	34.889***	37.235***	35.478***	36.132***	36.580***	34.415***	32.427***	32.892***	33.113***
	(59.040)	(35.844)	(33.037)	(35.303)	(55.656)	(29.494)	(28.384)	(28.772)	(60.145)	(26.737)	(26.980)	(26.686)
CAPEX	−41.896***	−83.566***	−51.201***	−51.906***	−44.841***	−94.554***	−78.694***	−79.442***	−47.663***	−85.176***	−58.481***	−62.969***
	(−9.529)	(−7.901)	(−4.858)	(−4.755)	(−8.253)	(−8.823)	(−6.771)	(−7.172)	(−9.644)	(−8.791)	(−6.366)	(−6.429)
$CAPEX^2$	228.966***	485.128***	368.513***	356.713***	294.648***	590.059***	536.005***	515.171***	227.624***	406.127***	318.008***	335.280***
	(8.239)	(8.113)	(5.187)	(5.243)	(8.859)	(9.067)	(7.677)	(7.654)	(8.331)	(7.261)	(5.878)	(5.835)
Extrema Point	*0.091*	*0.085*	*0.069*	*0.073*	*0.076*	*0.080*	*0.073*	*0.077*	*0.105*	*0.105*	*0.092*	*0.094*
Lind-Mehlum	*6.87*	*7.50*	*4.86*	*4.75*	*8.25*	*8.55*	*6.77*	*7.17*	*6.90*	*5.80*	*5.18*	*5.14*
p-value	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*
OWN1	−4.360***	−4.821***	−6.558***	−4.757***	−7.525***	−7.013***	−8.136***	−7.995***	−2.873***	−0.632	−2.787**	−2.462*
	(−3.532)	(−3.074)	(−4.307)	(−2.930)	(−6.997)	(−5.037)	(−5.468)	(−5.330)	(−3.118)	(−0.459)	(−2.189)	(−1.836)
ECONFREE	−0.027*	−0.021	−0.033	−0.016	−0.076***	−0.037	−0.054**	−0.040*	−0.031*	−0.003	−0.017	0.006
	(−1.703)	(−0.887)	(−1.507)	(−0.693)	(−5.318)	(−1.634)	(−2.249)	(−1.784)	(−1.899)	(−0.141)	(−0.827)	(0.271)
WGI	7.111***	6.216**	8.106***	5.647**	8.605***	5.226*	8.855***	6.786**	8.105***	6.803**	9.283***	8.181***
	(3.108)	(2.018)	(2.809)	(1.979)	(4.338)	(1.788)	(3.332)	(2.578)	(4.068)	(2.498)	(3.713)	(3.187)
GNP	−0.046***	−0.037***	−0.037***	−0.038***	−0.048***	−0.041***	−0.035***	−0.041***	−0.056***	−0.042***	−0.044***	−0.047***
	(−19.387)	(−8.193)	(−7.853)	(−8.288)	(−20.605)	(−8.818)	(−7.028)	(−8.525)	(−27.676)	(−9.139)	(−9.644)	(−10.919)
Crisis	1.054***	0.999***	1.125***	1.152***	0.927***	0.811***	0.833***	0.927***	0.810***	0.646***	0.647***	0.712***
	(37.262)	(16.241)	(17.171)	(18.383)	(25.523)	(11.351)	(11.280)	(12.390)	(23.396)	(10.451)	(10.523)	(11.633)
Constant	−27.874***	−20.569***	−17.973***	−20.017***	−28.669***	−24.004***	−24.567***	−23.546***	−31.102***	−33.770***	−32.873***	−37.229***
	(−6.120)	(−3.451)	(−3.230)	(−3.483)	(−6.154)	(−3.960)	(−4.169)	(−3.741)	(−7.809)	(−6.440)	(−6.292)	(−6.685)
Observations	3248	3248	3248	3248	3384	3384	3384	3384	3359	3359	3359	3359
Cross-sections	325	325	325	325	331	331	331	331	331	331	331	331
Country Dummy	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Year Dummy	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Instruments	189	146	146	146	213	165	165	165	213	165	165	165

(Continues)

TABLE 5 | (Continued)

Variables	ZScore	ZScore	ZScore	ZScore	ZScore	ZScore	ZScore	ZScore	ZScore	ZScore	ZScore	ZScore
Avrg. Obs. per Group	9.994	9.994	9.994	9.994	10.22	10.22	10.22	10.22	10.15	10.15	10.15	10.15
AR(1)	−2.735	−2.863	−2.832	−2.830	−2.601	−2.976	−3.377	−3.353	−2.674	−3.060	−2.777	−2.772
p-value	0.006	0.004	0.004	0.004	0.003	0.016	0.000	0.000	0.007	0.040	0.005	0.005
AR(2)	−2.864	−2.689	−2.819	−2.861	−2.882	−2.393	−2.244	−2.346	−2.601	−2.049	−2.359	−2.385
p-value	0.418	0.716	0.481	0.423	0.931	0.292	0.248	0.190	0.929	0.222	0.183	0.171
Hansen	254.3	201	215.1	215.3	256	208.3	216.6	213.4	267.3	210.2	228.7	229.7
F-test	2836	468.4	336.2	387.4	1901	331.3	292.4	367.9	1826	359.6	358	381.4

Note: The table displays the results to test the third research hypothesis. The results considered ZScore as the dependent variable, and sustainability measured through ESGEnv, ESGSoc, ESGGov, and ESGINDEX. Section 3 of the study describes the variables. Below the coefficients, the table reports the standard errors robust to heteroskedasticity following the method proposed by Windmeijer (2005). The suitable t test of linear combination of coefficients was used to test the significance of the interacted variables. Nonlinearity of EQCR, EQCF, and CAPEX is assessed with the Lind-Mehlum test that provides the exact test of the presence of a U shaped (or inverse U shaped) relationship on an interval. Although not reported in the table, the option based on Fieller (1954) was used to find the interval for the extreme point. Arellano-Bond AR(1) and AR(2) is an autocorrelation test of first and second order, respectively, using residuals in differences, asymptotically distributes as an N(0.1) and under the null hypothesis of no autocorrelation. Although AR(1) is expected in first differences, it does not invalidate the results. Instruments refer to the number of instruments used in the system GMM. Hansen test is a test of overidentifying restrictions or whether the instruments, as a group, appear exogenous, asymptotically distributed as a X^2 and robust to heteroskedasticity. Endogenous variables were instrumentalized with up to 3 years lagged according to Jara-Bertin et al. (2008), and the number of instruments were kept blow the number of cross-sections as suggested by Roodman (2009). *F* test contrasts the joint nullity of the estimated parameters. *$p<0.05$; **$p<0.01$; ***$p<0.001$.

variables between industry sectors with a high environmental impact (High) and the various ESG scores, as well as for industry sectors with low environmental impact (Low). Second, we generated interaction variables between dummies identifying the primary, secondary, and tertiary sectors and the ESG scores. The results for the first set of interaction variables are presented in Panel A of Table 4, and the findings for the second set are shown in Panel B.

In Panel A, we explore the effect of ESG activities on default risk in high-impact (environmentally sensitive) industries compared to low-impact industries. In the first column, companies in low environmental impact industries (such as consumer cyclicals, non-cyclicals, healthcare, technology, and telecommunications) exhibit an estimated coefficient for the environmental score (ESGEnv) of −0.988 (p-value = 0.085). This suggests that a one standard deviation increase in the environmental score (0.215) is associated with a 1.53% reduction in default risk relative to the average risk. However, for companies in high environmental impact industries (such as basic materials, energy, industrials, and utilities), where the variable High equals 1, the coefficient (−0.375) is statistically insignificant (p-value = 0.352). This coefficient represents the addition of the estimated parameters of ESGEnv and the interaction term High ∗ ESGEnv, with a linear combination t-test confirming no significant effect in these high-impact industries. The effect is associated with a reduction of 0.58% on the average default risk for this group of high environmental-impact companies.

In the second column of Table 4, similar results emerge, though with stronger statistical significance. For companies in high-impact sectors, the social score (ESGSoc) reduces default risk, with a coefficient of −1.027, reflecting the combined effect of ESGSoc and High ∗ ESGSoc. A Wald-type test confirmed the robustness of this finding, rejecting the null hypothesis that $\beta = \beta_{ESGSoc} + \beta_{ESGSoc+High*ESGSoc} = 0$ (p-value = 0.0822). However, for companies in low environmental impact industries or also denominated low environmentally sensitive industries, the reduction in default risk is even more pronounced, with a coefficient of −2.855 (p-value = 0.001) as the social pillar of the non-financial performance improves. This indicates that companies in low environmental impact industries experience a greater reduction in default risk from improved social scores compared to those in environmentally sensitive sectors.

The governance score (ESGGov) yields similar results. In high-impact industries, firms reduce their default risk as their governance scores improve, with a coefficient of −1.261 (p-value = 0.054) for ESGGov + High ∗ ESGGov. However, no statistically significant results were found for governance scores in low-impact industries (when High = 0). In contrast, when considering the overall ESG score (ESGINDEX), companies in low-impact industries show a reduction in default risk with an estimated coefficient of −1.754 (p-value = 0.090) as their ESG scores increase, as seen in the fourth column. The estimated coefficient of −1.754 for ESGINDEX suggests that a one standard deviation increase in the index is associated with a 2.09% reduction in default risk. For companies operating in high environmental impact industries, the size of the estimated coefficient is −1.325 revealing a relatively lower risk mitigation effect as the ESG index improves in comparison to companies in low

A

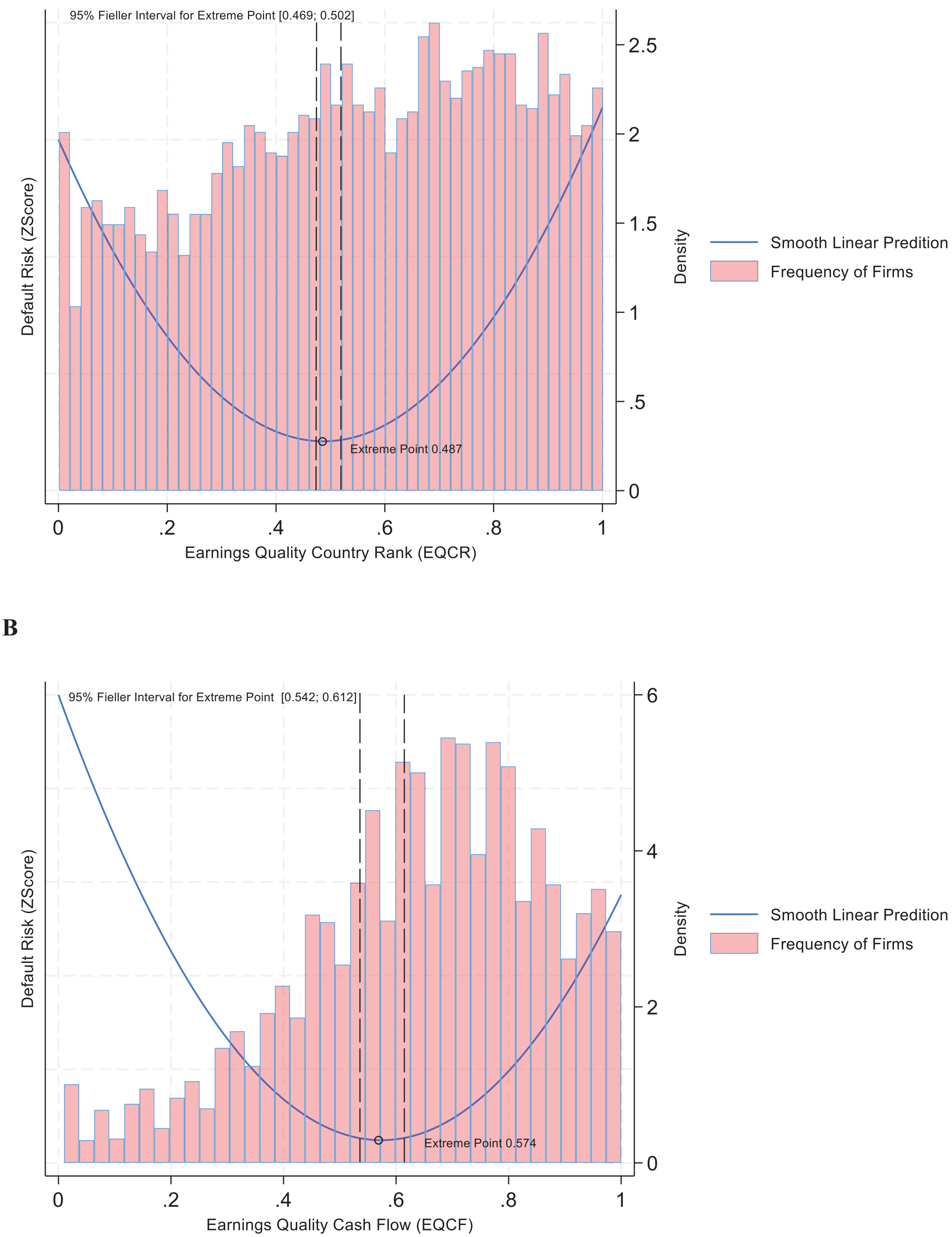

FIGURE 1 | Histogram and optimization of *Z*Score with respect to EQCR and EQCF variables. The figure shows the optimization of *Z*Score based on the linear predictions of Models 8 and 12 of Table 5, and the embedded histograms of variables EQCR and EQCF shown in Panels A and B, respectively. The corresponding Extrema Points as well as the 95% confidence level Fieller intervals are also shown.

environmental impact industries. Consequently, our findings reveal an asymmetrical effect of non-financial performance on default risk. Companies operating in low environmental impact industries reduce more risk as ESG improves than companies operating in high environmental industries.

