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RESEARCH ARTICLE OPEN ACCESS

Sustainability Performance and Its Impact on Financial Distress Risk—Evidence From STOXX Europe 600

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ABSTRACT

Sustainability performance (SP) has emerged as a central topic on both corporate and political agendas worldwide. This study investigated the relationship between SP and financial distress risk (FDR) among European listed firms, addressing the growing importance of SP in financial decision-making. Utilising a panel dataset from LSEG Data & Analytics (formerly Refinitiv) for STOXX Europe 600 firms between 2016 and 2022, we performed regression analyses to examine the impact of SP on FDR, measured through alternating scores. In contrast to most existing research, we found SP to increase FDR for most analyses performed, with the effect varying by SP dimension. Because we found environmental and governance SP to increase FDR, we did not find an association between social SP and FDR in most analyses performed. Our findings provide practical and theoretical implications for firms, investors and policymakers concerning the influence of SP investments on FDR and potential SP overinvestments in Europe's latest sustainability regulatory setting.

1 | Introduction

In recent years, sustainability regulation has undergone significant changes, particularly in the European Union (EU; e.g., Agoraki et al. 2023; Cicchiello et al. 2023; Wagenhofer 2024), which is now developing a preliminary regulation to improve the reliability and comparability of sustainability ratings (European Council 2024). Other countries, such as Japan, the United Kingdom, Switzerland, South Africa and Brazil, are following the EU's lead in sustainability regulations, adopting similar policies (Alamillos and de Mariz 2022; Hummel and Jobst 2024). One key element is the European Green Deal, whereby the EU is projected to become the first climate-neutral continent by 2050 (European Commission 2024). This ambitious goal requires the EU to become a global leader in the circular economy and clean technologies (Hereu-Morales et al. 2024; Sikora 2021). A recent study on banks and asset managers described the EU Action Plan on sustainable finance as 'today's key driver for sustainable finance' (Kuhn 2022). With climate change policy at the top of Europe's agenda, its capital market provides a unique

and relevant context for sustainability research (Velte 2021, 2023). Although various studies have examined the association between sustainability performance (SP)¹ and financial success (e.g., Cheng et al. 2014; Duque-Grisales and Aguilera-Caracuel 2021; Flori et al. 2024; Lee et al. 2016), there is limited research on the relationship between SP and financial distress (Habermann and Fischer 2023).

Although it continues to grow, research on the association of firms' SP and financial distress risk² (FDR) has so far provided limited evidence (e.g., Aslan et al. 2021; Barnett and Salomon 2012; Habermann and Fischer 2023; Hull and Rothenberg 2008; Nguyen and Nguyen 2015). Firms with high SP tend to have better reputations (Saeidi et al. 2015), face less price-sensitive demand (Albuquerque et al. 2019) and have greater innovation ability (Habermann and Fischer 2023), potentially resulting in lower FDR. However, recent studies suggest that the costs of SP may outweigh its benefits and increase FDR accordingly (e.g., Farah et al. 2021; Habermann and Fischer 2023). Empirically, most research indicates a negative link between SP and FDR

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(e.g., Aslan et al. 2021; Cohen 2022; Lisin et al. 2022; Suganda and Kim 2023). However, some studies have found the association between SP and FDR to be more complex, indicating further factors at play (e.g., business-cycle phase, level of SP or FDR, firm size) and finding at least partial support for a positive association between SP and FDR (e.g., Barth et al. 2022; Habermann and Fischer 2023; Vivel-Búa et al. 2023). Research on the association of SP and FDR in Europe is especially scarce; to the best of our knowledge, only Vivel-Búa et al. (2023) have studied this relationship in a European context. They found SP to generally decrease FDR, although they argued that the association may be influenced by the business-cycle phase and suggested studying this influence in greater depth in future research.

Given the economic significance of Europe as the world's second largest economic area, as well as its leading role in promoting sustainability³ and sustainability regulations (Alamillos and de Mariz 2022), this seems surprising. Increasing political pressure in Europe, recent regulatory changes and growing scepticism about the positive influence of SP (e.g., Damodaran 2023; Edmans 2024; Larcker et al. 2023) make this an opportune time to reassess this relationship in a pan-European setting. The limited research in a European context highlights a gap in the literature and underscores the need to expand previous studies on the influence of SP on FDR (e.g., Habermann and Fischer 2023; Vivel-Búa et al. 2023). We build on prior analyses by examining how the business cycle affects the association between SP and FDR, exploring the influence of firm size in greater detail, extending the observation period and using different FDR measures proposed by earlier studies (e.g., Boubaker et al. 2020; Habermann and Fischer 2023; Vivel-Búa et al. 2023). As most previous studies on the SP–FDR relationship have focused on single countries (e.g., Boubaker et al. 2020; Habermann and Fischer 2023; Suganda and Kim 2023) and used varying FDR methodologies (e.g., Atif and Ali 2021; Jamil and Khan 2024), this study adopts a multi-country approach, addressing calls from previous research (e.g., Habermann and Fischer 2023; Khan 2022; Suganda and Kim 2023) to further examine SP's influence on FDR.

To determine the association between SP and FDR, a multi-country regression analysis was conducted, focusing on the largest European listed firms within the STOXX Europe 600. The study employs various scoring models for FDR, utilising a panel dataset comprising 1211 firm-year observations spanning 2016 to 2022. LSEG Data & Analytics scores were used to measure SP, and FDR for the main model was calculated using the Altman Z-score (*ZSCORE*). For robustness checks, the Ohlson O-score (*OSCORE*) and the Zmijewski score (*XSCORE*) were used as alternative FDR measures as well as different industry classifications and various sample splits.

Based on the results of the main regression analysis (*ZSCORE*), we found no support for a general association between SP and FDR; rather, the association varies by SP dimension. Whereas the environmental and governance SP dimensions were associated with an increase in FDR, no significant relationship was observed between social SP and FDR in most analyses. Further, we found firm-size effects (median splits) to influence the association of SP and the negative association of SP with FDR to be more pronounced for firms under potential FDR according to

their risk score. The SP level and the business-cycle phase had no significant effect on the association of SP and FDR. Our results remained consistent across various robustness checks, including alternating measures of FDR (*OSCORE*, *XSCORE*) and industry classifications.

This study contributes to the literature on the financial implications of SP performance. More precisely, it provides manifold insights into the association between SP and FDR in a European context. First, it comprehensively studies the association between SP and FDR for all SP dimensions. Second, it yields insights into how individual SP dimensions influence FDR. Third, it analyses how firm characteristics, such as size or FDR level, affect the association between SP and FDR for large stock-listed European firms. Fourth, it presents further evidence on how business-cycle phases impact the link between SP and FDR. Fifth, it demonstrates that the application of different measures for FDR (*ZSCORE*, *OSCORE*, *XSCORE*) in this context provides significant and comparable results.

In addition, this study yields interesting insights for practitioners (e.g., managers, investors, regulators and market authorities). To managers, it offers insights for enhancing firms' SP effectiveness (investments) in terms of financial implications (i.e., FDR). The results also reveal differences in the capacity of various SP dimensions (investments) to influence the level of FDR, which could help managers fine-tune their firms' capital allocation decisions. For investors, the study indicates that for STOXX Europe 600 firms between 2016 and 2022, SP tends to be costly in terms of distress risk. Thus, investors might critically review the financial implications of firms' SP investments. For regulators, the results indicate that SP comes at a cost for firms, but it does not uniformly influence FDR. Hence, regulators should avoid overstraining firms with excessively rapid policy advancements because related costs may divert important resources elsewhere, thereby increasing FDR. Yet apart from its influence on FDR, SP may also entail other financial and nonfinancial implications; accordingly, stakeholders should consider its implications in a broader context.

The remainder of this paper is structured as follows: After this introduction, Section 2 presents the relevant literature and the hypothesis development. Section 3 describes the data and sample. Section 4 outlines the research design, followed by an overview of the empirical results in Section 5. This is followed by a discussion of the results in Section 6. Section 7 acknowledges the study's limitations and suggests further research. Finally, Section 8 concludes by summarising the findings of this study and addressing the practical limitations.

2 | Literature Review and Hypothesis Development

The extant literature provides limited evidence on the relationship between firms' SP and FDR, while research continues to expand (e.g., Boubaker et al. 2020; Habermann and Fischer 2023; Nguyen and Nguyen 2015). Most studies indicate that SP and financial performance are positively correlated (e.g., Haque and Ntim 2020; Lisi 2018; Rahi et al. 2024; Velte 2017) and that SP is being given greater consideration

by investors (e.g., Amel-Zadeh and Serafeim 2018; Eccles et al. 2017; Hamrouni et al. 2019). Indeed, the paucity of research on the association between SP and FDR seems surprising, given that sustainability actions and SP are becoming increasingly integral elements of risk management (Hoi et al. 2013). Research on the relationship between firms' SP and FDR falls within the study of associations between SP and financial performance, which is primarily grounded in shareholder or stakeholder theory (Suganda and Kim 2023). According to shareholder theory, a firm should aim to maximise shareholder wealth (Friedman 1970); therefore, firms should not engage in activities that do not contribute to their financial performance (Cooper and Uzun 2019). Following this logic, firms should not engage in sustainability initiatives because they carry additional costs, decrease profits (Farah et al. 2021) and increase FDR (Habermann and Fischer 2023). However, management may nevertheless engage in sustainability activities because of social pressures, opposing shareholder interests and overinvesting in sustainability initiatives (Barnea and Rubin 2010; Habermann and Fischer 2023). Only a few research papers have employed shareholder theory to explain high investments in sustainability activities to potentially increase FDR (e.g., Barnea and Rubin 2010; Nguyen and Nguyen 2015). Barnea and Rubin (2010) identified high financing costs as a constraint to SP for highly leveraged firms, suggesting that these costs may outweigh the potential benefits. Employee benefits in particular may lead to increased costs and FDR (Nguyen and Nguyen 2015). Farah et al. (2021) found that the association between SP and FDR is U-shaped until a certain SP threshold and that firms bear additional costs without enjoying the benefits of superior SP, such as charging SP premiums.