Following Saona and Muro (2023), Panel B of Table 4 analyzes the industry heterogeneity across primary, secondary, and tertiary sectors. A key finding is presented in the fifth column: for companies in the primary, extractive sector, default risk increases as the environmental score improves, with a coefficient

TABLE 6 | Robustness: Main results.

Variables	OScore	OScore	OScore	OScore
ESGEnv	−0.002***			
	(−13.091)			
ESGSoc		0.001		
		(1.015)		
ESGGov			0.000	
			(0.800)	
ESGINDEX				−0.001***
				(−3.151)
LnFV	−0.004***	−0.004***	−0.003***	−0.005***
	(−80.898)	(−13.330)	(−7.059)	(−31.412)
Size	0.002***	0.002***	0.002***	0.003***
	(36.436)	(9.523)	(6.501)	(18.292)
Lev	0.038***	0.036***	0.036***	0.034***
	(89.880)	(22.896)	(15.668)	(34.604)
CAPEX	−0.045***	−0.046***	−0.040*	−0.058***
	(−14.985)	(−3.157)	(−1.869)	(−6.669)
$CAPEX^2$	0.032**	0.119	0.033	0.018
	(2.202)	(1.282)	(0.234)	(0.384)
Extrema Point	0.720	−0.195	−0.616	−1.590
Lind-Mehlum *p*-value	—	—	—	—
OWN1	−0.012***	−0.009***	−0.011***	−0.013***
	(−47.694)	(−6.204)	(−4.997)	(−17.183)
ECONFREE	−0.000***	−0.000	−0.000*	−0.000**
	(−13.507)	(−0.521)	(−1.885)	(−2.348)
WGI	0.008***	0.006**	0.006	0.012***
	(14.541)	(2.024)	(1.591)	(6.821)
GNP	0.000***	0.000***	0.000***	0.000***
	(59.006)	(11.497)	(5.209)	(25.268)
Crisis	0.002***	0.001***	0.001***	0.002***
	(48.811)	(7.065)	(2.641)	(22.400)
Constant	0.058***	0.041***	0.040***	0.065***
	(37.111)	(7.197)	(5.435)	(16.955)
Observations	3560	3560	3560	3560
Cross-sections	340	340	340	340
Country Dummy	YES	YES	YES	YES
Year Dummy	YES	YES	YES	YES
Instruments	331	216	167	260

(Continues)

TABLE 6 | (Continued)

Variables	OScore	OScore	OScore	OScore
Avrg. Obs. per Group	10.47	10.47	10.47	10.47
AR(1)	−3.938	−3.928	−3.899	−3.972
p-value	0.000	0.000	0.000	0.430
AR(2)	−0.671	−0.821	−0.756	−0.789
p-value	0.502	0.411	0.450	0.701
Hansen	297.9	228	174.4	269.7
F-test	9277	114.9	46.15	639.4

Note: The table displays the robustness results to test the first research hypothesis. The results considered OScore as the dependent variable, and sustainability measured through ESGEnv, ESGSoc, ESGGov, and ESGINDEX. Section 3 of the study describes the variables. Below the coefficients, the table reports the standard errors robust to heteroskedasticity following the method proposed by Windmeijer (2005). Nonlinearity of CAPEX is assessed with the Lind-Mehlum test that provides the exact test of the presence of a U shaped (or inverse U shaped) relationship on an interval. Although not reported in the table, the option based on Fieller (1954) was used to find the interval for the extreme point. Arellano-Bond AR(1) and AR(2) is an autocorrelation test of first and second order, respectively, using residuals in differences, asymptotically distributes as an N(0.1) and under the null hypothesis of no autocorrelation. Although AR(1) is expected in first differences, it does not invalidate the results. Instruments refer to the number of instruments used in the system GMM. Hansen test is a test of overidentifying restrictions or whether the instruments, as a group, appear exogenous, asymptotically distributed as a X^2 and robust to heteroskedasticity. Endogenous variables were instrumentalized with up to 3 years lagged according to Jara-Bertin et al. (2008), and the number of instruments were kept blow the number of cross-sections as suggested by Roodman (2009). *F* test contrasts the joint nullity of the estimated parameters. $^*p<0.05$; $^{**}p<0.01$; $^{***}p<0.001$.

of 3.240 (p-value = 0.001) for ESGEnv. However, in the secondary (manufacturing) sector, improved environmental scores lead to a lower increase in default risk, with a coefficient of 0.913, calculated as the sum of the parameters for ESGEnv and Secondary ∗ ESGEnv. The most significant reduction in default risk is seen in the tertiary (service-focused) sector, with a coefficient of −0.152 (p-value = 0.025), calculated as the sum of ESGEnv and Tertiary ∗ ESGEnv. A linear combination test rejected the null hypothesis that the impact of environmental scores on default risk is the same across these three sectors, indicating a gradient of risk mitigation from the primary to the tertiary sector.

Comparable patterns are observed in the sixth column for the social score (ESGSoc). While companies in the primary sector reveal that improved social scores lead to increased default risk, secondary sector companies experience some reduction in risk, though the effect is much stronger in the tertiary sector. When considering governance scores (ESGGov) or the aggregate score (ESGINDEX) as tabulated in the seventh and eighth columns of the table, the effects are statistically significant across all the three industry sectors and systematically in a gradient way, from an increase in the default risk in the primary sector as the score improves, to a reduction in the risk for the tertiary sector focused on services. Table 4 also shows that the control variables yield results consistent with those observed in Table 3.

4.4 | Default Risk and Earnings Quality

The last part of our empirical analysis explores the role of financial statement transparency as a driver of insolvency risk. This specific focus on corporate governance aims to address specification errors often observed in the literature. Previous studies have shown that governance scores as predictors of default risk typically yield non-significant or weak explanatory power (e.g., Di Tommaso and Thornton (2020); Li et al. (2022); Maquieira et al. (2024); Pistolesi and Teti (2024); Sassen et al. (2016); among others). Additionally, in their survey of economic literature, Hermalin and Weisbach (2003) suggest that a firm's governance structure is endogenously determined. To overcome these limitations, we use financial reporting transparency as a corporate governance metric, in addition to the ownership structure (OWN1) variable to better capture the corporate governance aspects that determine the insolvency risk, alongside the governance score (ESGGov). Financial transparency is assessed using several earnings quality measures developed by StarMine and available through LSEG Workspace. Given that all these governance variables are theoretically endogenous, the econometric method employed in this study addresses this issue by generating instruments using lagged values.

The results are presented in Table 5. The first transparency variable is the earnings restatement dummy (EQER). The adverse consequences of earnings restatement have been supported in the previous empirical studies (Desai et al. 2006; Ettredge et al. 2012). The table demonstrates that companies required to restate their financial statements due to a lack of transparency exhibit higher default risk than those that did not, as seen across the first four regressions. Additionally, as previously discussed, the social (ESGSoc) and governance (ESGGov) scores, as well as the overall ESG index (ESGINDEX), continue to have a negative impact on a company's default risk.

Next, we analyze the earnings quality country rank (EQCR) and its squared term to examine the non-linear relationship with default risk. The literature suggests that both low and excessively high levels of financial transparency can increase default risk, while moderate levels can mitigate it. At relatively low levels of transparency, improvements in the quality of financial reporting and earnings reduce information asymmetries and mitigate corporate risk (Bhattacharya et al. 2013). From a corporate governance perspective, poor financial transparency can conceal risks, such as the opportunistic manipulation of statements or the overstatement of earnings, which misleads investors (Dechow et al. 1996). Conversely, as Beck and Casu (2016), the

TABLE 7 | Robustness: Main results for heterogeneity by industry sector.

	Panel A				Panel B			
Variables	**OScore**	**OScore**	**OScore**	**OScore**	**OScore**	**OScore**	**OScore**	**OScore**
ESGEnv	−0.001***				−0.003***			
	(−3.513)				(−9.587)			
High * ESGEnv	0.001***							
	(4.473)							
ESGEnv + High * ESGEnv	*−0.000*							
t-test	*(−2.055)*							
Secondary * ESGEnv					−0.054***			
					(−9.185)			
Tertiary * ESGEnv					−0.080*			
					(−3.084)			
ESGSoc		−0.100**				0.003***		
		(−0.029)				(6.025)		
High * ESGSoc		0.001						
		(0.472)						
ESGSoc + High * ESGSoc		*−0.090**						
t-test		*(−1.627)*						
Secondary * ESGSoc						−0.077**		
						(−3.039)		
Tertiary * ESGSoc						−0.102*		
						(−2.461)		
ESGGov			−0.072*				0.002**	
			(−1.744)				(2.571)	
High * ESGGov			0.005**					
			(2.402)					
ESGGov + High * ESGGov			*−0.067**					
t-test			*(−1.107)*					
Secondary * ESGGov							−0.041**	
							(−2.983)	
Tertiary * ESGGov							−0.102*	
							(−3.390)	
ESGINDEX				−0.000				0.000
				(−1.164)				(0.521)
High *ESGINDEX				0.000				
				(0.191)				

(Continues)

TABLE 7 | (Continued)

	Panel A				Panel B			
Variables	**OScore**	**OScore**	**OScore**	**OScore**	**OScore**	**OScore**	**OScore**	**OScore**
ESGINDEX + High * ESGINDEX				*−0.000*				
t-test				*(−1.257)*				
Secondary * ESGINDEX								−0.041**
								(−3.586)
Tertiary * ESGINDEX								−0.123**
								(−3.459)
LnFV	−0.005***	−0.004***	−0.002***	−0.005***	−0.004***	−0.005***	−0.004***	−0.004***
	(−85.480)	(−12.700)	(−6.065)	(−59.881)	(−74.374)	(−32.850)	(−14.849)	(−13.319)
Size	0.003***	0.002***	0.002***	0.002***	−0.003***	−0.002***	−0.002***	−0.002***
	(39.841)	(9.148)	(5.855)	(30.173)	(−30.941)	(−17.969)	(−10.151)	(−10.813)
Lev	0.038***	0.035***	0.035***	0.038***	0.039***	0.034***	0.032***	0.036***
	(168.329)	(22.503)	(15.336)	(91.090)	(106.034)	(36.980)	(20.067)	(22.655)
CAPEX	−0.060***	−0.045***	−0.038*	−0.088***	0.040***	0.069***	0.065***	0.065***
	(−22.935)	(−3.070)	(−1.718)	(−17.111)	(11.269)	(7.558)	(4.284)	(4.298)
$CAPEX^2$	0.071***	0.123	0.054	0.251***	−0.027	0.013	−0.042	−0.082
	(5.211)	(1.328)	(0.383)	(9.937)	(−1.538)	(0.251)	(−0.494)	(−0.943)
Extrema Point	*0.424*	*0.183*	*0.349*	*0.175*	*0.738*	*−2.664*	*0.774*	*0.398*
Lind-Mehlum	—	—	—	*3.40*	—	—	—	—
p-value	—	—	—	*0.384*	—	—	—	—
OWN1	−0.013***	−0.009***	−0.013***	−0.010***	−0.011***	−0.012***	−0.012***	−0.010***
	(−43.060)	(−5.985)	(−5.679)	(−26.902)	(−39.675)	(−15.310)	(−8.117)	(−6.795)
ECONFREE	−0.000***	−0.000	−0.000*	−0.000***	−0.000***	−0.000***	−0.000	−0.000
	(−13.357)	(−0.563)	(−1.928)	(−6.280)	(−9.210)	(−2.870)	(−0.864)	(−0.969)
WGI	0.011***	0.006**	0.007*	0.009***	0.006***	0.011***	0.012***	0.008***
	(30.221)	(2.044)	(1.876)	(8.449)	(12.109)	(6.965)	(4.236)	(2.615)
GNP	0.000***	0.000***	0.000***	0.000***	0.000***	0.000***	0.000***	0.000***
	(75.118)	(11.170)	(5.013)	(63.820)	(54.190)	(27.788)	(9.128)	(9.666)
Crisis	0.002***	0.001***	0.001***	0.002***	0.002***	0.002***	0.002***	0.001***
	(45.944)	(7.307)	(2.742)	(31.216)	(41.101)	(21.290)	(8.295)	(7.100)
Constant	0.064***	0.040***	0.039***	0.056***	0.059***	0.059***	0.051***	0.049***
	(36.505)	(7.138)	(5.096)	(29.784)	(29.915)	(16.169)	(9.090)	(9.449)
Observations	3560	3560	3560	3560	3560	3560	3560	3560
Cross-sections	340	340	340	340	340	340	340	340
Country Dummy	YES	YES	YES	YES	YES	YES	YES	YES
Year Dummy	YES	YES	YES	YES	YES	YES	YES	YES

(Continues)

TABLE 7 | (Continued)

	Panel A				Panel B			
Variables	**OScore**	**OScore**	**OScore**	**OScore**	**OScore**	**OScore**	**OScore**	**OScore**
Instruments	343	216	167	298	331	260	216	216
Avrg. Obs. per Group	10.47	10.47	10.47	10.47	10.47	10.47	10.47	10.47
AR(1)	−3.944	−3.930	−3.899	−3.942	−3.928	−3.971	−3.950	−3.918
p-value	0.000	0.412	0.434	0.000	0.000	0.398	0.000	0.449
AR(2)	−0.683	−0.821	−0.782	−0.676	−0.661	−0.846	−0.831	−0.758
p-value	0.495	0.355	0.198	0.499	0.508	0.717	0.406	0.892
Hansen	304.2	229.1	170.5	301.5	298.3	269.8	234.1	230
F-test	309.66	96.03	35.70	3186	6209	547.6	86.38	97.23

Note: The table displays the robustness results to test the second research hypothesis. Results in Panel A are used to assess the heterogeneous effect of ESG scores on listed firms in industry sectors separated by high (basic materials, energy, industrials, and utilities) and low (consumer cyclicals and non-cyclicals, healthcare, technology, and telecommunication services) environmental impact. Results in Panel B are used to assess the heterogenous effect of ESG scores on listed firms in industry sectors classified in primary (basic materials, energy, and industrials), secondary (consumer cyclicals and non-cyclicals, and utilities), and tertiary (healthcare, technology, and telecommunication services). The results considered OScore as the dependent variable, and sustainability measured through ESGEnv, ESGSoc, ESGGov, and ESGINDEX. Section 3 of the study describes the variables. Below the coefficients, the table reports the standard errors robust to heteroskedasticity following the method proposed by Windmeijer (2005). The suitable t test of linear combination of coefficients was used to test the significance of the interacted variables. Nonlinearity of CAPEX is assessed with the Lind-Mehlum test that provides the exact test of the presence of a U shaped (or inverse U shaped) relationship on an interval. Although not reported in the table, the option based on Fieller (1954) was used to find the interval for the extreme point. The nonlinearity of CAPEX is trivially rejected in all models except the fourth one as the extremum is outside the interval of the variable. Arellano-Bond AR(1) and AR(2) is an autocorrelation test of first and second order, respectively, using residuals in differences, asymptotically distributes as an N(0.1) and under the null hypothesis of no autocorrelation. Although AR(1) is expected in first differences, it does not invalidate the results. Instruments refer to the number of instruments used in the system GMM. Hansen test is a test of overidentifying restrictions or whether the instruments, as a group, appear exogenous, asymptotically distributed as a X^2 and robust to heteroskedasticity. Endogenous variables were instrumentalized with up to 3 years lagged according to Jara-Bertin et al. (2008), and the number of instruments were kept blow the number of cross-sections as suggested by Roodman (2009). *F* test contrasts the joint nullity of the estimated parameters. *$p<0.05$; **$p<0.01$; ***$p<0.001$.

financial recession of 2007–08 prompted the European Union to revise its corporate governance regulations, introducing additional disclosure requirements and enhancing Codes of Good Governance (CGGs). As noted by Impink et al. (2022), the gradual expansion of regulation-induced disclosures in annual reports has led to unintended consequences such as information overload, which increases risk factors. Similarly, excessive transparency can elevate default risk by disclosing too much sensitive information, potentially triggering overreactions from investors and creditors and exposing the company to unnecessary risks (Peasnell et al. 2005). As Sloan (1996) observed, stock prices often reflect naïve expectations about fundamental valuation attributes such as earnings, even when a firm's fundamentals are not significantly different from those of more opaque firms (Verrecchia 2001). Such overreactions can increase market volatility.

At the intersection of these arguments, moderate levels of financial disclosure provide investors and fund suppliers with sufficient information for informed decision-making. Based on this, we hypothesized a U-shaped relationship between the quality of financial statements and a company's default risk.

This hypothesis is strongly supported by the results in Table 5. In three out of four regressions, the EQCR variable exhibits a U-shaped relationship with default risk, as does the EQCF variable in all the models. For example, when considering the general models that account for the overall ESG score (ESGINDEX)–such as Models 8 and 12 in the table–, it is observed that corporate default risk is minimized when EQCR is 0.487, and when EQCF is 0.574, respectively. Graphically, these critical points are shown in Figure 1, Panels A and B, respectively, with Fieller (1954) confidence intervals also displayed. As shown in the histograms, the estimated optimization levels fall below the actual mean values of these variables, as detailed in Table 1. This suggests that companies have room to further reduce their default risk by properly balancing their financial transparency and disclosure policies.

The remaining results in Table 5 are qualitatively similar to those observed in previous tables, adding further robustness to our overall findings.

4.5 | Robustness Analysis

This section serves to verify the reliability of our main findings by conducting a robustness analysis. The analysis is carried out in two stages. In the first stage, we replace the (Altman 1968) *Z*-Score with the Ohlson (1980) O-Score as the dependent variable. Both are accounting-based measures of a firm's default risk and exhibit a strong positive correlation (0.513), indicating they aim to capture the same underlying risk. These results are presented in TableS 6–8. In the second stage, we change the estimation technique from the system GMM estimator (Blundell and Bond 1998) to the first-difference GMM estimator (Arellano and Bond 1991). The main advantage of the first-difference GMM is its ability to handle lagged dependent variables, thus capturing dynamic and persistent effects in the data. These results are reported in Tables A1–A3.

When using the O-Score as the dependent variable (OScore), the results remain largely consistent with the main findings. Table 6

TABLE 8 | Robustness: Main results for heterogeneity by earnings quality.

Variables	OScore	OScore	OScore	OScore	OScore	OScore	OScore	OScore	OScore	OScore	OScore	OScore
ESGEnv	−0.001**				−0.003***				−0.003***			
	(−2.140)				(−5.021)				(−5.679)			
ESGSoc		−0.001**				−0.001				−0.001		
		(−2.346)				(−1.501)				(−1.521)		
ESGGov			0.000				−0.000				0.001*	
			(0.143)				(−0.101)				(1.696)	
ESGINDEX				−0.000				−0.000				−0.001
				(−0.011)				(−0.216)				(−0.764)
EQER	0.003***	0.003***	0.003***	0.003***								
	(15.108)	(9.755)	(9.047)	(8.622)								
EQCR					−0.022***	−0.020***	−0.017***	−0.018***				
					(−17.170)	(−7.330)	(−6.268)	(−6.875)				
$EQCR^2$					0.019***	0.018***	0.015***	0.016***				
					(15.559)	(6.890)	(5.769)	(6.395)				
Extrema Point					*0.567*	*0.567*	*0.578*	*0.57*				
Lind-Mehlum					*13.68*	*6.32*	*5.16*	*0.79*				
p-value					*0.000*	*0.000*	*0.000*	*0.000*				
EQCF									−0.075***	−0.076***	−0.064***	−0.059***
									(−23.717)	(−15.456)	(−13.381)	(−11.252)
$EQCF^2$									0.055***	0.058***	0.047***	0.042***
									(20.496)	(13.475)	(11.420)	(9.228)
Extrema Point									*0.673*	*0.664*	*0.683*	*0.702*
Lind-Mehlum									*15.68*	*10.51*	*8.39*	*6.31*
p-value									*0.000*	*0.000*	*0.000*	*0.000*
LnFV	−0.004***	−0.003***	−0.003***	−0.004***	−0.005***	−0.003***	−0.004***	−0.004***	−0.003***	−0.002***	−0.003***	−0.003***
	(−29.632)	(−13.293)	(−14.575)	(−16.502)	(−23.837)	(−9.706)	(−10.917)	(−10.988)	(−13.819)	(−5.258)	(−9.287)	(−7.516)
Size	0.002***	0.001***	0.001***	0.001***	0.002***	0.002***	0.002***	0.002***	0.002***	0.001***	0.002***	0.002***

(Continues)

TABLE 8 | (Continued)

Variables	OScore	OScore	OScore	OScore	OScore	OScore	OScore	OScore	OScore	OScore	OScore	OScore
	(14.072)	(6.442)	(7.413)	(7.166)	(17.607)	(8.313)	(11.077)	(9.708)	(12.524)	(7.042)	(9.727)	(8.174)
Lev	0.031***	0.029***	0.030***	0.030***	0.036***	0.036***	0.034***	0.038***	0.033***	0.038***	0.034***	0.038***
	(35.248)	(21.221)	(23.725)	(21.812)	(33.996)	(19.700)	(18.004)	(20.043)	(31.025)	(21.631)	(19.351)	(21.378)
CAPEX	0.049***	0.012	0.020	0.037**	0.005	0.018	0.025	0.034*	−0.017	−0.003	0.001	0.032*
	(5.150)	(0.786)	(1.362)	(2.551)	(0.511)	(1.019)	(1.415)	(1.773)	(−1.612)	(−0.208)	(0.087)	(1.912)
$CAPEX^2$	−0.188***	0.081	0.080	−0.004	0.050	−0.029	−0.033	−0.084	−0.001	−0.082	−0.051	−0.219**
	(−3.092)	(0.794)	(0.807)	(−0.039)	(0.779)	(−0.264)	(−0.289)	(−0.683)	(−0.014)	(−0.803)	(−0.482)	(−2.020)
Extrema Point	*0.131*	*−0.075*	*−0.123*	*4.833*	*−0.052*	*0.311*	*0.386*	*0.206*	*−9.300*	*−0.021*	*0.013*	*0.072*
Lind-Mehlum	*1.82*	—	—	—	—	—	—	*0.05*	—	—	*0.09*	*1.91*
p-value	*0.035*	—	—	—	—	—	—	*0.479*	—	—	*0.466*	*0.028*
OWN1	−0.005***	−0.003**	−0.006***	−0.005***	−0.009***	−0.008***	−0.012***	−0.010***	−0.005***	−0.005***	−0.008***	−0.007***
	(−6.615)	(−2.507)	(−3.719)	(−3.575)	(−9.500)	(−4.875)	(−7.066)	(−6.376)	(−5.891)	(−3.272)	(−5.352)	(−4.928)
ECONFREE	0.000	0.000	0.000	−0.000	−0.000	−0.000	−0.000*	−0.000*	−0.000	−0.000	−0.000**	−0.000**
	(1.456)	(0.312)	(0.094)	(−0.258)	(−0.578)	(−1.302)	(−1.859)	(−1.959)	(−1.351)	(−1.542)	(−2.247)	(−2.112)
WGI	0.011***	0.005*	0.008***	0.004	0.008***	0.003	0.008**	0.002	0.008***	0.005*	0.006**	0.004
	(5.972)	(1.952)	(3.110)	(1.572)	(4.365)	(0.769)	(2.389)	(0.454)	(4.393)	(1.751)	(2.299)	(1.571)
GNP	0.000***	0.000***	0.000***	0.000***	0.000***	0.000***	0.000***	0.000***	0.000***	0.000***	0.000***	0.000***
	(10.318)	(3.522)	(3.462)	(2.788)	(16.785)	(7.157)	(8.480)	(6.995)	(17.957)	(8.285)	(8.241)	(8.083)
Crisis	0.003***	0.003***	0.003***	0.003***	0.002***	0.001***	0.002***	0.001***	0.001***	0.001***	0.001***	0.001***
	(17.252)	(10.324)	(9.438)	(9.965)	(12.575)	(5.960)	(7.711)	(6.314)	(12.914)	(3.637)	(4.626)	(3.903)
Constant	0.041***	0.024***	0.033***	0.030***	0.053***	0.041***	0.057***	0.050***	0.063***	0.052***	0.064***	0.058***
	(13.221)	(5.247)	(6.388)	(5.863)	(15.058)	(7.617)	(10.313)	(8.599)	(16.949)	(10.018)	(12.257)	(10.869)
Observations	3305	3305	3305	3305	3462	3462	3462	3462	3442	3442	3442	3442
Cross-sections	333	333	333	333	339	339	339	339	339	339	339	339
Country Dummy	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Year Dummy	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Instruments	244	188	188	188	268	207	207	207	268	207	207	207