According to stakeholder theory, firms should consider the needs of various stakeholders in addition to the goals of their owners (i.e., profit motive; Freeman 1984) because these stakeholders are essential to firms' success, survival and growth. Improved SP is recognised as financially beneficial through improved stakeholder relationships (Aslan et al. 2021; Barnett and Salomon 2012; Hull and Rothenberg 2008). Following stakeholder theory, Saeidi et al. (2015) suggested that engaging in SP enhances firm reputation and, as a result, financial performance, potentially through less price-sensitive demand (Albuquerque et al. 2019). Thus, not being 'sustainable' is recognised as a competitive disadvantage (Waddock and Graves 1997) resulting in inferior performance (Flammer 2015; Marti et al. 2015). Similarly, strong SP decreases the likelihood of a loss of reputation with stakeholders (Liang and Renneboog 2017) and related increases in FDR. Furthermore, strong SP may enhance a firm's ability to detect distress early through increased stakeholder engagement and enhanced innovation ability (Habermann and Fischer 2023). This influence may be particularly advantageous during economic recessions (Lisin et al. 2022) because social performance may increase employee satisfaction and motivation as well as stakeholder relations (De Roeck et al. 2016; Edmans 2011; Scheidler et al. 2019). Thus, following stakeholder theory, SP may positively influence corporate bond ratings (e.g., Aslan et al. 2021; Attig et al. 2013; Jiraporn et al. 2014), reduce the cost of capital (e.g., Aslan et al. 2021; Cheng et al. 2014; Cooper and Uzun 2019) and ease access to alternative capital

(Badayi et al. 2021), ultimately resulting in lower FDR. Hence, according to stakeholder theory, SP decreases FDR (Vivel-Búa et al. 2023).

Empirically, few studies have found the relationship between SP and FDR to support shareholder theory (e.g., Barnea and Rubin 2010; Becchetti et al. 2015; Nguyen and Nguyen 2015). While Nguyen and Nguyen (2015) observed investments in SP to increase firm risk for US firms, Becchetti et al. (2015) found that SP is positively associated with firm volatility. Further, Barnea and Rubin (2010) indicated that overinvestment in SP results in higher FDR. Most empirical studies supporting stakeholder theory have found partial support for SP being positively associated with FDR (e.g., Habermann and Fischer 2023; Vivel-Búa et al. 2023). For instance, Habermann and Fischer (2023) found higher SP to increase FDR solely in times of economic upswing, whereas Vivel-Búa et al. (2023) observed SP and FDR to be positively associated only for larger firms. Similarly, Farah et al. (2021) and Barth et al. (2022) posited the SP–FDR association to be U-shaped and found the association between SP and FDR to be positive for firms with both low and high SP.

Most empirical studies on the association between SP and FDR have found SP and FDR to be negatively associated (e.g., Cohen 2022; Lisin et al. 2022; Suganda and Kim 2023), thus supporting stakeholder theory. However, study settings and observation periods vary. Most of these studies used samples of US firms (e.g., Aslan et al. 2021; Boubaker et al. 2020; Cohen 2022; Lisin et al. 2022), but studies of other developed countries (e.g., Suganda and Kim 2023; Vivel-Búa et al. 2023), firms in developing countries (e.g., Badayi et al. 2021) or international samples (e.g., S. Kim and Li 2021) have also found a negative association between SP and FDR. Furthermore, different studies have identified additional factors (e.g., firm characteristics, phase in the economic cycle, level of FDR or SP) that may influence the relationship between SP and FDR. For example, Jo and Na (2012) found that SP and FDR were negatively associated for firms in controversial industries (e.g., alcohol, tobacco, and gambling). Al-Hadi et al. (2019) found SP to reduce FDR, especially for older firms. Furthermore, various empirical studies have found that SP reduces FDR most acutely in times of economic crisis (e.g., Broadstock et al. 2021; Lisin et al. 2022; Vivel-Búa et al. 2023), only for the effect to decrease afterwards (Bouslah et al. 2018; Broadstock et al. 2021). Most recently, Gianfrate et al. (2024) found support for SP and FDR's negative association in US firms during the COVID-19 crisis. Further, Boubaker et al. (2020) and Lin and Dong (2018) demonstrated that the level of FDR influences the SP–FDR nexus. They reported that SP reduces FDR, especially for firms with a higher likelihood of bankruptcy or those already in financial distress. Many studies have indicated that SP level influences the association between SP and FDR (e.g., Barth et al. 2022; Farah et al. 2021; Oikonomou et al. 2012). Oikonomou et al. (2012) showed that SP reduces FDR more notably in firms with low SP. Similarly, Farah et al. (2021) and Barth et al. (2022) presented the SP–FDR association as being U-shaped, finding a negative association between SP and FDR only for firms with medium SP.

To summarise, most theoretical considerations and empirical studies indicate that SP and FDR are negatively associated, corroborating stakeholder theory. However, recent economic

shocks (e.g., Russia's invasion of Ukraine) have ignited new discourse questioning the financial benefits of SP (e.g., Cornell and Damodaran 2020; Damodaran 2023; Rahman et al. 2023), with some studies explicitly calling for revisiting the SP–FDR nexus in a European setting, including the period of COVID-19 that began in 2020 (Vivel-Búa et al. 2023). Furthermore, Attig and Cleary (2015) attributed findings of lower FDR among firms with higher SP to the generally better management quality of those firms. Meanwhile, Barnett and Salomon (2012) posited that the effect of SP on FDR is influenced not only by the level of SP but also by the firm's ability to effectively leverage it. Hence, we wish to revisit the association between SP and FDR using a sample of the largest European listed firms (STOXX Europe 600) because, to the best of our knowledge, no such study has been conducted. This perspective is especially relevant because the EU plays a leading role in promoting sustainability and sustainability regulations (Alamillos and de Mariz 2022).

Following stakeholder theory, we formulate the following hypothesis to test how SP influences FDR for the largest European listed firms:

Hypothesis 1. *SP and FDR are negatively associated for the largest European listed firms.*

In addition to studying the overall impact of SP on FDR, different theoretical considerations suggest that individual SP dimensions (environmental, social, governance) influence FDR differently. Investments in environmental SP, for example, may reduce FDR because they decrease the risk of losing reputation by violating environmental regulations (Liang and Renneboog 2017). Investments in social SP may increase crisis performance by fostering more reliable stakeholder relationships (Vishwanathan et al. 2020). In addition, Cheng et al. (2014) suggested that governance SP is especially relevant in detecting distress early and reducing FDR.

Various studies have empirically assessed the influence of individual SP dimensions on FDR exclusively (e.g., Cohen 2022; Hoepner et al. 2024; Suganda and Kim 2023). Whereas some studies found that all SP dimensions (environmental, social, governance) collectively reduced FDR (e.g., Aslan et al. 2021; Suganda and Kim 2023), other studies reported that only some SP dimensions reduced FDR (e.g., Ahn and Park 2018; Cohen 2022). For example, Cohen (2022) indicated that only environmental and social SP reduced FDR and found no such association between governance SP and FDR. Similarly, Ahn and Park (2018) found that only social SP was effective, while Hoepner et al. (2024) highlighted environmental SP as being most influential in reducing FDR.

Hence, in addition to studying the influence of SP dimensions on FDR collectively, we aim to study how different sustainability dimensions individually influence FDR for European listed firms. Accordingly, we formulate the following hypotheses in line with stakeholder theory:

Hypothesis 1a. *Environmental SP and FDR are negatively associated for the largest European listed firms.*

Hypothesis 1b. *Social SP and FDR are negatively associated for the largest European listed firms.*

Hypothesis 1c. *Governance SP and FDR are negatively associated for the largest European listed firms.*

3 | Data and Sample

Our research investigated the impact of SP on ZSCORE, OSCORE and XSCORE (see Section 4.1). We examined the constituents of the STOXX Europe 600 index by gathering data from 2016 to 2022. Our approach is similar to that of previous studies by Suganda and Kim (2023) and Habermann and Fischer (2023), albeit with a nuanced distinction: Their observation was confined to US and Korean entities during the 2010–2019 period—a prolonged phase of economic resurgence—whereas our sample period spans 2016–2020, incorporating developments in EU corporate sustainability regulation (Velte 2023). The 2016 starting point of our sample (lagged ESG scores from 2015) coincides with the finalisation of the Non-Financial Reporting Directive (NFRD), ensuring coverage of all effects within Europe's latest sustainability regulatory framework and aligning with other research focusing on sustainability in the EU for NFRD periods (Al-Dosari et al. 2023; Cicchiello et al. 2023; Cuomo et al. 2024).

Utilising LSEG Data & Analytics (formerly Refinitiv) ESG resources—specifically Datastream—we extracted the 2022 fiscal records for the STOXX Europe 600, comprising 600 constituents as of December 2023, to obtain the latest SP data.⁴ Over 7 years, from 2016 through 2022, this resulted in 4800 firm-year observations (see Table A1). We removed financial industries (SIC1 = 6; Finance, Insurance and Real Estate) from our dataset, resulting in a reduction of 1064 firm-year observations (e.g., Pucheta-Martínez and Gallego-Álvarez 2019; Thun and Zülch 2023). Furthermore, we only considered firms with available FDR scores, resulting in a reduction of 958 firm-year observations. Additionally, we only considered firms with an available ESG absolute score for both the combined and single pillar scores from LSEG Data & Analytics, leading to a reduction of 162 firm-year observations. The sample was further reduced by 108 firm-year observations due to data missing from the ESG delta scores. Missing data for controls in LSEG Data & Analytics reduced firm-year observations by 1297, leaving us with a final sample of 1211 firm-year observations for our analysis.

4 | Research Design

4.1 | Dependent Variables

From the various models available for predicting bankruptcy risk, we selected ZSCORE (Altman 1968), OSCORE (Ohlson 1980) and XSCORE (Zmijewski 1984). These models were chosen because they are the most frequently referenced and have a high level of accuracy for predicting bankruptcy (Altman et al. 2017; Bărbuță-Mișu and Madaleno 2020; Campobasso and Boscia 2023; Wu et al. 2010).

ZSCORE, developed in 1968, was the first accounting-based model. Altman (1968) is considered the pioneer of insolvency prediction models and was the first researcher to successfully

use stepwise multiple discriminant analysis to create a prediction model with a high degree of accuracy (95%). The original study involved a sample of 66 industrial firms—33 bankrupt and 33 nonbankrupt—analysed over 20 years (1946–1965).

This formula considers five different business ratios, calculated and weighted based on the Altman framework. *ZSCORE* provides a continuous measure: A score below 1.88 indicates a high probability of bankruptcy, a score between 1.88 and 2.99 is considered questionable (grey zone), and a score above 2.99 signifies a low risk of default (Altman 1968; Habermann and Fischer 2023).