(Continues)

TABLE 8 | (Continued)

Variables	OScore	OScore	OScore	OScore	OScore	OScore	OScore	OScore	OScore	OScore	OScore	OScore
Avrg. Obs. per Group	9.925	9.925	9.925	9.925	10.21	10.21	10.21	10.21	10.15	10.15	10.15	10.15
AR(1)	−3.460	−3.437	−3.441	−3.449	−3.972	−3.911	−3.900	−3.893	−4.106	−4.077	−4.007	−3.947
p-value	0.001	0.001	0.644	0.001	0.000	0.000	0.000	0.874	0.656	0.000	0.649	0.000
AR(2)	−0.416	−0.457	−0.462	−0.440	−0.137	−0.165	−0.236	−0.159	−0.446	−0.373	−0.456	−0.434
p-value	0.678	0.648	0.601	0.660	0.891	0.869	0.813	0.499	0.403	0.709	0.614	0.664
Hansen	251.1	199	190.6	199.5	261.4	197.2	205.4	206.9	253.5	201.5	213.8	211.9
F-test	480.6	493.2	187.8	202.1	264.5	86.09	106.7	91.03	286.4	109.1	104.1	111

Note: The table displays the robustness results to test the third research hypothesis. The results considered OScore as the dependent variable, and sustainability measured through ESGEnv, ESGSoc, ESGGov, and ESGINDEX. Section 3 of the study describes the variables. Below the coefficients, the table reports the standard errors robust to heteroskedasticity following the method proposed by Windmeijer (2005). The suitable t test of linear combination of coefficients was used to test the significance of the interacted variables. Nonlinearity of EQCR, EQCF, and CAPEX is assessed with the Lind-Mehlum test that provides the exact test of the presence of a U shaped (or inverse U shaped) relationship on an interval. Although not reported in the table, the option based on Fieller (1954) was used to find the interval for the extreme point. The nonlinearity of CAPEX is trivially rejected in almost all models as the extremum is outside the interval of the variable. Arellano-Bond AR(1) and AR(2) is an autocorrelation test of first and second order, respectively, using residuals in differences, asymptotically distributes as an N(0.1) and under the null hypothesis of no autocorrelation. Although AR(1) is expected in first differences, it does not invalidate the results. Instruments refer to the number of instruments used in the system GMM. Hansen test is a test of overidentifying restrictions or whether the instruments, as a group, appear exogenous, asymptotically distributed as a X^2 and robust to heteroskedasticity. Endogenous variables were instrumentalized with up to 3 years lagged according to Jara-Bertin et al. (2008), and the number of instruments were kept blow the number of cross-sections as suggested by Roodman (2009). *F* test contrasts the joint nullity of the estimated parameters. *$p<0.05$; **$p<0.01$; ***$p<0.001$.

confirms our first hypothesis that both ESGEnv and ESGINDEX retain negative and statistically significant coefficients, suggesting that better ESG performance is associated with reduced default risk.

Table 7 further supports our second hypothesis by accounting for industry effects. Firms in low environmental impact industries benefit more from ESG improvements than those in high-impact sectors when it comes to risk mitigation. Moreover, when industries are categorized as primary, secondary, and tertiary, we observe a gradient effect as concluded in the main findings. It means that while companies in the primary sector show some risk reduction with higher environmental and governance scores, the effect is stronger in the secondary sector and strongest in the tertiary sector. These patterns also hold when using the ESGINDEX variable.

Table 8 replicates the findings from Table 5, again showing that improved ESG scores are generally associated with reduced default risk, though some models show weaker statistical significance. Importantly, these results continue to support our first hypothesis. The third hypothesis, regarding the governance score, also finds further backing, where the findings indicated that companies required to restate financial reports (EQER) show increased default risk, and a U-shaped relationship emerges between financial transparency and the O-Score, reinforcing the non-linear dynamics posited in our third hypothesis (e.g., see variables EQCR and EQCF and their squared terms, as well as the estimated extrema points for further details).

Regarding control variables, the results are mostly consistent with the main analysis. However, capital expenditure (CAPEX) does not appear to significantly explain insolvency risk in any of the models from Tables 6–8. This does not undermine our primary conclusions. Additionally, while Gross National Product (GNP) shows a positive and statistically significant coefficient (unlike the negative one in the main results), its economic effect remains negligible due to the small magnitude of the estimated parameters (<0.000). As GNP is merely a control variable, this change does not affect the robustness of our key findings.

The second part of the robustness checks, reported in Tables A1–A3, mirrors the main analysis (Tables 3–5) but uses the first-difference GMM estimator. These models include a lagged dependent variable $\left(Z\text{Score}_{t-1}\right)$, which is positive and statistically significant across all models, indicating persistence in default risk. The results in these tables again confirm support for all three hypotheses. Control variables behave similarly to those in the main analysis, further affirming the robustness and consistency of our key results, even under alternative variable definitions and estimation techniques.

5 | Conclusions

This study aimed to assess the impact of ESG (Environmental, Social, and Governance) initiatives on corporate risk, specifically focusing on default risk, using data from European firms across 20 countries from 2008 to 2022. Through this multi-country analysis, we have extended the existing literature by addressing gaps related to the relationship between ESG activities and default risk, offering valuable insights into both statistical and economic relationships. We consider this field to be insufficiently explored. Most studies on this topic have focused on single-country analyses, limiting the generalizability of their findings (Korinth and Lueg 2022; Li et al. 2022; Peiró-Signes and Segarra-Oña 2013; Pistolesi and Teti 2024). Additionally, existing multi-country studies, in our view, present econometric limitations that compromise the robustness of their results (Maquieira et al. 2024; Sassen et al. 2016; Vivel-Búa et al. 2024). We see it as essential to move beyond these previous studies, and in our research, we have contextualized the hypotheses in light of the current European framework, aiming to align theoretical arguments with actionable implications.

First, our results demonstrate a strong, negative relationship between ESG initiatives and corporate default risk, suggesting that companies investing in sustainability tend to experience reduced financial uncertainty. For the sample of EU companies used in this study, these results are robust to different specifications, including year, country, and firm fixed effects; industry sector heterogeneity, econometric techniques, alternative specifications for the dependent variables, as well as corporate transparency control. This effect is particularly pronounced in low environmental impact industries, where investments in environmental, social, and governance practices are more effective in mitigating risk. In high-impact industries, also called environmentally sensitive industries, such as energy, industrials, and basic materials, the relationship between ESG scores and default risk is more complex, with limited evidence of risk mitigation. These results suggest that industry-specific factors play a crucial role in determining the effectiveness of ESG practices, highlighting the need for more nuanced strategies when assessing ESG impacts across different sectors.

Second, our analysis reveals a non-linear relationship between financial transparency and default risk. Moderate levels of financial transparency, as measured by earnings quality metrics, are most effective in minimizing default risk. Both insufficient and excessive transparency can increase the risk of insolvency—either by concealing critical risks or by exposing too much sensitive information to the market, leading to overreactions from investors and creditors. This finding has significant implications for corporate governance practices, suggesting that firms should carefully calibrate their financial disclosure strategies to achieve an optimal balance between transparency and confidentiality.

Third, these findings offer several implications for various stakeholders. For investors, particularly those focused on ESG criteria, the results provide evidence that aligning with ESG principles can serve as a risk-mitigation tool, especially in less environmentally aggressive industries. Investors should, however, be mindful of the industry context when evaluating ESG scores as indicators of financial stability. For policymakers, the study stresses the importance of promoting ESG disclosure standards that are tailored to different sectors, as a one-size-fits-all approach may not be effective in reducing corporate risk across the board. Moreover, regulators should consider the nuanced role of financial transparency in corporate governance, ensuring that disclosure requirements strike the right balance to avoid the adverse effects of both opacity and excessive transparency. In this respect, European regulatory policies, such as the EU Non-Financial Reporting Directive (NFRD), serve as crucial tools in ensuring that firms disclose relevant ESG information, fostering investor confidence and market stability. Extending and refining these regulations can further reduce corporate risk, particularly in high-impact sectors. For credit markets, the results suggest that ESG factors should be integrated into credit risk assessments, particularly for companies in sectors where ESG activities are shown to significantly reduce insolvency risk. For managers and board members, the findings reveal that a company's ESG activities must be aligned with the overarching firm strategy toward risk management. This requires ESG objectives to be fully integrated into operations like capital investments, corporate governance like reporting and control, and financing, like capital structure decisions. This study shows evidence that all these factors together correlate with the likelihood of bankruptcy.

Despite its contributions, this study has limitations that offer avenues for future research. For example, a specific research avenue could involve analyzing the interaction between ESG activities and other risk factors, such as innovation capacity or geopolitical risk, to provide a more holistic understanding of corporate risk management. Additionally, our analysis is restricted to non-financial firms in Europe, which may limit the generalizability of our findings to other regions or financial industries. Further analyses focused on the banking industry might shed light on this underexplored field.

In summary, this study enhances our understanding of the relationship between ESG practices across European companies of various non-financial sectors, financial transparency, and default risk. By doing so, it offers valuable insights for investors, policymakers, and credit markets, and lays the groundwork for future research on the evolving role of sustainability in corporate finance.

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Endnotes

[1] For more information visit https://climate-pact.europa.eu/index_en.

[2] Regulation (EU) 2019/2088 of the European Parliament and of the Council of 27 November 2019.

[3] https://databank.worldbank.org/source/worldwide-governance-indicators.

[4] https://www.heritage.org/index/.

[5] It measures a company's impact on living and non-living natural systems, including the air, land and water, as well as complete ecosystems. It reflects how well a company uses best management practices to avoid environmental risks and capitalize on environmental opportunities to general long term shareholder value.

[6] It measures a company's capacity to generate trust and loyalty with its workforce, customers and society, through its use of best management practices. It is a reflection of the company's reputation and the health of its license to operate, which are key factors in determining its ability to generate long term shareholder value.

[7] It measures a company's system and processes, which ensure that its board members and executives act in the best interest of its long-term shareholders. It reflects a company's capacity, through its use of best management practices, to direct and control its rights and responsibilities through the creation of incentives, as well as checks and balances in order to general long-term shareholder value.

[8] Tobin's Q is a concept borrowed from macroeconomics, originally introduced by economist James Tobin, and is defined as the market value of a firm's assets divided by their replacement cost. However, since this variable is typically unobservable to outsiders, it is common practice in finance and law literature to rely on proxy variables. In this study, the proxy used defines the denominator of the metric as the book value of total assets. Saona (2014) applies a metric that incorporates both a proxy for the replacement value of total assets and the traditional metric using the book value of total assets, finding a correlation coefficient of 0.95 between the two. Similarly, Perfect and Wiles (1994) report a cosrrelation coefficient of 0.96 between the two variables. Therefore, despite the criticisms in the literature regarding the use of a proxy for Tobin's Q (Barlett and Partnoy 2020) as a measure of firm value, we believe that the proxy is highly correlated with the original metric and is appropriate as an independent variable in our estimations.

[9] Recall that in order to run *ZScore* variable from low to high scores as default risk increases, the variable was multiplied by −1, as by original construction, its interpretation was in the other direction.

[10] For saving space, the VIF test for multicollinearity was not reported.

[11] Although we state that the U-shaped relationship is observed due to the negative and statistically significant coefficient of CAPEX and in the positive and significant coefficients of $CAPEX^2$, in addition to finding the extremum point within the rage of the CAPEX variable is just a weak criterion to justify the U shape. According to Lind and Mehlum (2010), this criterion is neither sufficient nor necessary. Indeed, the authors state that the significance of the quadratic variable alone is always a necessary condition in the test. Consequently, we use the Lind-Mehlum test to contrast the corresponding hypothesis of non-monotonic relationship between CAPEX and *Z*Score.

References

Abinzano, I., A. Gonzalez-Urteaga, L. Muga, and S. Sanchez. 2020. "Performance of Default-Risk Measures: The Sample Matters." *Journal of Banking & Finance* 120: 105959. https://doi.org/10.1016/j.jbankfin.2020.105959.

Abinzano, I., L. Garcés-Galdeano, and B. Martinez. 2023. "Female CEOs and Default Risk in Listed Family Firms." *Gender in Management: An International Journal* 38: 1135–1152. https://doi.org/10.1108/GM-01-2022-0030.

Abu-Ghunmi, D., A. Bino, and M. Tayeh. 2015. "Idiosyncratic Risk and Corporate Governance: Evidence From Jordan." *Emerging Markets Finance and Trade* 51, no. sup4: S40–S50. https://doi.org/10.1080/1540496X.2015.1026717.

Adams, R. B. 2016. "Women on Boards: The Superheroes of Tomorrow?" *Leadership Quarterly* 27, no. 3: 371–386. https://doi.org/10.1016/j.leaqua.2015.11.001.

Aggarwal, R., and N. Aung. 2009. "International Variations in Transparency and Capital Structure: Evidence From European Firms." *Journal of International Financial Management & Accounting* 20, no. 1: 1–34.

Agnese, P., F. Battaglia, F. Busato, and S. Taddeo. 2023. "ESG Controversies and Governance: Evidence From the Banking Industry." *Finance Research Letters* 53: 103397. https://doi.org/10.1016/j.frl.2022.103397.

Alareeni, B. A., and A. Hamdan. 2020. "ESG Impact on Performance of US S&P 500-Listed Firms." *Corporate Governance: The International Journal of Business in Society* 20, no. 7: 1409–1428. https://doi.org/10.1108/CG-06-2020-0258.

Altman, E. I. 1968. "Financial Ratios, Discriminant Analysis and the Prediction of Corporate Bankruptcy." *Journal of Finance* 23, no. 4: 589–609. https://doi.org/10.2307/2978933.

Altman, E. I., A. R. Bell, C. Brooks, and M. Prokopczuk. 2013. "Chapter 17: Predicting Financial Distress of Companies: Revisiting the Z-Score and ZETA Models." In *Handbook of Research Methods and Applications in Empirical Finance*, edited by A. R. Bell, C. Brooks, and M. Prokopczuk. Edward Elgar Publishing. https://doi.org/10.4337/9780857936080.00027.

Altman, E. I., M. Iwanicz-Drozdowska, E. K. Laitinen, and A. Suvas. 2017. "Financial Distress Prediction in an International Context: A Review and Empirical Analysis of Altman's Z-Score Model." *Journal of International Financial Management & Accounting* 28, no. 2: 131–171. https://doi.org/10.1111/jifm.12053.

Antonakis, J., N. Bastardoz, and M. Rönkkö. 2021. "On Ignoring the Random Effects Assumption in Multilevel Models: Review, Critique, and Recommendations." *Organizational Research Methods* 24, no. 2: 443–483. https://doi.org/10.1177/1094428119877457.

Arellano, M., and S. Bond. 1991. "Some Tests of Specification for Panel Data: Monte Carlo Evidence and an Application to Employment Equation." *Review of Economic Studies* 58, no. 2: 277–297.

Atz, U., T. Van Holt, Z. Z. Liu, and C. C. Bruno. 2023. "Does Sustainability Generate Better Financial Performance? Review, Meta-Analysis, and Propositions." *Journal of Sustainable Finance & Investment* 13, no. 1: 802–825. https://doi.org/10.1080/20430795.2022.2106934.

Baldini, M., L. D. Maso, G. Liberatore, F. Mazzi, and S. Terzani. 2018. "Role of Country- and Firm-Level Determinants in Environmental, Social, and Governance Disclosure." *Journal of Business Ethics* 150, no. 1: 79–98. https://doi.org/10.1007/s10551-016-3139-1.

Bansal, P., and I. Clelland. 2004. "Talking Trash: Legitimacy, Impression Management, and Unsystematic Risk in the Context of the Natural Environment." *Academy of Management Journal* 47, no. 1: 93–103. https://doi.org/10.2307/20159562.

Bansal, P., and M. R. DesJardine. 2014. "Business Sustainability: It Is About Time." *Strategic Organization* 12, no. 1: 70–78. https://doi.org/10.1177/1476127013520265.

Barlett, R., and F. Partnoy. 2020. "The Misuse of Tobin's q." *Vanderbilt Law Review* 73, no. 2: 353–424.

Barros, L. A. B. C., D. R. Bergmann, F. H. Castro, and A. D. M. d. Silveira. 2020. "Endogeneity in Panel Data Regressions: Methodological Guidance for Corporate Finance Researchers." *Revista Brasileira de Gestão de Negócios* 22, no. 1: 437–461.

Beck, T., and B. Casu. 2016. "European Banking: An Overview." In *The Palgrave Handbook of European Banking*, edited by T. Beck and B. Casu, 3–24. Palgrave Macmillan UK. https://doi.org/10.1057/978-1-137-52144-6_1.

Bekaert, G., C. R. Harvey, C. T. Lundblad, and S. Siegel. 2014. "Political Risk Spreads." *Journal of International Business Studies* 45, no. 4: 471–493. https://doi.org/10.1057/jibs.2014.4.

Bharath, S. T., J. Sunder, and S. V. Sunder. 2008. "Accounting Quality and Debt Contracting." *Accounting Review* 83, no. 1: 1–28. http://www.jstor.org/stable/30243509.

Bhattacharya, N., H. Desai, and K. Venkataraman. 2013. "Does Earnings Quality Affect Information Asymmetry? Evidence From Trading Costs." *Contemporary Accounting Research* 30, no. 2: 482–516. https://doi.org/10.1111/j.1911-3846.2012.01161.x.

Bhojraj, S., and P. Sengupta. 2003. "Effect of Corporate Governance on Bond Ratings and Yields: The Role of Institutional Investors and Outside Directors." *Journal of Business* 76, no. 3: 455–475. https://doi.org/10.1086/344114.

Blundell, R., and S. Bond. 1998. "Initial Conditions and Moment Restrictions in Dynamic Panel Data Models." *Journal of Econometrics* 87, no. 1: 115–143.

Boubaker, S., A. Cellier, R. Manita, and A. Saeed. 2020. "Does Corporate Social Responsibility Reduce Financial Distress Risk?" *Economic Modelling* 91: 835–851. https://doi.org/10.1016/j.econmod.2020.05.012.

Busch, T., and S. Lewandowski. 2018. "Corporate Carbon and Financial Performance: A Meta-Analysis." *Journal of Industrial Ecology* 22, no. 4: 745–759. https://doi.org/10.1111/jiec.12591.

Bushman, R., Q. Chen, E. Engel, and A. Smith. 2004. "Financial Accounting Information, Organizational Complexity and Corporate Governance Systems." *Journal of Accounting and Economics* 37, no. 2: 167–201. https://doi.org/10.1016/j.jacceco.2003.09.005.

Camilleri, M. A. 2015. "Environmental, Social and Governance Disclosures in Europe." *Sustainability Accounting, Management and Policy Journal* 6, no. 2: 224–242. https://doi.org/10.1108/SAMPJ-10-2014-0065.

Capelli, P., F. Ielasi, and A. Russo. 2021. "Forecasting Volatility by Integrating Financial Risk With Environmental, Social, and Governance Risk." *Corporate Social Responsibility and Environmental Management* 28, no. 5: 1483–1495. https://doi.org/10.1002/csr.2180.

Cathcart, L., A. Dufour, L. Rossi, and S. Varotto. 2020. "The Differential Impact of Leverage on the Default Risk of Small and Large Firms." *Journal of Corporate Finance* 60: 101541. https://doi.org/10.1016/j.jcorpfin.2019.101541.

Chen, C. R., and Y. S. Huang. 2009. "Economic Freedom, Equity Performance and Market Volatility." *International Journal of Accounting and Information Management* 17, no. 2: 189–197. https://doi.org/10.1108/18347640911001221.

Cheng, B., I. Ioannou, and G. Serafeim. 2014. "Corporate Social Responsibility and Access to Finance." *Strategic Management Journal* 35, no. 1: 1–23. https://doi.org/10.1002/smj.2131.

Choi, Y. M., and K. Park. 2022. "Zero-Leverage Policy and Stock Price Crash Risk: Evidence From Korea." *International Review of Financial Analysis* 81: 102102. https://doi.org/10.1016/j.irfa.2022.102102.

Chu, X., Q. Liu, and G. G. Tian. 2015. "Does Control-Ownership Divergence Impair Market Liquidity in an Emerging Market? Evidence From China." *Accounting and Finance* 55, no. 3: 881–910. https://doi.org/10.1111/acfi.12073.

Clark, G., A. Feiner, and M. Viehs. 2015. "From the Stockholder to the Stakeholder: How Sustainability Can Drive Financial Outperformance." University of Oxford and Arabesque Partners Report.

Clarkson, P. M., Y. Li, M. Pinnuck, and G. D. Richardson. 2015. "The Valuation Relevance of Greenhouse Gas Emissions Under the European Union Carbon Emissions Trading Scheme." *European Accounting Review* 24, no. 3: 551–580. https://doi.org/10.1080/09638180.2014.927782.

Cline, B. N., C. R. Williamson, and H. Xiong. 2021. "Culture and the Regulation of Insider Trading Across Countries." *Journal of Corporate Finance* 67: 101917. https://doi.org/10.1016/j.jcorpfin.2021.101917.

Croci, E., and D. Petmezas. 2015. "Do Risk-Taking Incentives Induce CEOs to Invest? Evidence From Acquisitions." *Journal of Corporate Finance* 32: 1–23. https://doi.org/10.1016/j.jcorpfin.2015.03.001.

Dechow, P. M., R. G. Sloan, and A. P. Sweeney. 1996. "Causes and Consequences of Earnings Manipulation: An Analysis of Firms Subject to Enforcement Actions by the SEC." *Contemporary Accounting Research* 13, no. 1: 1–36. https://doi.org/10.1111/j.1911-3846.1996.tb00489.x.

Deegan, C. 2002. "Introduction: The Legitimising Effect of Social and Environmental Disclosures – A Theoretical Foundation." *Accounting, Auditing & Accountability Journal* 15, no. 3: 282–311. https://doi.org/10.1108/09513570210435852.

Desai, H., C. E. Hogan, and M. S. Wilkins. 2006. "The Reputational Penalty for Aggressive Accounting: Earnings Restatements and Management Turnover." *Accounting Review* 81, no. 1: 83–112. http://www.jstor.org/stable/4093129.

Di Tommaso, C., and J. Thornton. 2020. "Do ESG Scores Effect Bank Risk Taking and Value? Evidence From European Banks." *Corporate Social Responsibility and Environmental Management* 27, no. 5: 2286–2298. https://doi.org/10.1002/csr.1964.

Diamond, D. W., and R. E. Verrecchia. 1991. "Disclosure, Liquidity, and the Cost of Capital." *Journal of Finance* 46, no. 4: 1325–1359. https://doi.org/10.1111/j.1540-6261.1991.tb04620.x.

Djankov, S., R. La Porta, F. Lopez-de-Silanes, and A. Shleifer. 2002. "The Regulation of Entry." *Quarterly Journal of Economics* 117, no. 1: 1–37. https://EconPapers.repec.org/RePEc:oup:qjecon:v:117:y:2002:i:1:p:1-37.

Eccles, R. G., I. Ioannou, and G. Serafeim. 2014. "The Impact of Corporate Sustainability on Organizational Processes and Performance." *Management Science* 60, no. 11: 2835–2857. http://www.jstor.org/stable/24550546.

Eccles, R. G., L.-E. Lee, and J. C. Stroehle. 2020. "The Social Origins of ESG: An Analysis of Innovest and KLD." *Organization & Environment* 33, no. 4: 575–596. https://doi.org/10.1177/1086026619888994.

El Ghoul, S., O. Guedhami, C. C. Y. Kwok, and D. R. Mishra. 2011. "Does Corporate Social Responsibility Affect the Cost of Capital?" *Journal of Banking & Finance* 35, no. 9: 2388–2406. https://doi.org/10.1016/j.jbankfin.2011.02.007.

Ettredge, M., Y. Huang, and W. Zhang. 2012. "Earnings Restatements and Differential Timeliness of Accounting Conservatism." *Journal of Accounting and Economics* 53, no. 3: 489–503. https://doi.org/10.1016/j.jacceco.2012.01.002.

European Commission. 2019. "The European Green Deal." COM(2019) 640 final.

Fazzari, S. M., R. G. Hubbard, B. C. Petersen, A. S. Blinder, and J. M. Poterba. 1988. "Financing Constraints and Corporate Investment." *Brookings Papers on Economic Activity* 1988, no. 1: 141–206. https://doi.org/10.2307/2534426.

Fieller, E. C. 1954. "Some Problems in Interval Estimation." *Journal of the Royal Statistical Society, Series B: Statistical Methodology* 16, no. 2: 175–185. http://www.jstor.org/stable/2984043.

Flammer, C. 2015. "Does Corporate Social Responsibility Lead to Superior Financial Performance? A Regression Discontinuity Approach." *Management Science* 61, no. 11: 2549–2568. https://doi.org/10.1287/mnsc.2014.2038.

García Lara, J. M., B. García Osma, and F. Penalva. 2016. "Accounting Conservatism and Firm Investment Efficiency." *Journal of Accounting and Economics* 61, no. 1: 221–238. https://doi.org/10.1016/j.jacceco.2015.07.003.

Giese, G., L.-E. Lee, D. Melas, Z. Nagy, and L. Nishikawa. 2019. "Foundations of ESG Investing: How ESG Affects Equity Valuation, Risk, and Performance." *Journal of Portfolio Management* 45, no. 5: 69. https://doi.org/10.3905/jpm.2019.45.5.069.