The equation of the *ZSCORE* is formulated as follows:

$$Z = 0.012X_1 + 0.014X_2 + 0.033X_3 + 0.006X_4 + 0.999X_5 \quad (1)$$

where X_1 = ratio of working capital to total assets, X_2 = ratio of retained earnings to total assets, X_3 = ratio of earnings before interest and taxes to total assets, X_4 = ratio of market value of equity to book value of total liabilities and X_5 = ratio of sales to total assets.

Developed by Ohlson in 1980, *OSCORE* was designed to enhance the Altman model by utilising a larger sample size to verify its effectiveness. It can detect financial distress in firms by employing a logit analysis, which addresses shortcomings in the multiple discriminate analysis techniques. *OSCORE* incorporates nine independent variables comprising various financial ratios by using logistic regression (Lisin et al. 2022; Ohlson 1980; Seno Pamungkas 2023). The lowest sum of the two error types in the original study was 0.38 (Ohlson 1980).

The equation of the *OSCORE* is formulated as follows:

$$O = -1.32 - 0.407Y_1 + 6.03Y_2 - 1.43Y_3 + 0.757Y_4 - 1.72Y_5 - 2.37Y_6 - 1.83Y_7 + 0.285Y_8 - 0.521Y_9 \quad (2)$$

where Y_1 = log of ratio total assets to gross national product price index; Y_2 = ratio of total liabilities to total assets; Y_3 = ratio of working capital to total assets; Y_4 = ratio of current liabilities to current assets; Y_5 = 1 if $TL > TA$, 0 otherwise; Y_6 = ratio of net income to total assets; Y_7 = ratio of funds from operations to total liabilities; Y_8 = 1 if a net loss for the last 2 years, 0 otherwise; and Y_9 = ratio of the difference between current net income and net income from last period to the sum of absolute values of current net income and absolute value net income from last period.

The Zmijewski (1984) *XSCORE* is a bankruptcy model that predicts a firm's probability of bankruptcy within 2 years. In his study, Zmijewski criticised previous models for oversampling distressed firms and favouring situations with more complete data. The accuracy rate of the *XSCORE* for the estimation sample was 99%. Zmijewski examined two methodological issues related to the estimation of bankruptcy prediction models. The ratio used in the *XSCORE* was determined by probit analysis, a probability unit that maps values between 0 and 1. An *XSCORE* greater than 0.5 represents a higher probability of default (Bărbuță-Mișu and Madaleno 2020; Zmijewski 1984).

The *XSCORE* equation is formulated as follows:

$$X = -4.3 - 4.5Z_1 + 5.7Z_2 + 0.004Z_3 \quad (3)$$

where Z_1 = ratio of net income to total assets, Z_2 = ratio of total liabilities to total assets and Z_3 = ratio of current assets to current liabilities.

4.2 | Independent Variables

The SP of sample firms was measured using the LSEG Data & Analytics ESG scores, which are widely accepted and applied in academic literature (e.g., Cheng et al. 2014; Dyck et al. 2019; Habermann and Fischer 2023). In addition to the overall ESG score, we used the three pillar scores of environmental, social and governance to measure the effect of each pillar in our sample. The scores range from 0 to 100, with a score of 100 reflecting the best possible SP. The E pillar encompasses the categories of resources, emissions and innovation. The S pillar comprises workforce, human rights, community and product responsibility. The G pillar covers management, shareholders and CSR strategy. Each category contains a varying number of measures that determine its weight. The overall ESG score is calculated as a weighted average of the scores across these 10 categories. The LSEG Data & Analytics overall ESG score is based on self-reported information of the companies' measures regarding the 10 categories. For definitions, see Table A2.

4.3 | Control Variables

In addition to our variable of interest, we included a set of control variables that influence a firm's default risk when testing our hypothesis. Following Suganda and Kim (2023), we included the following control variables, all lagged by one period to account for potential reverse causality, and stored them in our vector of control (Fernando et al. 2017; Flammer 2015; Habermann and Fischer 2023).

The market-to-book value (*MTBV*) reflects a firm's growth opportunities. An inverse relationship is expected. In our model, a firm's risk and volatility are represented by the standard deviation of monthly stock returns over the year (*VOL*). More volatile stocks are associated with higher default risk. We also included firms' monthly stock return over the year (*RET*) to account for a lower risk of distress. Cash and cash equivalents relative to a firm's total assets (*CCE2TA*) serve as a control for lower distress by reducing dependence on external financing. In our model, we define firm size as the natural logarithm of the firm's total assets (*LNSIZE*). Larger firms are expected to face higher distress risk due to a greater propensity for higher debt financing. Moreover, the ratio of a firm's total fixed assets to its total assets (*FA2TA*) is included to reflect greater asset tangibility. An overview and short descriptions of all variables are presented in Table A2.

4.4 | Regression Models

To analyse our hypotheses, we used the following ordinary least squares (OLS) regression model for panel data:

$$\begin{aligned} \text{Dependent Variables}_{i,t} = & \alpha_0 + \beta_1 \text{Variables of Interest}_{i,t-1} \\ & + \beta_2 \text{Controls}_{i,t-1} + \text{FIXED EFFECTS} + \varepsilon \end{aligned} \quad (4)$$

where the *Dependent Variable* is *ZSCORE*, *OSCORE* or *XSCORE*. The *Variable of Interest* is *ESG_LAG1*, *ESG_delta*, *ENV_LAG1*, *ENV_delta*, *SOC_LAG1*, *SOC_delta*, *GOV_LAG1* or *GOV_delta*. Firms and years are represented by *i* and *t*, respectively. The equation contains an intercept term α_0 and an unobserved error term ε . We used controls based on previous research from Habermann and Fischer (2023) as well as Suganda and Kim (2023). For variable definitions, see Table A2. To choose between random and fixed-effects models, we performed a Hausman test, which indicated that a fixed-effects model must be applied because we rejected the null hypothesis. We incorporated year-, industry- and country-fixed effects, as well as a constant term. Because ESG scores vary widely cross-sectionally, we applied industry-fixed effects rather than firm-fixed effects as in prior research (e.g., Aroui and Pijourlet 2017; Habermann and Fischer 2023; Servaes and Tamayo 2013). Standard errors were clustered by firms to account for within-cluster correlation that our models may not account for. Further, analogous to Habermann and

Fischer (2023), we winsorised all variables at the 1st and 99th percentiles to mitigate the influence of outliers.

5 | Empirical Results

5.1 | Descriptive Data Analysis

Table 1 presents a comprehensive statistical overview of various variables across 1211 observations.

We observed metrics such as *OSCORE*, *ZSCORE* and *XSCORE* for *dependent variables*. Overall, the mean value of *OSCORE* (−2.246) indicates no risk of default on average. In addition, *ZSCORE*'s mean value of 4.386 indicates no risk of default for the firms in the sample period. The standard deviations suggest varying degrees of dispersion around the mean, with *ZSCORE* having the highest variability (5.318), whereas *OSCORE* has a standard deviation of 1.435. *XSCORE* displays the lowest variation around the mean of 1.060.

In the variables of interest section, *ESG_LAG1*, *ENV_LAG1*, *SOC_LAG1* and *GOV_LAG1* represent lagged variables. The

TABLE 1 | Summary of descriptive statistics.

Variable	N	Mean	SD	Min	p25	p50	p75	Max
Dependent variables								
<i>OSCORE</i>	1211	−2.246	1.435	−6.895	−3.138	−2.138	−1.229	0.758
<i>ZSCORE</i>	1211	4.386	5.318	0.543	1.936	2.843	4.684	39.386
<i>XSCORE</i>	1211	−1.391	1.060	−4.180	−2.035	−1.323	−0.675	1.099
Variables of interest								
<i>ESG_LAG1</i>	1211	70.473	14.567	29.520	61.470	73.070	81.230	93.660
<i>ENV_LAG1</i>	1211	67.345	21.132	1.250	55.280	72.210	83.340	97.490
<i>SOC_LAG1</i>	1211	75.541	16.074	23.430	66.990	79.400	87.250	97.000
<i>GOV_LAG1</i>	1211	65.228	20.150	14.380	52.390	68.420	81.540	96.550
<i>ESG_delta</i>	1211	1.976	4.703	−8.440	−1.050	1.360	4.430	16.720
<i>ENV_delta</i>	1211	1.798	5.937	−12.530	−1.030	0.820	3.500	26.210
<i>SOC_delta</i>	1211	1.719	6.025	−10.760	−1.560	0.300	3.550	24.370
<i>GOV_delta</i>	1211	2.590	9.920	−21.240	−3.460	1.770	8.390	30.100
Control variables								
<i>MTBV</i>	1211	4.012	3.805	0.390	1.700	2.920	4.750	22.450
<i>VOL</i>	1211	0.077	0.033	0.031	0.054	0.069	0.090	0.195
<i>RET</i>	1211	0.012	0.023	−0.048	−0.003	0.012	0.025	0.078
<i>CCE2TA</i>	1211	0.128	0.118	0.008	0.058	0.097	0.154	0.756
<i>LNSIZE</i>	1211	16.524	1.611	13.079	15.338	16.522	17.710	19.920
<i>FA2TA</i>	1211	0.234	0.168	0.011	0.104	0.191	0.318	0.744
<i>TL2TA</i>	1211	0.556	0.171	0.069	0.451	0.568	0.672	0.940
<i>ROA</i>	1211	7.059	6.834	−11.180	3.700	6.170	9.580	34.450

Note: All metric variables are winsorized at the 1st and 99th percentiles. All control variables are lagged by 1 year. For variable definitions, see Table A1.

sample firms performed best in the social pillar (mean *SOC_LAG1* = 75.541). The deltas (changes) for these variables showed smaller mean values albeit with notable variability—as seen in their standard deviations—highlighting the fluctuations in these variables over time. On average, the firms improved their ESG score (mean *ESG_delta* = 1.976) during the sample period. All pillar scores also had positive mean values, indicating a tendency to improve across the environmental, social and governance dimensions.

The control variables section includes metrics like *MTBV*, *VOL* and *RET*. These variables showed a wide range of mean values and standard deviations, indicating diverse distributions and variability within the dataset. The average firm in our sample had a positive monthly stock return (mean *RET* = 0.012) and a relatively higher market value compared to its book value (mean *MTBV* = 4.012).

5.2 | Correlation Statistics

Table 2 presents the pairwise correlation matrix. The independent variables of each ESG pillar showed a positive and high correlation with the aggregate ESG score, indicating that all three pillars contribute to a firm's overall ESG score in our sample. Our dependent variables for credit quality were significantly correlated with each other. The presented correlation of *ZSCORE*, *OSCORE* and *XSCORE* correctly reflects their opposite direction for measuring an increasing level of FDR. Furthermore, most control variables were significantly correlated with *ZSCORE*, reflecting their relevance in our FDR context. *ESG_LAG1* and its pillar scores were applied only in separate models to avoid potential multicollinearity issues. Further potential multicollinearity issues were not detected because the absolute value of correlation coefficients was less than 0.8. In addition, the variance inflation factors (VIFs) did not suggest multicollinearity as a significant concern in our analysis because all values were below 3. A moderately strong positive correlation (*XSCORE*) and moderately strong negative correlation (*OSCORE* and *ZSCORE*) with *LNSIZE* indicate that larger firm size is associated with higher FDR values, which aligns with the findings of Agoraki et al. (2023). Another notable correlation is *MTBV* with *LNSIZE*, with a negative correlation of -0.2432 at the 5% level, indicating that larger firms tend to have a lower market-to-book value, aligning with Fama and French (1995). Furthermore, we found a weak inverse relationship between *MTBV* and *VOL* based on the Spearman correlation, which indicates that firms with higher market-to-book value are less vulnerable to volatility, confirming the findings of Chi and Su (2017). Overall, the correlations between *RET* and *CCE2TA* were weak, suggesting a limited positive association between them. However, the practical significance of this relationship appears minimal.

5.3 | Empirical Analysis

Following the research model of Suganda and Kim (2023), Table 3 showcases the outcomes of our main model (Models 1 through 10), which is a fixed-effects regression analysis on the impact of SP and its subdimensions on FDR. The analysis

revealed a significant negative relationship between the *ESG_LAG1* and *ZSCORE* (Model 1: $\beta = -0.067$, $p < 0.072$), as well as between *ENV_LAG1* (Model 3: $\beta = -0.043$, $p < 0.087$) and *GOV_LAG1* (Model 7: $\beta = -0.032$, $p < 0.042$) with *ZSCORE*, refuting **H1**, **H1a** and **H1c** by indicating a negative association with *ZSCORE*. We found no significant relationship between social performance and *ZSCORE*; thus, **H1b** is not supported. Those findings contradict previous findings of an FDR-reducing effect of SP and its subdimensions (e.g., Boubaker et al. 2020; Cohen 2022; Suganda and Kim 2023).

The economic significance of these coefficients should be interpreted cautiously due to the relatively small magnitudes of their coefficients compared to some control variables. The magnitude of the SP coefficients is comparable to that of other studies (e.g., Habermann and Fischer 2023; Suganda and Kim 2023).

Concerning the control variables, we found a positive (distress-reducing) and highly significant ($p < 0.05$) influence in all models for *MTBV* and *RET* on *ZSCORE*, similar to prior studies (e.g., Boubaker et al. 2020; Suganda and Kim 2023). Further, we found a negative (distress-increasing) and highly significant ($p < 0.05$) association of *VOL* and *LNSIZE* on *ZSCORE* in line with existing studies (e.g., Habermann and Fischer 2023; Suganda and Kim 2023). However, contrary to existing research (e.g., Habermann and Fischer 2023; Suganda and Kim 2023), non-significant associations were detected for *CCE2TA* and *FA2TA*.

The *R*-squared adjusted (*r2_a*) across Models 1 to 10, which indicates explanatory power, ranged from 0.345 to 0.372, comparable to prior studies (e.g., Habermann and Fischer 2023; Suganda and Kim 2023).

5.3.1 | Sample Splits ZSCORE by Firm Size

Because firm size had a significant influence on the association between SP and FDR in our first analysis, we wanted to examine the influence of firm size in more detail, as prior research has suggested that firm size is positively associated with SP (e.g., Habermann and Fischer 2023; Orazalin 2020; Vivel-Búa et al. 2023) and that higher debt ratios may result in higher FDR (e.g., Boubaker et al. 2020; Hsu et al. 2015). Thus, we split the sample into a below-median sample ($N = 605$) and above-median sample ($N = 606$) based on the median of the variable *LNSIZE* (16.522).

Table 4 presents the fixed-effects regression results (Models 11 through 20), analysing our main model for the below-median sample. Specifically, the negative coefficient for *ESG_LAG1* suggests a decrease in *ZSCORE* (Model 11: $\beta = -0.38$, $p < 0.017$). Further, *GOV_LAG1* also showed a significant and negative effect in both Model 17 ($\beta = -0.034$, $p < 0.000$) and Model 19 ($\beta = -0.033$, $p < 0.000$). Similar to the main regression analysis results, these findings contradict **H1** and **H1c**. For the association of *SOC_LAG1* and *ZSCORE*, repeatedly, no significant results were obtained supporting **H1b**. Further, compared to the results of the main regression analysis, the association of *ENV_LAG1* and *ZSCORE* became insignificant, no longer contradicting—but also not supporting — **H1b**.

TABLE 2 | Correlation table.

	OSCORE	ZSCORE	XSCORE	ESG_ LAG1	ENV_ LAG1	SOC_ LAG1	GOV_ LAG1	ESG_ delta	ENV_ delta	SOC_ delta	GOV_ delta	MTBV	VOL	RET	CCE2TA	LNSIZE	FA2TA
OSCORE	1.0000	-0.6163*	0.8048*	0.0461	0.0447	-0.0242	0.0852*	0.0208	-0.0351	0.0412	0.0071	-0.0574*	0.0658*	-0.1202*	0.0379	-0.1134*	-0.0399
ZSCORE	-0.5744*	1.0000	-0.7593*	-0.3853*	-0.3730*	-0.2294*	-0.2516*	0.0962*	0.1057*	0.0296	0.0569*	0.5621*	-0.0069	0.2778*	0.0824*	-0.4676*	-0.1961*
XSCORE	0.8317*	-0.6074*	1.0000	0.2888*	0.2705*	0.1954*	0.1786*	-0.0607*	-0.0868*	-0.0216	-0.0146	-0.1565*	0.0190	-0.1619*	0.0336	0.3672*	0.0635*
ESG_ LAG1	0.0876*	-0.3388*	0.3019*	1.0000	0.7714*	0.8046*	0.6819*	-0.3724*	-0.2500*	-0.2484*	-0.1931*	-0.2725*	-0.0829*	-0.1460*	0.0029	0.5347*	0.1500*
ENV_ LAG1	0.0822*	-0.3747*	0.2990*	0.8080*	1.0000	0.5713*	0.2521*	-0.2748*	-0.3172*	-0.1589*	-0.0868*	-0.3196*	-0.0122	-0.0905*	0.0169	0.4993*	0.2334*
SOC_ LAG1	0.0188	-0.2440*	0.2192*	0.8332*	0.6339*	1.0000	0.3237*	-0.2588*	-0.1356*	-0.3136*	-0.0481	-0.1403*	-0.1419*	-0.1102*	0.0067	0.4391*	0.0427
GOV_ LAG1	0.1261*	-0.2127*	0.1886*	0.6627*	0.2596*	0.3063*	1.0000	-0.3290*	-0.1304*	-0.0908*	-0.3411*	-0.1380*	-0.0532	-0.1233*	0.0056	0.2549*	0.0473
ESG_ delta	0.0080	0.0885*	-0.0835*	-0.4001*	-0.2926*	-0.3114*	-0.3179*	1.0000	0.4548*	0.5607*	0.7121*	0.0820*	-0.0066	0.1039*	0.0197	-0.1685*	-0.0315
ENV_ delta	-0.0414	0.0835*	-0.1125*	-0.2570*	-0.3382*	-0.1491*	-0.1141*	0.5377*	1.0000	0.1654*	0.0816*	0.0601*	-0.0158	0.0148	0.0016	-0.1414*	-0.0690*
SOC_ delta	0.0461	0.0227	-0.0351	-0.3304*	-0.2223*	-0.4205*	-0.1039*	0.6336*	0.1952*	1.0000	0.0719*	0.0324	0.0280	0.0512	0.0037	-0.0997*	-0.0293
GOV_ delta	0.0019	0.0745*	-0.0251	-0.2015*	-0.0777*	-0.0613*	-0.3495*	0.6923*	0.1020*	0.0614*	1.0000	0.0600*	0.0028	0.0830*	0.0346	-0.0818*	0.0076
MTBV	-0.0913*	0.4287*	-0.0926*	-0.1695*	-0.2151*	-0.1106*	-0.0889*	0.0167	0.0407	-0.0205	0.0207	1.0000	-0.1415*	0.2025*	0.1219*	-0.3294*	-0.3362*
VOL	0.0805*	0.0550	0.0312	-0.0839*	-0.0735*	-0.1348*	-0.0098	0.0208	0.0038	0.0475	0.0035	-0.0451	1.0000	0.0960*	0.2413*	-0.1632*	0.0350
RET	-0.1338*	0.1949*	-0.1625*	-0.1505*	-0.1134*	-0.1130*	-0.1239*	0.0951*	0.0200	0.0472	0.0844*	0.1982*	0.0966*	1.0000	0.0791*	-0.1654*	-0.0767*
CCE2TA	-0.0633*	0.3883*	-0.1254*	-0.1423*	-0.1832*	-0.1403*	-0.0021	0.0785*	0.0555	0.0577*	0.0472	0.1658*	0.2883*	0.1240*	1.0000	-0.1541*	-0.2285*
LNSIZE	-0.0614*	-0.3130*	0.3952*	0.5197*	0.5166*	0.4450*	0.2350*	-0.1780*	-0.1526*	-0.1417*	-0.0754*	-0.2432*	-0.1650*	-0.1597*	-0.2598*	1.0000	0.1683*
FA2TA	-0.0357	-0.1591*	0.0204	0.1271*	0.2130*	0.0631*	0.0182	-0.0332	-0.0503	-0.0264	0.0122	-0.2062*	0.0125	-0.0740*	-0.2705*	0.1363*	1.0000

Note: Pearson correlation coefficients are shown below and Spearman correlations coefficients above the diagonal.

*A significance level of 5%.

TABLE 3 | Multivariate regression results—ZSCORE.