Godfrey, P. C., C. B. Merrill, and J. M. Hansen. 2009. "The Relationship Between Corporate Social Responsibility and Shareholder Value: An Empirical Test of the Risk Management Hypothesis." *Strategic Management Journal* 30, no. 4: 425–445. https://doi.org/10.1002/smj.750.

Gompers, P., J. Ishii, and A. Metrick. 2003. "Corporate Governance and Equity Prices." *Quarterly Journal of Economics* 118, no. 1: 107–156. https://doi.org/10.1162/00335530360535162.

Goss, A., and G. S. Roberts. 2011. "The Impact of Corporate Social Responsibility on the Cost of Bank Loans." *Journal of Banking & Finance* 35, no. 7: 1794–1810. https://doi.org/10.1016/j.jbankfin.2010.12.002.

Habermann, F., and F. B. Fischer. 2023. "Corporate Social Performance and the Likelihood of Bankruptcy: Evidence From a Period of Economic Upswing." *Journal of Business Ethics* 182, no. 1: 243–259. https://doi.org/10.1007/s10551-021-04956-4.

Hawn, O., A. K. Chatterji, and W. Mitchell. 2018. "Do Investors Actually Value Sustainability? New Evidence From Investor Reactions to the Dow Jones Sustainability Index (DJSI)." *Strategic Management Journal* 39, no. 4: 949–976. https://doi.org/10.1002/smj.2752.

He, F., S. Qin, Y. Liu, and J. Wu. 2022. "CSR and Idiosyncratic Risk: Evidence From ESG Information Disclosure." *Finance Research Letters* 49: 102936. https://doi.org/10.1016/j.frl.2022.102936.

Hermalin, B. E., and M. S. Weisbach. 2003. "Boards of Directors as an Endogenously Determined Institution: A Survey of the Economic Literature." *Economic Policy Review* 9, no. 1: 7–26.

Hermalin, B. E., and M. S. Weisbach. 2012. "Information Disclosure and Corporate Governance." *Journal of Finance* 67, no. 1: 195–233. https://doi.org/10.1111/j.1540-6261.2011.01710.x.

Hill, C. W. L., and T. M. Jones. 1992. "Stakeholder-Agency Theory." *Journal of Management Studies* 29, no. 2: 131–154. https://doi.org/10.1111/j.1467-6486.1992.tb00657.x.

Impink, J., M. Paananen, and A. Renders. 2022. "Regulation-Induced Disclosures: Evidence of Information Overload?" *Abacus* 58, no. 3: 432–478. https://doi.org/10.1111/abac.12246.

Jara-Bertin, M., F. J. López-Iturriaga, and Ó. López-de-Foronda. 2008. "The Contest to the Control in European Family Firms: How Other Shareholders Affect Firm Value." *Corporate Governance: An International Review* 16, no. 3: 146–159. https://doi.org/10.1111/j.1467-8683.2008.00677.x.

Jensen, M. C. 1986. "Agency Costs of Free Cash Flow, Corporate Finance, and Takeovers." *American Economic Review* 76, no. 2: 323–329.

Jensen, M. C., and W. Meckling. 1976. "Theory of the Firm: Managerial Behaviour, Agency Cost and Ownership Structure." *Journal of Financial Economics* 3, no. 4: 305–360.

John, K., L. Litov, and B. Yeung. 2008. "Corporate Governance and Risk-Taking." *Journal of Finance* 63, no. 4: 1679–1728. https://doi.org/10.1111/j.1540-6261.2008.01372.x.

Kaiser, L. 2020. "ESG Integration: Value, Growth and Momentum." *Journal of Asset Management* 21, no. 1: 32–51. https://doi.org/10.1057/s41260-019-00148-y.

Kaufmann, D., A. Kraay, and M. Mastruzzi. 2011. "The Worldwide Governance Indicators: Methodology and Analytical Issues." *Hague Journal on the Rule of Law* 3, no. 2: 220–246. https://doi.org/10.1017/S1876404511200046.

Khan, M. A. 2022. "ESG Disclosure and Firm Performance: A Bibliometric and Meta Analysis." *Research in International Business and Finance* 61: 101668. https://doi.org/10.1016/j.ribaf.2022.101668.

Kiviet, J., M. Pleus, and R. Poldermans. 2017. "Accuracy and Efficiency of Various GMM Inference Techniques in Dynamic Micro Panel Data Models." *Econometrics* 5, no. 1: 14.

Kılcı, E. N. 2019. "Analysis of the Relationship Between Economic Freedom Index and Stock Market Indices; Evidence From Turkey [Ekonomik Özgürlük Endeksi ve Hisse Senedi Piyasası Endeksi Arasındaki İlişkinin Analizi; Türkiye Örneği]." *Maliye Ve Finans Yazıları* 111: 117–134. https://doi.org/10.33203/mfy.4916362019.

Korinth, F., and R. Lueg. 2022. "Corporate Sustainability and Risk Management—The U-Shaped Relationships of Disaggregated ESG Rating Scores and Risk in the German Capital Market." *Sustainability* 14, no. 9: 5735. https://www.mdpi.com/2071-1050/14/9/5735.

La Torre, M., S. Sabelfeld, M. Blomkvist, L. Tarquinio, and J. Dumay. 2018. "Harmonising Non-Financial Reporting Regulation in Europe." *Meditari Accountancy Research* 26, no. 4: 598–621. https://doi.org/10.1108/MEDAR-02-2018-0290.

Laeven, L., and R. Levine. 2009. "Bank Governance, Regulation and Risk Taking." *Journal of Financial Economics* 93, no. 2: 259–275. https://doi.org/10.1016/j.jfineco.2008.09.003.

Leuz, C., and P. D. Wysocki. 2016. "The Economics of Disclosure and Financial Reporting Regulation: Evidence and Suggestions for Future Research." *Journal of Accounting Research* 54, no. 2: 525–622. https://doi.org/10.1111/1475-679X.12115.

Li, H., X. Zhang, and Y. Zhao. 2022. "ESG and Firm's Default Risk." *Finance Research Letters* 47: 102713. https://doi.org/10.1016/j.frl.2022.102713.

Lind, J. T., and H. Mehlum. 2010. "With or Without U? The Appropriate Test for a U-Shaped Relationship." *Oxford Bulletin of Economics and Statistics* 72: 109–118. https://doi.org/10.1111/j.1468-0084.2009.00569.x.

Löffler, G. 2004. "Ratings Versus Market-Based Measures of Default Risk in Portfolio Governance." *Journal of Banking & Finance* 28, no. 11: 2715–2746. https://doi.org/10.1016/j.jbankfin.2004.06.007.

Maquieira, C. P., J. T. Arias, and C. Espinosa-Méndez. 2024. "The Impact of ESG on the Default Risk of Family Firms: International Evidence." *Research in International Business and Finance* 67: 102136. https://doi.org/10.1016/j.ribaf.2023.102136.

Nirino, N., E. Battisti, A. Ferraris, S. Dell'Atti, and M. F. Briamonte. 2022. "How and When Corporate Social Performance Reduces Firm Risk? The Moderating Role of Corporate Governance." *Corporate Social Responsibility and Environmental Management* 29, no. 6: 1995–2005. https://doi.org/10.1002/csr.2296.

Oberthür, S., and C. Dupont. 2021. "The European Union's International Climate Leadership: Towards a Grand Climate Strategy?" *Journal of European Public Policy* 28, no. 7: 1095–1114. https://doi.org/10.1080/13501763.2021.1918218.

Ohlson, J. A. 1980. "Financial Ratios and the Probabilistic Prediction of Bankruptcy." *Journal of Accounting Research* 18, no. 1: 109–131. https://doi.org/10.2307/2490395.

Patten, D. M. 2002. "The Relation Between Environmental Performance and Environmental Disclosure: A Research Note." *Accounting, Organizations and Society* 27, no. 8: 763–773. https://doi.org/10.1016/S0361-3682(02)00028-4.

Peasnell, K. V., P. F. Pope, and S. Young. 2005. "Board Monitoring and Earnings Management: Do Outside Directors Influence Abnormal Accruals?" *Journal of Business Finance & Accounting* 32, no. 7–8: 1311–1346. https://doi.org/10.1111/j.0306-686X.2005.00630.x.

Peiró-Signes, A., and M.-d.-V. Segarra-Oña. 2013. "Trends in ESG Practices: Differences and Similarities Across Major Developed Markets." In *Sustainability Appraisal: Quantitative Methods and Mathematical Techniques for Environmental Performance Evaluation*, edited by M. G. Erechtchoukova, P. A. Khaiter, and P. Golinska, 125–140. Springer Berlin Heidelberg. https://doi.org/10.1007/978-3-642-32081-1_6.

Perfect, S., and K. Wiles. 1994. “Alternative Constructions of Tobin's Q: An Empirical Comparison.” *Journal of Empirical Finance* 1, no. 3–4: 313–341.

Pistolesi, F., and E. Teti. 2024. “Shedding Light on the Relationship Between ESG Ratings and Systematic Risk.” *Finance Research Letters* 60: 104882. https://doi.org/10.1016/j.frl.2023.104882.

Plumlee, M., D. Brown, R. M. Hayes, and R. S. Marshall. 2015. “Voluntary Environmental Disclosure Quality and Firm Value: Further Evidence.” *Journal of Accounting and Public Policy* 34, no. 4: 336–361. https://doi.org/10.1016/j.jaccpubpol.2015.04.004.

Richardson, S. 2006. “Over-Investment of Free Cash Flow.” *Review of Accounting Studies* 11, no. 2: 159–189. https://doi.org/10.1007/s11142-006-9012-1.

Roodman, D. 2009. “A Note on the Theme of Too Many Instruments.” *Oxford Bulletin of Economics and Statistics* 71, no. 1: 135–158. https://doi.org/10.1111/j.1468-0084.2008.00542.x.

Saona, P. 2014. “Internal Corporate Governance Mechanisms as Drivers of Firm Value: Panel Data Evidence for Chilean Firms.” *Review of Managerial Science* 8, no. 4: 575–604. https://doi.org/10.1007/s11846-013-0115-3.

Saona, P., and L. Muro. 2023. “The Influence of Firms' ESG Initiatives on Firm Value: An Analysis of Select European Firms.” In *The Routledge Handbook of Green Finance*, edited by O. M. Lehner, T. Harrer, H. Silvola, and O. Weber, vol. 1, 167–188. Routledge.

Saona, P., and P. San Martín. 2016. “Country Level Governance Variables and Ownership Concentration as Determinants of Firm Value in Latin America.” *International Review of Law and Economics* 47, no. 1: 84–95.

Saona, P., L. Muro, P. San Martín, and C. Cid. 2020. “Ibero-American Corporate Ownership and Boards of Directors: Implementation and Impact on Firm Value in Chile and Spain.” *Economic Research-Ekonomska Istraživanja* 33, no. 1: 2138–2170. https://doi.org/10.1080/1331677X.2019.1694558.

Saona, P., L. Muro, P. San Martín, and R. McWay. 2024. “Do Board Gender Diversity and Remuneration Impact Earnings Quality? Evidence From Spanish Firms.” *Gender in Management: An International Journal* 39, no. 1: 18–51. https://doi.org/10.1108/GM-04-2021-0113.

Saona, P., P. San Martín, and M. Jara. 2018. “Group Affiliation and Ownership Concentration as Determinants of Capital Structure Decisions: Contextualizing the Facts for an Emerging Economy.” *Emerging Markets Finance and Trade* 54, no. 14: 3312–3329. https://doi.org/10.1080/1540496X.2017.1392850.

Saona, P., P. San-Martin, and E. Vallelado. 2024. “The Zero-Debt Puzzle in BRICS Countries: Disentangling the Financial Flexibility and Financial Constraints Hypotheses.” *Emerging Markets Review* 61: 101163. https://doi.org/10.1016/j.ememar.2024.101163.

Sassen, R., A.-K. Hinze, and I. Hardeck. 2016. “Impact of ESG Factors on Firm Risk in Europe.” *Journal of Business Economics* 86, no. 8: 867–904. https://doi.org/10.1007/s11573-016-0819-3.

Sengupta, P. 1998. “Corporate Disclosure Quality and the Cost of Debt.” *Accounting Review* 73, no. 4: 459–474. http://www.jstor.org/stable/248186.

Sharma, Z., and L. Song. 2018. “Corporate Social Responsibility (CSR) Practices by SIN Firms.” *Asian Review of Accounting* 26, no. 3: 359–372. https://doi.org/10.1108/ARA-06-2017-0102.

Sharpe, W. F. 1972. “Risk, Market Sensitivity and Diversification.” *Financial Analysts Journal* 28, no. 1: 74–79. https://doi.org/10.2469/faj.v28.n1.74.