Model	1	2	3	4	5	6	7	8	9	10
ZSCORE										
Dependent variables										
Variables of interest										
<i>ESG_LAG1</i>	−0.067*									
	0.072									
<i>ESG_delta</i>		−0.014								
		0.266								
<i>ENV_LAG1</i>			−0.043*						−0.035**	
			0.087						0.036	
<i>ENV_delta</i>				−0.003						0.001
				0.758						0.959
<i>SOC_LAG1</i>					−0.039				−0.012	
					0.199				0.504	
<i>SOC_delta</i>						−0.023				−0.024
						0.313				0.328
<i>GOV_LAG1</i>							−0.032**		−0.027**	
							0.042		0.020	
<i>GOV_delta</i>								0.002		0.003
								0.830		0.779
Control variables										
<i>MTBV</i>	0.333***	0.324***	0.328***	0.324***	0.334***	0.322***	0.322***	0.325***	0.328***	0.322***
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
<i>VOL</i>	−18.968***	−17.803***	−18.380***	−17.782***	−19.262***	−17.638***	−18.448***	−17.749***	−19.285***	−17.599***
	0.000	0.000	0.001	0.000	0.000	0.001	0.001	0.000	0.000	0.001
<i>RET</i>	12.024**	14.799**	13.778**	14.624**	13.283**	14.826**	12.653**	14.570**	11.886*	14.748**
	0.041	0.018	0.024	0.018	0.030	0.016	0.035	0.022	0.052	0.021

(Continues)

TABLE 3 | (Continued)

Model	1	2	3	4	5	6	7	8	9	10
<i>CCE2TA</i>	11.790	11.560	11.602	11.534	11.528	11.577	12.011	11.523	11.986	11.566
<i>LNSIZE</i>	0.251	0.268	0.254	0.268	0.269	0.266	0.248	0.270	0.240	0.269
	−0.450**	−0.844***	−0.508**	−0.839***	−0.635***	−0.848***	−0.684***	−0.835***	−0.385*	−0.847***
<i>FA2TA</i>	0.020	0.006	0.023	0.006	0.003	0.007	0.008	0.005	0.052	0.006
	1.241	0.687	1.682*	0.682	1.019	0.666	0.554	0.678	1.480	0.658
	0.271	0.638	0.057	0.637	0.437	0.651	0.692	0.640	0.110	0.656
<i>_cons</i>	14.499**	16.502**	13.639**	16.390**	15.871**	16.597**	15.883**	16.323**	13.650**	16.563**
	0.016	0.012	0.014	0.014	0.014	0.014	0.017	0.012	0.021	0.014
Year-fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry-fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country-fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
<i>N</i>	1211	1211	1211	1211	1211	1211	1211	1211	1211	1211
<i>r</i> ²	0.381	0.361	0.378	0.361	0.370	0.362	0.373	0.361	0.388	0.362
<i>r</i> ² _a	0.366	0.346	0.364	0.346	0.355	0.346	0.358	0.346	0.372	0.345
Mean VIF	1.32	1.22	1.32	1.21	1.27	1.22	1.24	1.21	1.43	1.19

Note: All metric variables are winsorized at the 1st and 99th percentiles. For variable definitions, see Table A1. OLS regressions are run with standard errors clustered by firm. All regressions include a constant term. *p*-values are displayed below the respective variable.

*, ** and *** indicate significance at the 10%, 5% and 1% level, respectively.

TABLE 4 | Multivariate results—ZSCORE—below-median sample.

Model	11	12	13	14	15	16	17	18	19	20
ZSCORE										
Dependent variables										
Variables of interest										
<i>ESG_LAG1</i>	−0.038**									
	0.017									
<i>ESG_delta</i>		−1.343								
		0.500								
<i>ENV_LAG1</i>			−0.010						−0.008	
			0.303						0.422	
<i>ENV_delta</i>				0.112						0.439
				0.955						0.842
<i>SOC_LAG1</i>					0.001				0.005	
					0.958				0.539	
<i>SOC_delta</i>						−0.891				−0.941
						0.633				0.677
<i>GOV_LAG1</i>							−0.034***		−0.033***	
							0.000		0.000	
<i>GOV_delta</i>								−0.624		−0.626
								0.662		0.649
Control variables										
<i>MTBV</i>	0.447***	0.440***	0.441***	0.442***	0.442***	0.440***	0.439***	0.442***	0.437***	0.440***
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
<i>VOL</i>	−27.701***	−27.862***	−28.261***	−27.843***	−27.830***	−27.763***	−26.745***	−27.943***	−27.076***	−27.889***
	0.004	0.002	0.003	0.003	0.003	0.002	0.002	0.002	0.002	0.002
<i>RET</i>	8.081*	9.934*	9.337*	9.617*	9.640*	9.694*	7.839	10.008*	7.864	10.113*
	0.090	0.068	0.064	0.064	0.062	0.060	0.119	0.088	0.120	0.082

(Continues)

TABLE 4 | (Continued)

Model	11	12	13	14	15	16	17	18	19	20
<i>CCE2TA</i>	10.694	11.020	10.911	10.986	10.996	11.015	11.137	11.005	11.146	11.033
	0.208	0.205	0.204	0.206	0.207	0.204	0.200	0.206	0.199	0.205
<i>LNSIZE</i>	-1.380*	-1.621**	-1.537*	-1.615*	-1.619*	-1.617*	-1.428*	-1.618**	-1.393*	-1.617**
	0.087	0.049	0.067	0.050	0.056	0.052	0.064	0.050	0.084	0.049
<i>FA2TA</i>	3.523**	3.772**	3.826**	3.750**	3.752**	3.754**	3.006*	3.780**	3.104**	3.789**
	0.029	0.018	0.013	0.018	0.017	0.018	0.051	0.017	0.030	0.017
<i>_cons</i>	26.008*	27.377*	26.645*	27.237*	27.262*	27.305*	26.324*	27.304*	25.903*	27.301*
	0.062	0.052	0.062	0.053	0.056	0.056	0.055	0.053	0.063	0.052
Year-fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry-fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country-fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
<i>N</i>	605	605	605	605	605	605	605	605	605	605
<i>r</i> ²	0.464	0.459	0.46	0.459	0.459	0.459	0.469	0.459	0.469	0.459
<i>r</i> ² _a	0.438	0.433	0.434	0.433	0.433	0.433	0.443	0.433	0.441	0.431

Note: All metric variables are winsorized at the 1st and 99th percentiles. For variable definitions, see Table A1. OLS regressions are run with standard errors clustered by firm. All regressions include a constant term. *p*-values are displayed below the respective variable.

*, ** and *** indicate significance at the 10%, 5% and 1% level, respectively.

TABLE 5 | Multivariate results—ZSCORE—above-median sample.

Model	21	22	23	24	25	26	27	28	29	30
ZSCORE										
Dependent variables										
Variables of interest										
<i>ESG_LAG1</i>	-0.123*									
	0.077									
<i>ESG_delta</i>		1.946								
		0.150								
<i>ENV_LAG1</i>			-0.103*						-0.068**	
			0.065						0.031	
<i>ENV_delta</i>				1.555						1.617
				0.558						0.528
<i>SOC_LAG1</i>					-0.140				-0.091	
					0.109				0.154	
<i>SOC_delta</i>						-1.753				-2.249
						0.449				0.384
<i>GOV_LAG1</i>							-0.032*		-0.005	
							0.072		0.330	
<i>GOV_delta</i>								1.391		1.489
								0.303		0.323
Control variables										
<i>MTBV</i>	0.088	0.079	0.095	0.079	0.107	0.081	0.078	0.081	0.108	0.083
	0.411	0.489	0.341	0.486	0.323	0.481	0.468	0.480	0.280	0.496
<i>VOL</i>	-14.811***	-12.313***	-9.527**	-12.297***	-17.942***	-12.285**	-14.140***	-12.255**	-14.416***	-12.148***
	0.001	0.010	0.031	0.008	0.002	0.013	0.009	0.011	0.003	0.009
<i>RET</i>	11.360***	18.510**	15.515**	18.481**	10.443***	18.757**	15.867**	18.796**	10.884***	19.091**
	0.008	0.011	0.013	0.011	0.002	0.012	0.012	0.012	0.009	0.013

(Continues)

TABLE 5 | (Continued)

Model	21	22	23	24	25	26	27	28	29	30
<i>CCE2TA</i>	18.053	14.437	17.217	14.436	18.793	14.49	15.427	14.392	19.232	14.379
	0.255	0.392	0.267	0.391	0.233	0.392	0.355	0.397	0.212	0.397
<i>LNSIZE</i>	-0.405	-0.908***	-0.394	-0.906***	-0.487*	-0.909***	-0.730**	-0.906***	-0.267	-0.899***
	0.169	0.007	0.363	0.006	0.080	0.008	0.011	0.007	0.542	0.006
<i>FA2TA</i>	0.628	-1.871	1.767	-1.870	0.567	-1.916	-1.469	-1.887	2.175	-1.890
	0.554	0.486	0.194	0.482	0.652	0.480	0.456	0.481	0.176	0.475
<i>_cons</i>	18.506***	18.613**	16.205***	18.584**	22.199***	18.652**	17.577**	18.581**	19.168***	18.485**
	0.001	0.012	0.002	0.011	0.003	0.014	0.012	0.012	0.000	0.011
Year-fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry-fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country-fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
<i>N</i>	606	606	606	606	606	606	606	606	606	606
<i>r</i> ²	0.314	0.239	0.338	0.239	0.340	0.239	0.255	0.240	0.373	0.240
<i>r</i> ² _a	0.284	0.206	0.310	0.206	0.312	0.206	0.223	0.207	0.343	0.205

Note: All metric variables are winsorized at the 1st and 99th percentiles. For variable definitions, see Table A1. OLS regressions are run with standard errors clustered by firm. All regressions include a constant term. *p*-values are displayed below the respective variable.

*, ** and *** indicate significance at the 10%, 5% and 1% level, respectively.

Like the results of the main model, these findings refute our hypotheses that sustainability and governance performance are inversely associated with default risk, contrary to prior research (e.g., Boubaker et al. 2020; Cohen 2022; Suganda and Kim 2023). Further, we observed no statistical influence of social or environmental performance on default risk.

Table 5 presents the fixed-effects regression results (Models 21 through 30), analysing our main model for the above-median sample. The table highlights the significance of the lagged ESG factor and its subdimensions on *ZSCORE*. For instance, *ESG_LAG1* negatively impacts the *ZSCORE* in Model 21 ($\beta = -0.123$, $p < 0.077$), whereas *ENV_LAG1* (Model 23: $\beta = -0.103$, $p < 0.065$) and *GOV_LAG1* (Model 27: $\beta = -0.032$, $p < 0.072$) remain negatively associated with *ZSCORE*. Similar to the main regression analysis results, these findings contradict H1, H1a and H1c.

Further, we observed no statistical influence of social performance on FDR, and thus, we cannot refute H1b. Interestingly, different from the regression analysis results for below-median sample firms, for above-median sample firms, the association of *ENV_LAG1* and *ZSCORE* becomes significant, thus refuting H1a, similar to the results of the main model.

5.3.2 | Sample Splits ZSCORE by Business Cycle

Prior research indicates that the financial impact of SP depends on the phase of the current economic cycle (e.g., Bouslah et al. 2018; Broadstock et al. 2021; Habermann and Fischer 2023). Especially during times of economic crisis, strong SP may be financially beneficial by increasing growth, profitability and stock returns (Lins et al. 2017) as well as by decreasing FDR (e.g., Bouslah et al. 2018; Broadstock et al. 2021; Habermann and Fischer 2023). Based on these previous findings, we assume that the state of the economy may influence the effect of SP on FDR in the economic cycle. The years until 2019 are classified as a period of economic upswing (pre-COVID-19; Habermann and Fischer 2023; Vivel-Búa et al. 2023).

Hence, we reran the regressions of our main model on split samples containing firm-year observations from years of economic upswing ('upswing sample'; years 2016 to 2019). We defined the years 2020 to 2022 as the 'downswing sample' to represent an economic downturn. The year 2020 is defined as the start of the COVID-19 period, following the example set by existing research (e.g., Basuony et al. 2022), and the year 2022 is the latest available dataset in LSEG Data & Analytics. Table 6 highlights the significant negative impacts of *ESG_delta* (Model 32: $\beta = -4.694$, $p < 0.081$) and *SOC_delta* (Model 36: $\beta = -3.701$, $p < 0.001$) on *ZSCORE*. Furthermore, *ESG_LAG1* (Model 31: $\beta = -0.039$, $p < 0.067$), *ENV_LAG1* (Model 33: $\beta = -0.032$, $p < 0.099$) and *GOV_LAG1* (Model 37: $\beta = -0.020$, $p < 0.059$) are significantly negatively related to *ZSCORE*. These findings contradict H1, H1a and H1c because we found a negative association of the aforementioned ESG factors. For H1b, the results are not significant because we observed no association of *SOC_LAG1* and *ZSCORE*, while *SOC_delta* refuted our hypothesis.

Table 7 presents the fixed-effects regression results (Models 41 through 50), performing the same analysis as in our main model with the business cycle 'downswing sample' (2020–2022). The table highlights the significance of ESG factors and control variables in predicting *ZSCORE*. Notably, *ESG_LAG1* (Model 41: $\beta = -0.138$, $p < 0.078$), *ENV_LAG1* (Model 43: $\beta = -0.066$, $p < 0.092$) and *GOV_LAG1* (Model 47: $\beta = -0.063$, $p < 0.052$) exhibit varying levels of significance across models, indicating the nuanced influence of ESG components on FDR. These findings contradict H1, H1a and H1c. For H1b, the results yielded no significant result because we observed no association between *SOC_LAG1* and *ZSCORE*. In contrast to the 'upswing sample', further investment in SP and its subdimensions is not associated with an increased likelihood of bankruptcy.

5.3.3 | Sample Splits ZSCORE by FDR Cluster

Prior research indicates that SP may be vital when firms are in financial distress, but not otherwise, because SP decreases distressed firms' likelihood of filing for bankruptcy and is linked with a more rapid recovery from distress (e.g., Godfrey 2005; Godfrey et al. 2009; Lin and Dong 2018). Therefore, we expected the level of FDR to influence the association between SP and FDR and also for the association of SP on FDR to be more pronounced for firms with high levels of FDR, similar to Lin and Dong (2018). Thus, we reran the regressions of our main model on split samples containing firm-year observations of firms that are not in financial distress ('non-FDR sample'; *ZSCORE* > 2.99), firm-year observations of firms that are in financial distress ('FDR sample'; *ZSCORE* < 1.88) and firm-year observations of firms that are in between ('grey-zone FDR sample'; *ZSCORE* ≥ 1.88, *ZSCORE* ≤ 2.99) similar to Habermann and Fischer (2023) based on Altman (1968).

Table 8 presents the fixed-effects regression results (Models 51 through 60) for the influence of SP and its subdimensions on FDR for non-FDR sample firms ($N = 554$). *ENV_LAG1* (Model 53: $\beta = -0.068$, $p < 0.097$) and *GOV_LAG1* (Model 57: $\beta = -0.054$, $p < 0.097$) were significantly negatively associated with *ZSCORE*. Notably, *SOC_delta* (Model 56: $\beta = -4.406$, $p < 0.030$) showed a significant negative impact, indicating that recent improvements or declines in these areas can affect a firm's financial health. These findings refute our hypotheses that sustainability, environmental, social and governance performance are positively associated with FDR for firms not in financial distress.

Table 9 presents the fixed-effects regression results (Models 61 through 70) for the influence of SP and its subdimensions on FDR for grey-zone FDR sample firms ($N = 371$). *ENV_LAG1* in Model 63 ($\beta = -0.003$, $p < 0.001$) showed a highly significant negative impact on *ZSCORE*, indicating that past environmental performance negatively affects financial health. Hence, for firms that are neither in financial distress nor enjoying superior financial health, we must refute H1a. For ESG-, S- and G-scores, no significant association with *ZSCORE* was observed; thus, we reject H1, H1b and H1c. Interestingly, these findings provide evidence that environmental performance is negatively associated with default risk at a small magnitude for firms that are in neither financial distress nor superior financial health—that is, firms in the 'grey zone'.

TABLE 6 | Multivariate results—ZSCORE—upswing sample.

Model	31	32	33	34	35	36	37	38	39	40
ZSCORE										
Dependent variables										
Variables of interest										
<i>ESG_LAG1</i>	−0.039*									
	0.067									
<i>ESG_delta</i>		−4.694*								
		0.081								
<i>ENV_LAG1</i>			−0.032*						−0.030*	
			0.099						0.077	
<i>ENV_delta</i>				−0.787						0.018
				0.742						0.994
<i>SOC_LAG1</i>					−0.020				0.001	
					0.203				0.921	
<i>SOC_delta</i>						−3.701***				−3.529***
						0.001				0.009
<i>GOV_LAG1</i>							−0.020*		−0.016*	
							0.059		0.054	
<i>GOV_delta</i>								−1.597		−1.449
								0.225		0.281
Control variables										
<i>MTBV</i>	0.357***	0.341***	0.355***	0.346***	0.356***	0.340***	0.346***	0.346***	0.354***	0.339***
	0.002	0.001	0.002	0.001	0.002	0.001	0.001	0.001	0.002	0.001
<i>VOL</i>	−12.598***	−12.609***	−12.340**	−12.425***	−12.710***	−12.562***	−13.059***	−12.462***	−12.881**	−12.625***
	0.007	0.003	0.012	0.004	0.007	0.003	0.004	0.004	0.010	0.002
<i>RET</i>	6.827	8.774	7.573	8.444	7.806	8.744	7.059	8.784	6.496	8.982
	0.296	0.208	0.252	0.191	0.232	0.209	0.305	0.195	0.346	0.190

(Continues)

TABLE 6 | (Continued)

Model	31	32	33	34	35	36	37	38	39	40
<i>CCE2TA</i>	9.785	9.706	9.853	9.658	9.584	9.691	10.005	9.725	10.113	9.743
	0.296	0.301	0.291	0.303	0.310	0.303	0.286	0.301	0.278	0.299
<i>LNSIZE</i>	-0.529***	-0.815***	-0.502**	-0.791***	-0.670***	-0.813***	-0.681***	-0.787***	-0.445**	-0.815***
	0.003	0.002	0.018	0.002	0.002	0.002	0.002	0.003	0.020	0.002
<i>FA2TA</i>	1.661	1.434	2.063*	1.434	1.576	1.375	1.301	1.481	1.898*	1.415
	0.171	0.295	0.057	0.287	0.223	0.313	0.338	0.268	0.088	0.294
<i>_cons</i>	13.381**	15.640***	12.322**	15.140***	14.531**	15.635**	14.543**	15.078**	12.179**	15.674***
	0.012	0.009	0.017	0.008	0.011	0.010	0.013	0.011	0.019	0.007
Year-fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry-fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country-fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
<i>N</i>	695	695	695	695	695	695	695	695	695	695
<i>r</i> ²	0.370	0.363	0.373	0.361	0.364	0.363	0.367	0.362	0.377	0.365
<i>r</i> ² _a	0.347	0.340	0.350	0.337	0.341	0.340	0.343	0.338	0.352	0.339

Note: All metric variables are winsorized at the 1st and 99th percentiles. For variable definitions, see Table A1. OLS regressions are run with standard errors clustered by firm. All regressions include a constant term. *p*-values are displayed below the respective variable.

*, ** and *** indicate significance at the 10%, 5% and 1% level, respectively.

TABLE 7 | Multivariate results—ZSCORE—downswing sample.