Shleifer, A., and R. W. Vishny. 1986. “Large Shareholders and Corporate Control.” *Journal of Political Economy* 94, no. 3, Part 1: 461–488.

Singhania, M., and D. Gupta. 2024. “Impact of Environmental, Social and Governance (ESG) Disclosure on Firm Risk: A Meta-Analytical Review.” *Corporate Social Responsibility and Environmental Management* 31, no. 4: 3573–3613. https://doi.org/10.1002/csr.2725.

Sloan, R. G. 1996. “Do Stock Prices Fully Reflect Information in Accruals and Cash Flows About Future Earnings?” *Accounting Review* 71, no. 3: 289–315. http://www.jstor.org/stable/248290.

Suchman, M. C. 1995. “Managing Legitimacy: Strategic and Institutional Approaches.” *Academy of Management Review* 20, no. 3: 571–610. https://doi.org/10.2307/258788.

Tahmid, T., F. Nasrin, P. Saona, and M. A. K. Azad. 2024. “Revisiting the Impact of Board Characteristics on Environmental, Social and Governance Performance: Lesson From European Firms.” *International Journal of Sustainable Economy* 16, no. 4: 452–486. https://doi.org/10.1504/ijse.2024.141703.

Tao, H., S. Zhuang, R. Xue, W. Cao, J. Tian, and Y. Shan. 2022. “Environmental Finance: An Interdisciplinary Review.” *Technological Forecasting and Social Change* 179: 121639. https://doi.org/10.1016/j.techfore.2022.121639.

Traczynski, J. 2017. “Firm Default Prediction: A Bayesian Model-Averaging Approach.” *Journal of Financial and Quantitative Analysis* 52, no. 3: 1211–1245. https://doi.org/10.1017/S002210901700031X.

Turban, D. B., and D. W. Greening. 1997. “Corporate Social Performance and Organizational Attractiveness to Prospective Employees.” *Academy of Management Journal* 40, no. 3: 658–672. https://doi.org/10.5465/257057.

Verrecchia, R. E. 2001. “Essays on disclosure.” *Journal of Accounting and Economics* 32, no. 1: 97–180. https://doi.org/10.1016/S0165-4101(01)00025-8.

Vivel-Búa, M., R. Lado-Sestayo, A. Martínez-Salgueiro, and M. Díaz-Ballesteros. 2024. “Environmental, Social, and Governance Perfomance and Default Risk in the Eurozone.” *Review of Managerial Science* 18, no. 10: 2953–2980. https://doi.org/10.1007/s11846-023-00702-4.

Vivel-Búa, M., R. Lado-Sestayo, and L. Otero-González. 2018. “Risk Determinants in the Hotel Sector: Risk Credit in MSMEs.” *International Journal of Hospitality Management* 70: 110–119. https://doi.org/10.1016/j.ijhm.2017.11.004.

Windmeijer, F. 2005. “A Finite Sample Correction for the Variance of Linear Efficient Two-Step GMM Estimators.” *Journal of Econometrics* 126: 25–51.

Zmijewski, M. E. 1984. “Methodological Issues Related to the Estimation of Financial Distress Prediction Models.” *Journal of Accounting Research* 22: 59–82. https://doi.org/10.2307/2490859.

Appendix A

TABLE A1 | Main results.

Variables	*Z*Score	*Z*Score	*Z*Score	*Z*Score
*Z*Score$_{t-1}$	0.038***	0.029***	0.034***	0.035***
	(91.623)	(40.499)	(50.288)	(50.440)
ESGEnv	−0.447***			
	(−13.224)			
ESGSoc		−1.236***		
		(−32.531)		
ESGGov			−0.212***	
			(−6.843)	
ESGINDEX				−1.114***
				(−21.379)
LnFV	−16.891***	−16.790***	−17.048***	−16.901***
	(−919.480)	(−837.182)	(−985.520)	(−1039.513)
Size	0.881***	0.881***	0.996***	0.870***
	(−27.248)	(−70.617)	(−48.505)	(−43.497)
Lev	36.292***	36.858***	36.824***	36.492***
	(341.243)	(247.907)	(518.372)	(376.283)
CAPEX	−4.419***	−0.872	−0.257	−0.768
	(−5.730)	(−1.338)	(−0.383)	(−1.421)
CAPEX^2	43.157***	26.465***	24.713***	25.028***
	(11.162)	(7.082)	(7.611)	(7.432)
Extrema Point	*0.051*	*0.016*	*0.005*	*0.015*
Lind-Mehlum	*5.720*	*1.330*	*0.370*	*1.410*
p-value	*0.000*	*0.092*	*0.355*	*0.080*
OWN1	−2.142***	−1.622***	−2.159***	−1.749***
	(−20.967)	(−15.802)	(−25.766)	(−22.306)
ECONFREE	−0.026***	−0.033***	−0.028***	−0.030***
	(−12.602)	(−14.088)	(−14.088)	(−11.162)
WGI	12.968***	7.933***	11.845***	10.143***
	(52.450)	(33.291)	(44.530)	(30.281)
GNP	−0.005***	−0.007***	−0.006***	−0.004***
	(−14.209)	(−10.066)	(−11.825)	(−8.714)
Crisis	0.591***	0.600***	0.596***	0.571***
	(−51.834)	(−49.443)	(−70.128)	(−134.183)
Constant	−6.724***	−2.058***	−3.467***	−4.404***
	(−7.494)	(−7.784)	(−7.457)	(−6.624)
Observations	2716	2716	2716	2716
Cross-sections	304	304	304	304

(Continues)

TABLE A1 | (Continued)

Variables	*Z*Score	*Z*Score	*Z*Score	*Z*Score
Country Dummy	YES	YES	YES	YES
Year Dummy	YES	YES	YES	YES
Instruments	343	343	343	343
Avrg. Obs. per Group	8.934	8.934	8.934	8.934
AR(1)	−2.853**	−2.785**	−2.829***	−2.829***
AR(2)	−1.663	−1.772	−1.750	−1.748
Sargan	291.2	293.4	295.6	296.8
Wald	3770***	8521***	3540***	5030***

Note: The table displays the robustness results to test the first research hypothesis. The results considered *Z*Score as the dependent variable, and sustainability measured through ESGEnv, ESGSoc, ESGGov, and ESGINDEX. Section 3 of the study describes the variables. Below the coefficients, the table reports the standard errors robust to heteroskedasticity following the method proposed by Windmeijer (2005). Nonlinearity of CAPEX is assessed with the Lind-Mehlum test that provides the exact test of the presence of a U shaped (or inverse U shaped) relationship on an interval. Although not reported in the table, the option based on Fieller (1954) was used to find the interval for the extreme point. Arellano-Bond AR(1) and AR(2) is an autocorrelation test of first and second order, respectively, using residuals in differences, asymptotically distributes as an N(0.1) and under the null hypothesis of no autocorrelation. Although AR(1) is expected in first differences, it does not invalidate the results. Instruments refer to the number of instruments used in the first-difference GMM estimator. Sargan test is a test of overidentifying restrictions or whether the instruments, as a group, appear exogenous, asymptotically distributed as a X^2 and robust to heteroskedasticity. The null hypothesis is that the overidentifying restrictions are valid. Endogenous variables were instrumentalized with up to 3 years lagged according to Jara-Bertin et al. (2008), and the number of instruments were kept blow the number of cross-sections as suggested by Roodman (2009). Wald test contrasts the joint nullity of the estimated parameters. *$p < 0.05$; **$p < 0.01$; ***$p < 0.001$.

TABLE A2 | Main results for heterogeneity by industry sector.

Variables	Panel A				Panel B			
	*Z*Score	*Z*Score	*Z*Score	*Z*Score	*Z*Score	*Z*Score	*Z*Score	*Z*Score
*Z*Score$_{t-1}$	0.041***	0.031***	0.035***	0.037***	0.039***	0.028***	0.035***	0.035***
	(77.568)	(35.974)	(52.156)	(49.300)	(63.253)	(61.342)	(47.293)	(43.794)
ESGEnv	−1.703***				0.145**			
	(−17.484)				(2.017)			
High * ESGEnv	2.303***							
	(16.513)							
ESGEnv + High * ESGEnv	*0.600*							
t-test	*(0.780)*							
Secondary * ESGEnv					−0.922***			
					(−6.987)			
Tertiary * ESGEnv					−1.714***			
					(−7.725)			
ESGSoc		−2.969***				−0.400***		
		(−39.592)				(−7.513)		
High * ESGSoc		3.137***						
		(22.984)						
ESGSoc + High * ESGSoc		*0.168**						
t-test		*(2.320)*						
Secondary * ESGSoc						−0.358***		
						(−3.876)		
Tertiary * ESGSoc						−4.413***		
						(−27.802)		
ESGGov			−0.191***				−0.536***	
			(−6.045)				(−14.114)	
High * ESGGov			0.034***					
			(23.150)					
ESGGov + High * ESGGov			*−0.157**					
t-test			*(−1.540)*					
Secondary * ESGGov							−0.236***	
							(−3.169)	
Tertiary * ESGGov							−1.008***	
							(−23.089)	
ESGINDEX				−2.045***				−0.637***
				(−27.356)				(−7.182)
High *ESGINDEX				1.893***				
				(16.046)				
ESGINDEX + High * ESGINDEX				*−0.152**				
t-test				*(−1.407)*				
Secondary * ESGINDEX								−0.500***
								(−3.187)
Tertiary * ESGINDEX								−1.476***
								(−10.028)

(Continues)

Variables	Panel A ZScore	Panel A ZScore	Panel A ZScore	Panel A ZScore	Panel B ZScore	Panel B ZScore	Panel B ZScore	Panel B ZScore
LnFV	−16.899***	−16.805***	−17.004***	−16.913***	−16.915***	−16.807***	−17.006***	−16.902***
	(−5.976)	(−7.881)	(−6.809)	(−1.574)	(−533.621)	(−1200.695)	(−552.369)	(−677.863)
Size	0.827***	0.817***	0.989***	0.852***	−0.849***	−0.822***	−0.991***	−0.853***
	(28.757)	(30.772)	(67.201)	(38.687)	(−27.229)	(−58.109)	(−42.700)	(−30.238)
Lev	36.306***	36.920***	36.786***	36.482***	36.334***	36.787***	36.835***	36.462***
	(346.833)	(266.209)	(354.424)	(339.994)	(295.555)	(266.583)	(442.711)	(347.436)
CAPEX	−5.087***	−0.883	−0.476	−0.955	−4.828***	−1.237	0.264	−2.112*
	(−4.752)	(−1.300)	(−0.791)	(−1.584)	(−5.845)	(−1.437)	(0.376)	(−1.933)
$CAPEX^2$	46.752***	26.549***	25.712***	26.371***	45.139***	26.882***	21.696***	32.138***
	(8.709)	(7.283)	(8.530)	(7.421)	(10.875)	(6.080)	(5.758)	(5.337)
Extrema Point	*0.054*	*0.017*	*0.009*	*0.018*	*0.535*	*0.023*	*−0.006*	*0.033*
Lind-Mehlum	*4.75*	*1.29*	*0.78*	*1.57*	*5.84*	*1.43*	—	*1.93*
p-value	*0.000*	*0.099*	*0.218*	*0.058*	*0.000*	*0.076*	—	*0.027*
OWN1	−2.293***	−1.701***	−2.216***	−1.833***	−2.206***	−1.647***	−2.100***	−1.888***
	(−17.931)	(−17.391)	(−23.762)	(−17.205)	(−17.399)	(−20.389)	(−22.218)	(−11.998)
ECONFREE	−0.026***	−0.040***	−0.027***	−0.032***	−0.023***	−0.039***	−0.024***	−0.033***
	(−9.631)	(−18.076)	(−11.908)	(−9.191)	(−11.338)	(−16.460)	(−9.882)	(−10.750)
WGI	12.807***	7.953***	11.869***	10.195***	13.194***	7.566***	12.116***	10.165***
	(46.714)	(28.831)	(33.402)	(38.435)	(66.957)	(25.519)	(37.363)	(34.976)
GNP	−0.004***	−0.007***	−0.006***	−0.005***	−0.004***	−0.006***	−0.006***	−0.004***
	(−10.308)	(−12.143)	(−13.511)	(−7.700)	(−10.831)	(−14.246)	(−11.250)	(−6.966)
Crisis	0.590***	0.597***	0.590***	0.576***	0.590***	0.589***	0.591***	0.579***
	(60.968)	(71.675)	(77.342)	(94.435)	(43.307)	(63.868)	(74.500)	(63.426)
Constant	−7.822***	−2.870***	−3.696***	−4.672***	−7.880***	−2.678***	−4.073***	−4.571***
	(−12.054)	(−5.309)	(−9.463)	(−8.024)	(−9.827)	(−6.271)	(−7.018)	(−5.899)
Observations	2716	2716	2716	2716	2716	2716	2716	2716
Cross-sections	304	304	304	304	304	304	304	304
Country Dummy	YES	YES	YES	YES	NO	NO	NO	NO
Year Dummy	YES	YES	YES	YES	YES	YES	YES	YES
Instruments	344	344	344	344	345	345	345	345
Avrg. Obs. per Group	8.934	8.934	8.934	8.934	8.934	8.934	8.934	8.934
AR(1)	−2.864	−2.769	−2.838	−2.834	−2.853	−2.764	−2.831	−2.834
AR(2)	−1.638**	−1.711***	−1.763**	−1.692***	−1.647***	−1.771**	−1.754**	−1.716**
Sargan	292.9	295.5	295.2	296.1	292.5	294.2	292	295.2
Wald	48266***	2470***	1230***	2770**	1209***	5307***	5743***	6270***