Model	41	42	43	44	45	46	47	48	49	50
ZSCORE										
Dependent variables										
Variables of interest										
<i>ESG_LAG1</i>	-0.138*									
	0.078									
<i>ESG_delta</i>		3.756								
		0.166								
<i>ENV_LAG1</i>			-0.066*						-0.042**	
			0.092						0.012	
<i>ENV_delta</i>				-1.002						-1.336
				0.750						0.666
<i>SOC_LAG1</i>					-0.090				-0.051	
					0.207				0.331	
<i>SOC_delta</i>						-0.128				-0.248
						0.979				0.958
<i>GOV_LAG1</i>							-0.063*		-0.056**	
							0.052		0.014	
<i>GOV_delta</i>								4.629		4.692
								0.315		0.335
Control variables										
<i>MTBV</i>	0.285***	0.292***	0.281***	0.292***	0.292***	0.291***	0.284***	0.294***	0.279***	0.294***
	0.001	0.000	0.001	0.000	0.001	0.000	0.001	0.000	0.001	0.000
<i>VOL</i>	-25.663**	-21.888**	-23.429**	-21.758**	-27.186***	-21.791**	-22.214**	-21.074**	-26.269***	-20.952**
	0.010	0.013	0.012	0.015	0.005	0.020	0.0018	0.015	0.007	0.024
<i>RET</i>	16.270**	20.329**	20.665***	21.340***	18.820**	21.229***	17.558**	19.459**	16.246**	19.636**
	0.024	0.010	0.009	0.006	0.012	0.008	0.015	0.012	0.029	0.011

(Continues)

TABLE 7 | (Continued)

Model	41	42	43	44	45	46	47	48	49	50
<i>CCE2TA</i>	14.346	13.676	13.429	13.862	14.272	13.827	14.559	13.658	14.483	13.718
	0.199	0.245	0.228	0.236	0.220	0.237	0.211	0.249	0.193	0.242
<i>LNSIZE</i>	-0.261	-0.891**	-0.513**	-0.910**	-0.517**	-0.906**	-0.659**	-0.868**	-0.213	-0.874**
	0.251	0.017	0.048	0.019	0.027	0.017	0.041	0.012	0.342	0.015
<i>FA2TA</i>	1.064	-0.698	1.226	-0.681	0.423	-0.678	-0.635	-0.789	1.206	-0.794
	0.383	0.693	0.182	0.713	0.772	0.709	0.709	0.665	0.274	0.668
<i>_cons</i>	18.153**	18.177**	16.443**	18.583**	19.256**	18.500**	19.014**	17.575**	18.075*	17.678**
	0.038	0.027	0.025	0.028	0.035	0.025	0.037	0.019	0.052	0.022
Year-fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry-fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country-fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
<i>N</i>	516	516	516	516	516	516	516	516	516	516
<i>r</i> ²	0.422	0.370	0.398	0.370	0.400	0.369	0.399	0.374	0.432	0.374
<i>r</i> ² _a	0.395	0.341	0.370	0.340	0.372	0.340	0.371	0.344	0.403	0.342

Note: All metric variables are winsorized at the 1st and 99th percentiles. For variable definitions, see Table A1. OLS regressions are run with standard errors clustered by firm. All regressions include a constant term. *p*-values are displayed below the respective variable.

*, ** and *** indicate significance at the 10%, 5% and 1% level, respectively.

TABLE 8 | Multivariate results—*ZSCORE*—non-FDR sample.

Model	51	52	53	54	55	56	57	58	59	60
Dependent variables	<i>ZSCORE</i>									
Variables of interest										
<i>ESG_LAG1</i>	−0.106									
	0.134									
<i>ESG_delta</i>		−2.372								
		0.220								
<i>ENV_LAG1</i>			−0.068*						−0.043**	
			0.097						0.010	
<i>ENV_delta</i>				−2.774						−2.484
				0.155						0.183
<i>SOC_LAG1</i>					−0.073				−0.034	
					0.218				0.424	
<i>SOC_delta</i>						−4.406**				−4.119*
						0.030				0.050
<i>GOV_LAG1</i>							−0.054*		−0.042*	
							0.097		0.069	
<i>GOV_delta</i>								1.834		2.073
								0.198		0.107
Control variables										
<i>MTBV</i>	0.328***	0.302***	0.311***	0.303***	0.324***	0.297***	0.318***	0.306***	0.328***	0.298***
	0.002	0.000	0.002	0.000	0.004	0.000	0.000	0.000	0.004	0.000
<i>VOL</i>	−15.113	−10.607	−16.716	−10.492	−17.184	−9.842	−9.410	−10.011	−16.668	−9.251
	0.190	0.193	0.137	0.198	0.245	0.221	0.172	0.192	0.179	0.223
<i>RET</i>	−9.654*	−4.663	−7.547	−5.329	−8.011	−4.603	−8.437	−5.900	−10.656*	−5.840
	0.083	0.433	0.181	0.366	0.143	0.403	0.166	0.322	0.068	0.320
<i>CCE2TA</i>	12.105	11.323	13.094	11.249	11.012	11.463	12.113	11.277	12.950	11.396
	0.233	0.276	0.178	0.275	0.297	0.269	0.242	0.279	0.212	0.269
<i>LNSIZE</i>	0.079	−0.582	−0.086	−0.589	−0.145	−0.588	−0.306	−0.551	0.137	−0.592
	0.818	0.160	0.802	0.157	0.663	0.171	0.369	0.183	0.695	0.155
<i>FA2TA</i>	−1.658	−3.724	−0.418	−3.832	−2.249	−3.767	−3.836	−3.781	−1.038	−3.956
	0.661	0.329	0.907	0.311	0.549	0.321	0.329	0.319	0.769	0.293
<i>_cons</i>	11.288	14.987*	10.764	15.127*	13.405	15.108	13.701	14.354	10.867	15.187*
	0.151	0.095	0.161	0.092	0.133	0.104	0.115	0.106	0.189	0.091
Year-fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry-fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

(Continues)

TABLE 8 | (Continued)

Model	51	52	53	54	55	56	57	58	59	60
Country-fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
<i>N</i>	554	554	554	554	554	554	554	554	554	554
<i>r</i> ²	0.333	0.295	0.327	0.296	0.321	0.297	0.320	0.296	0.347	0.298
<i>r</i> ² _a	0.299	0.259	0.292	0.260	0.286	0.261	0.285	0.260	0.311	0.260

Note: All metric variables are winsorized at the 1st and 99th percentiles. For variable definitions, see Table A1. OLS regressions are run with standard errors clustered by firm. All regressions include a constant term. *p*-values are displayed below the respective variable.

*, ** and *** indicate significance at the 10%, 5% and 1% level, respectively.

Table 10 presents the fixed-effects regression results (Models 71 through 80) for the influence of SP and its subdimensions on FDR for FDR sample firms ($N=286$). *ESG_LAG1* (Model 71: $\beta=0.004$, $p<0.015$) showed a significant positive association with *ZSCORE*, albeit with a small magnitude of the coefficient. Conversely, *ESG_delta* (Model 72: $\beta=-0.279$, $p<0.028$) demonstrated a significant negative effect, highlighting that rapid changes in ESG scores may negatively affect *ZSCORE*. For *ENV_LAG1* (Model 73: $\beta=0.002$, $p<0.002$) and *SOC_LAG1* (Model 75: $\beta=0.004$, $p<0.000$), we observed a positive and highly significant association (both with small magnitudes of coefficients) with *ZSCORE*. However, we observed no association between *GOV_LAG* and *ZSCORE*.

Hence, we can confirm H1, H1a and H1b for firms under FDR. This applies only to the levels of the ESG and its subdimensions scores, not to the increase in the scores (delta) itself for *ESG_delta*. For H1c, the results yielded no significant result because we observed no association of *GOV_LAG1* and *ZSCORE*.

5.4 | Robustness Checks

To ensure the robustness of our findings, we conducted a series of tests under varied conditions. We altered the dependent variables in our regression models from *ZSCORE* to *OSCORE* and *XSCORE*, as shown in Tables A3 and A4, respectively. These modifications did not affect the consistency of our results with those of the original model. Additionally, we implemented sample splits analogous to those in our primary analysis, although these were not tabulated. To further assess the robustness of our conclusions, we adjusted the industry classification systems from *SIC1*⁵ to *SIC4*, *FF12*⁶ and *INDM*⁷; these changes also were not tabulated. Moreover, we revised our control variables to match those used by Habermann and Fischer (2023) to account for omitted variable bias (e.g., leverage ratio), as outlined in Tables A5–A7. To test our equation with dynamic panel GMM estimation, we use second-period lags as instrument variables of the level and differences of SP following Boubaker et al. (2020) and El Ghouli et al. (2018). Addressing potential endogeneity, the GMM results reinforce the adverse effects of SP on the dependent variable, supporting the robustness of our main models. This extensive evaluation, which included changes to dependent variables, industry classifications, sample segmentation and GMM approaches, confirmed the reliability of our primary findings.

6 | Discussion

Although we found no general support for our hypotheses that SP and its subdimensions are negatively linked to FDR, which contradicts prior research (e.g., Boubaker et al. 2020; Cohen 2022; Suganda and Kim 2023), our study nonetheless yielded significant results that add fuel to the current debate (e.g., Damodaran 2023; Edmans 2024; Larcker et al. 2023) questioning a positive association between sustainability and economic performance. We found that SP mostly—but not invariably—increases FDR, which calls into question the notion of a general positive association between sustainability and distress resilience.

The findings related to the nexus of SP and FDR highlight a complex dynamic relationship between corporate sustainability practices and financial stability. Interpreting these results from a stakeholder theory perspective, it becomes evident that firms must balance the demands of various stakeholders with the overarching goal of financial longevity and growth (Dal Maso et al. 2018; Gupta et al. 2020). Research suggests that improved SP can foster financial benefits by strengthening stakeholder relationships, particularly when these investments align with ecological stewardship principles (Doni and Fiameni 2024; Rahi et al. 2024). However, our findings suggest that, at least in a European setting, high SP levels are associated with higher FDR, contradicting previous studies such as Habermann and Fischer (2023), Suganda and Kim (2023) and Vivel-Búa et al. (2023), which reported reduced FDR under certain conditions.

Our sample of STOXX Europe 600 firms displayed higher ESG scores than those in prior studies, with some ESG pillar scores exhibiting double the values observed by Habermann and Fischer (2023). This disparity suggests that firms with high levels of SP may face risk acceleration on additional SP investments: When SP levels are already high, further investments may bring only marginal benefits or even lead to higher FDR, as evidenced in our results. This aligns with the concept of diminishing marginal benefits suggested by Habermann (2021). Our findings suggest that overinvestment in SP can be counterproductive for well-established firms, especially in Europe, where large corporations may already operate at high SP and standards, reflected by high ESG scores.

For managers of such well-established European firms, these results emphasise the importance of strategic capital allocation

TABLE 9 | Multivariate results—ZSCORE — grey-zone FDR sample.