Note: The table displays the robustness results to test the second research hypothesis. Results in Panel A are used to assess the heterogeneous effect of ESG scores on listed firms in industry sectors separated by high (basic materials, energy, industrials, and utilities) and low (consumer cyclicals and non-cyclicals, healthcare, technology, and telecommunication services) environmental impact. Results in Panel B are used to assess the heterogenous effect of ESG scores on listed firms in industry sectors classified in primary (basic materials, energy, and industrials), secondary (consumer cyclicals and non-cyclicals, and utilities), and tertiary (healthcare, technology, and telecommunication services). The results considered ZScore as the dependent variable, and sustainability measured through ESGEnv, ESGSoc, ESGGov, and ESGINDEX. Section 3 of the study describes the variables. Below the coefficients, the table reports the standard errors robust to heteroskedasticity following the method proposed by Windmeijer (2005). The suitable t test of linear combination of coefficients was used to test the significance of the interacted variables. Nonlinearity of CAPEX is assessed with the Lind-Mehlum test that provides the exact test of the presence of a U shaped (or inverse U shaped) relationship on an interval. Although not reported in the table, the option based on Fieller (1954) was used to find the interval for the extreme point. The nonlinearity of CAPEX is trivially rejected in the seventh model as the extremum is outside the interval of the variable. Arellano-Bond AR(1) and AR(2) is an autocorrelation test of first and second order, respectively, using residuals in differences, asymptotically distributes as an N(0.1) and under the null hypothesis of no autocorrelation. Although AR(1) is expected in first differences, it does not invalidate the results. Instruments refer to the number of instruments used in the first-difference GMM estimator. Sargan test is a test of overidentifying restrictions or whether the instruments, as a group, appear exogenous, asymptotically distributed as a X^2 and robust to heteroskedasticity. The null hypothesis is that the overidentifying restrictions are valid. Endogenous variables were instrumentalized with up to 3 years lagged according to Jara-Bertin et al. (2008), and the number of instruments were kept blow the number of cross-sections as suggested by Roodman (2009). Wald test contrasts the joint nullity of the estimated parameters. *$p < 0.05$; **$p < 0.01$; ***$p < 0.001$.

TABLE A3 | Main results for heterogeneity by earnings quality.

Variables	*Z*Score	*Z*Score	*Z*Score	*Z*Score	*Z*Score	*Z*Score	*Z*Score	*Z*Score	*Z*Score	*Z*Score	*Z*Score	*Z*Score
$ZScore_{t-1}$	0.014***	0.015***	0.019***	0.019***	0.054***	0.052***	0.053***	0.053***	0.043***	0.039***	0.040***	0.041***
	(39.467)	(65.427)	(52.619)	(82.536)	(66.353)	(62.104)	(56.231)	(54.275)	(40.323)	(57.151)	(40.011)	(60.507)
ESGEnv	−0.329***				−0.664***				−0.575***			
	(−15.683)				(−9.418)				(−8.647)			
ESGSoc		−1.340***				−1.215***				−1.465***		
		(−34.208)				(−27.206)				(−21.715)		
ESGGov			−0.101***				−0.408***				−0.160***	
			(−10.155)				(−11.971)				(−3.821)	
ESGINDEX				−0.934***				−1.015***				−1.145***
				(−22.647)				(−10.861)				(−13.609)
EQER	−0.044***	−0.084***	−0.072***	−0.077***								
	(−6.100)	(−7.582)	(−3.818)	(−6.240)								
EQCR					0.122**	−0.184***	−0.114*	−0.209**				
					(2.300)	(−3.959)	(−1.793)	(−2.576)				
$EQCR^2$					0.497***	0.787***	0.725***	0.810***				
					(9.401)	(15.563)	(11.318)	(10.686)				
Extrema Point					*−0.122*	*0.117*	*0.079*	*0.129*				
Lind-Mehlum					—	*3.93*	*1.77*	*2.56*				
p-value					—	*0.000*	*0.038*	*0.001*				
EQCF									0.793***	0.619***	−0.029	0.391***
									(7.456)	(3.955)	(−0.075)	(4.147)
$EQCF^2$									0.032	0.142	0.687**	0.351***
									(0.353)	(1.102)	(2.138)	(4.196)
Extrema Point									*−12.405*	*−2.175*	*0.0211*	*−0.556*
Lind-Mehlum									—	—	*0.04*	—
p-value									—	—	*0.484*	—
LnFV	−16.832***	−16.664***	−16.940***	−16.833***	−16.870***	−16.881***	−16.905***	−16.933***	−17.011***	−16.969***	−17.041***	−17.039***
	(−1088.661)	(−1114.762)	(−1213.441)	(−1127.489)	(−740.256)	(−419.045)	(−323.739)	(−515.574)	(−327.293)	(−547.919)	(−372.654)	(−579.441)

(Continues)

TABLE A3 | (Continued)

Variables	*Z*Score	*Z*Score	*Z*Score	*Z*Score	*Z*Score	*Z*Score	*Z*Score	*Z*Score	*Z*Score	*Z*Score	*Z*Score	*Z*Score
Size	1.352***	1.139***	1.312***	1.194***	0.912***	0.807***	0.840***	0.872***	0.928***	0.829***	1.015***	0.867***
	(83.323)	(73.982)	(114.840)	(83.117)	(25.608)	(25.985)	(24.576)	(27.070)	(33.234)	(24.949)	(28.820)	(28.622)
Lev	38.156***	38.387***	38.165***	37.960***	36.838***	37.466***	37.350***	37.033***	36.404***	37.085***	37.320***	36.824***
	(719.691)	(638.702)	(504.129)	(493.415)	(356.661)	(242.133)	(286.428)	(277.062)	(235.271)	(345.103)	(335.898)	(393.987)
CAPEX	−12.649***	−8.679***	−6.465***	−8.399***	−6.401***	−3.941***	−5.839***	−3.324**	−5.991***	−5.420***	−5.540***	−4.947***
	(−72.602)	(−21.367)	(−13.651)	(−16.988)	(−6.556)	(−2.871)	(−4.589)	(−2.333)	(−6.050)	(−4.397)	(−5.979)	(−5.821)
$CAPEX^2$	113.456***	91.182***	78.950***	88.756***	67.461***	58.373***	66.313***	52.345***	60.338***	61.430***	56.478***	55.986***
	(103.931)	(44.465)	(30.880)	(35.307)	(13.051)	(7.915)	(9.022)	(6.979)	(10.593)	(9.473)	(9.722)	(11.860)
Extrema Point	*0.056*	*0.048*	*0.041*	*0.047*	*0.047*	*0.033*	*0.044*	*0.032*	*0.050*	*0.044*	*0.049*	*0.044*
Lind-Mehlum	*72.52*	*21.33*	*13.62*	*16.96*	*6.54*	*2.86*	*4.58*	*2.33*	*6.04*	*4.39*	*5.97*	*5.81*
p-value	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.002*	*0.000*	*0.010*	*0.000*	*0.000*	*0.000*	*0.000*
OWN1	−1.817***	−1.899***	−1.810***	−1.923***	−1.096***	−0.890***	−1.690***	−1.057***	−1.439***	−1.231***	−1.581***	−1.385***
	(−30.769)	(−22.382)	(−31.910)	(−28.783)	(−9.689)	(−9.566)	(−14.342)	(−11.347)	(−17.024)	(−9.352)	(−14.101)	(−15.654)
ECONFREE	0.021***	0.004*	0.010***	0.006***	−0.045***	−0.053***	−0.044***	−0.050***	−0.042***	−0.048***	−0.043***	−0.049***
	(15.888)	(1.928)	(8.939)	(4.334)	(−11.487)	(−14.337)	(−11.966)	(−22.065)	(−8.774)	(−11.305)	(−12.811)	(−11.188)
WGI	7.409***	1.666***	5.117***	4.719***	11.349***	7.285***	9.127***	8.251***	11.232***	7.220***	10.606***	8.516***
	(32.929)	(6.056)	(29.466)	(33.459)	(24.326)	(23.290)	(19.636)	(25.172)	(25.613)	(26.889)	(19.158)	(16.121)
GNP	−0.012***	−0.012***	−0.011***	−0.011***	−0.007***	−0.008***	−0.006***	−0.005***	−0.009***	−0.010***	−0.008***	−0.007***
	(−38.323)	(−32.157)	(−39.283)	(−29.502)	(−6.738)	(−10.563)	(−4.758)	(−7.189)	(−10.920)	(−9.287)	(−8.634)	(−7.784)
Crisis	0.960***	0.935***	0.890***	0.896***	0.557***	0.540***	0.523***	0.502***	0.494***	0.497***	0.501***	0.466***
	(413.486)	(225.641)	(543.008)	(297.927)	(38.598)	(47.012)	(41.120)	(35.530)	(56.336)	(51.948)	(29.713)	(42.251)
Constant	4.550***	6.434***	6.284***	4.803***	−3.352***	−1.799**	−3.702***	−1.576**	−3.220***	−1.440*	−1.175	−1.869**
	(12.297)	(24.477)	(22.913)	(17.146)	(−3.697)	(−2.319)	(−4.419)	(−2.282)	(−4.764)	(−1.817)	(−1.623)	(−2.308)
Observations	2395	2395	2395	2395	2602	2602	2602	2602	2578	2578	2578	2578
Cross-sections	301	301	301	301	300	300	300	300	300	300	300	300
Country Dummy	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Year Dummy	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Instruments	381	381	381	381	428	428	428	428	428	428	428	428

(Continues)

TABLE A3 | (Continued)

Variables	*Z*Score	*Z*Score	*Z*Score	*Z*Score	*Z*Score	*Z*Score	*Z*Score	*Z*Score	*Z*Score	*Z*Score	*Z*Score	*Z*Score
Avrg. Obs. per Group	7.957	7.957	7.957	7.957	8.673	8.673	8.673	8.673	8.593	8.593	8.593	8.593
AR(1)	−2.839	−2.823	−2.857	−2.857	−2.802	−2.760	−2.785	−2.788	−2.738	−2.684	−2.710	−2.724
AR(2)	−1.923**	−1.958**	−1.933**	−1.938**	−1.430***	−1.456***	−1.460**	−1.476***	−1.666*	−1.702*	−1.710*	−1.718*
Sargan	281.7	288.3	282.3	287.9	286.8	289.9	285.5	291.8	288	287.4	290.1	290.2
Wald	2290***	1961***	3888***	7390***	4552***	1261***	2986***	2130***	1087***	8298***	3099***	2450***

Note: The table displays the robustness results to test the third research hypothesis. The results considered *Z*Score as the dependent variable, and sustainability measured through ESGEnv, ESGSoc, ESGGov, and ESGINDEX. Section 3 of the study describes the variables. Below the coefficients, the table reports the standard errors robust to heteroskedasticity following the method proposed by Windmeijer (2005). The suitable t test of linear combination of coefficients was used to test the significance of the interacted variables. Nonlinearity of EQCR, EQCF, and CAPEX is assessed with the Lind-Mehlum test that provides the exact test of the presence of a U shaped (or inverse U shaped) relationship on an interval. Although not reported in the table, the option based on Fieller (1954) was used to find the interval for the extreme point. Arellano-Bond AR(1) and AR(2) is an autocorrelation test of first and second order, respectively, using residuals in differences, asymptotically distributes as an N(0.1) and under the null hypothesis of no autocorrelation. Although AR(1) is expected in first differences, it does not invalidate the results. Instruments refer to the number of instruments used in the first-difference GMM estimator. Sargan test is a test of overidentifying restrictions or whether the instruments, as a group, appear exogenous, asymptotically distributed as a X^2 and robust to heteroskedasticity. The null hypothesis is that the overidentifying restrictions are valid. Endogenous variables were instrumentalized with up to 3 years lagged according to Jara-Bertin et al. (2008), and the number of instruments were kept blow the number of cross-sections as suggested by Roodman (2009). Wald test contrasts the joint nullity of the estimated parameters. *$p < 0.05$; **$p < 0.01$; ***$p < 0.001$.