Model	61	62	63	64	65	66	67	68	69	70
ZSCORE										
Dependent variables										
Variables of interest										
<i>ESG_LAG1</i>	−0.002									
	0.169									
<i>ESG_delta</i>		−0.228								
		0.660								
<i>ENV_LAG1</i>			−0.003***						−0.004***	
			0.001						0.001	
<i>ENV_delta</i>				−0.214						−0.190
				0.639						0.657
<i>SOC_LAG1</i>					0.000				0.002	
					0.995				0.198	
<i>SOC_delta</i>						0.049				0.107
						0.833				0.682
<i>GOV_LAG1</i>							0.000		0.001	
							0.627		0.296	
<i>GOV_delta</i>								−0.191		−0.189
								0.322		0.283
Control variables										
<i>MTBV</i>	0.027*	0.025*	0.029*	0.025*	0.025*	0.025*	0.025*	0.026*	0.029**	0.026*
	0.089	0.076	0.052	0.075	0.088	0.076	0.072	0.073	0.041	0.070
<i>VOL</i>	−0.537**	−0.645***	−0.440*	−0.643**	−0.607**	−0.600**	−0.600**	−0.642**	−0.477*	−0.658**
	0.018	0.010	0.067	0.019	0.023	0.016	0.024	0.011	0.075	0.015
<i>RET</i>	0.987	1.071	1.047	1.057	1.03	1.016	1.038	1.031	1.139	1.022
	0.392	0.331	0.330	0.345	0.374	0.382	0.375	0.372	0.276	0.366

(Continues)

TABLE 9 | (Continued)

Model	61	62	63	64	65	66	67	68	69	70
<i>CCE2TA</i>	-0.607	-0.602*	-0.673**	-0.612*	-0.610*	-0.611*	-0.615*	-0.589*	-0.698**	-0.592*
	0.101	0.082	0.049	0.094	0.090	0.091	0.087	0.081	0.029	0.088
<i>LNSIZE</i>	-0.052**	-0.064***	-0.039**	-0.064***	-0.063***	-0.063***	-0.065***	-0.064***	-0.048**	-0.065***
	0.018	0.004	0.035	0.004	0.009	0.005	0.002	0.004	0.017	0.004
<i>FA2TA</i>	0.163	0.174	0.169	0.176	0.171	0.171	0.173	0.176	0.187	0.182
	0.373	0.366	0.321	0.348	0.379	0.373	0.377	0.353	0.303	0.322
<i>_cons</i>	3.336***	3.423***	3.228***	3.429***	3.400***	3.395***	3.409***	3.414***	3.267***	3.428***
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Year-fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry-fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country-fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
<i>N</i>	371	371	371	371	371	371	371	371	371	371
<i>r</i> ²	0.159	0.158	0.172	0.158	0.157	0.157	0.157	0.160	0.176	0.161
<i>r</i> ² _a	0.093	0.091	0.107	0.091	0.090	0.090	0.090	0.093	0.105	0.089

Note: All metric variables are winsorized at the 1st and 99th percentiles. For variable definitions, see Table A1. OLS regressions are run with standard errors clustered by firm. All regressions include a constant term. *p*-values are displayed below the respective variable.

*, ** and *** indicate significance at the 10%, 5% and 1% level, respectively.

TABLE 10 | Multivariate results—ZSCORE—FDR sample.

Model	71	72	73	74	75	76	77	78	79	80
ZSCORE										
Dependent variables										
Variables of interest										
<i>ESG_LAG1</i>	0.004**									
	0.015									
<i>ESG_delta</i>		−0.279**								
		0.028								
<i>ENV_LAG1</i>			0.002***						0.001	
			0.002						0.444	
<i>ENV_delta</i>				−0.023						−0.005
				0.751						0.965
<i>SOC_LAG1</i>					0.004***				0.003**	
					0.000				0.022	
<i>SOC_delta</i>						−0.093				−0.066
						0.621				0.773
<i>GOV_LAG1</i>							0.001		0.000	
							0.439		0.735	
<i>GOV_delta</i>								−0.143		−0.138
								0.421		0.466
Control variables										
<i>MTBV</i>	0.009	0.007	0.009	0.007	0.008	0.007	0.007	0.007	0.009	0.007
	0.154	0.322	0.246	0.355	0.179	0.343	0.318	0.345	0.146	0.340
<i>VOL</i>	−1.092**	−1.139**	−1.114**	−1.145**	−1.075**	−1.139**	−1.130**	−1.143***	−1.066**	−1.139**
	0.018	0.012	0.012	0.015	0.013	0.017	0.024	0.009	0.016	0.011
<i>RET</i>	2.310**	2.132**	2.106**	2.115**	2.289**	2.111**	2.190**	2.145**	2.297**	2.142**
	0.014	0.022	0.032	0.023	0.012	0.024	0.015	0.020	0.011	0.021

(Continues)

TABLE 10 | (Continued)

Model	71	72	73	74	75	76	77	78	79	80
<i>CCE2TA</i>	-0.204	-0.185	-0.158	-0.176	-0.21	-0.18	-0.193	-0.181	-0.206	-0.183
	0.465	0.533	0.539	0.545	0.396	0.543	0.550	0.540	0.425	0.545
<i>LNSIZE</i>	-0.070***	-0.053***	-0.062***	-0.052***	-0.066***	-0.052***	-0.055***	-0.052***	-0.069***	-0.053***
	0.000	0.004	0.004	0.005	0.004	0.004	0.000	0.004	0.001	0.004
<i>FA2TA</i>	0.986**	1.005**	1.001**	1.006**	1.025**	1.007**	0.987**	1.001**	1.012**	1.002**
	0.010	0.012	0.012	0.013	0.013	0.013	0.015	0.013	0.017	0.013
<i>_cons</i>	1.975***	1.989***	1.998***	1.958***	1.903***	1.966***	1.969***	1.972***	1.932***	1.979***
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Year-fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry-fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country-fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
<i>N</i>	286	286	286	286	286	286	286	286	286	286
<i>r</i> ²	0.423	0.414	0.417	0.413	0.423	0.413	0.415	0.414	0.424	0.414
<i>r</i> ² _a	0.366	0.355	0.358	0.354	0.365	0.354	0.356	0.355	0.361	0.350

Note: All metric variables are winsorized at the 1st and 99th percentiles. For variable definitions, see Table A1. OLS regressions are run with standard errors clustered by firm. All regressions include a constant term. *p*-values are displayed below the respective variable.

** and *** indicate significance at the 5% and 1% level, respectively.

and the need for an awareness of FDR implications when planning SP investments. Aligning with past findings, this study underscores the value of targeted investments in sustainability pillars that can efficiently mitigate FDR cost (Albuquerque et al. 2019; Bhattacharya et al. 2021). For instance, whereas environmental and social initiatives may reduce FDR, excessive investment in governance may have the opposite effect, suggesting that a balanced approach is crucial. Hence, managers must continually assess the marginal benefits of SP investments to avoid overinvestment and ensure financial stability.

Shareholder theory would appear to reject sustainability practices as an added expense that erodes profits due to diverting funds away from activities that directly impact returns adversely (Barnea and Rubin 2010; Farah et al. 2021). In fact, diminishing marginal benefits of SP investments (Habermann 2021) may lead to a value-destroying effect of additional SP investments and increase firms' FDR. Hence, overinvestment in sustainability could lead to higher FDR, particularly if these initiatives displace funds from other essential business areas, weakening the firm's financial resilience (Agoraki et al. 2023). In addition, acquiring unnecessary SP assets may lead to value destruction in overinvestment cases when the costs of sustainability activities outweigh any possible gains (Kayser and Zülch 2024; Tampakoudis et al. 2021; Wang et al. 2021).

From an investor's standpoint, higher SP costs may dilute shareholder returns by redirecting resources that could otherwise bolster the firm's profitability (Flori et al. 2024). This is particularly concerning in traditional shareholder-driven models where maximising short-term returns remains a priority (Habermann and Fischer 2023). Conversely, creditors may favour strong SP because it potentially signals a more responsible management approach and lower FDR, thereby benefiting their asymmetrical risk/return profile (Attig et al. 2013; Boubaker et al. 2020; Jiraporn et al. 2014). For firms not currently under FDR, a superior SP might serve as a safeguard against future financial instability.

In conclusion, although investors often prioritise maximising returns, creditors may value the risk-reducing effects of SP. Firms face the challenge of balancing sustainable initiatives that support long-term resilience and activities for immediate financial shareholders' gain. Considering recent findings (e.g., Habermann and Fischer 2023; Vivel-Búa et al. 2023), we recognise that SP investment decisions must be adaptable to the dynamic economic environment to achieve long-term financial sustainability. Firms can better align with economic shifts by ensuring flexibility in SP investment levels, encouraging resilience and safeguarding financial stability over time.

Our results for SP investment across different economic cycles (upswing and downswing) show a consistently positive association between SP and FDR, thus refuting H1, H1a and H1c. This trend is particularly noteworthy because it indicates that SP investments may increase FDR, irrespective of economic conditions in our sample. Specifically, in the 'downswing sample', our findings of a positive association between SP and FDR differ from previous studies (e.g., Habermann and Fischer 2023; Vivel-Búa et al. 2023) that showed SP investments reducing FDR in economic downturns. However, our analysis indicates that

additional SP investments during an economic downturn do not further increase FDR, suggesting a potentially stabilising effect of increased SP investments during these economic cycles for STOXX Europe 600 firms. Thus, our findings endorse a balanced and cycle-sensitive approach to SP investments, recognising the nuanced impacts on FDR across economic conditions.

The analysis of firm-size effects, segmented by median splits, delivers a perspective on the relationship between SP and FDR across different firm sizes. For firms in the below-median sample, the SP–FDR association is influenced primarily by governance elements, implying that strong governance aspects are central to managing FDR. However, in the above-median sample, the SP–FDR relationship appears to be driven by both environmental and governance factors, which implies that larger firms must balance environmental and governance investments to address FDR effectively. Interestingly, variations in SP levels, represented as *ESG_delta*, show no significant association with FDR, suggesting that only high SP levels may yield diminishing marginal benefits in mitigating FDR. This underscores the potential limitation of purely increasing ESG efforts without a strategic focus on the specific drivers relevant to firm size—namely, governance for smaller firms and a combination of environmental and governance practices for larger ones.

However, the negative association between SP and FDR is particularly strong for firms in potential financial distress. This observation aligns with prior research indicating that firms in financial distress benefit from higher SP levels as a buffer against FDR (Godfrey 2005; Godfrey et al. 2009; Lin and Dong 2018).

However, this relationship does not extend to changes in SP levels over time, as only current SP scores—rather than increases—are negatively associated with FDR. By contrast, firms in the 'grey zone' of potential distress do not show significant associations between SP and FDR, except for environmental performance. This suggests that SP effects are less consistent in edge cases. The results for firms not under FDR are similar to those of the main analysis.

Overall, not all SP dimensions are associated with FDR in the same way. Concerning the single pillars of SP, we identified the following patterns for STOXX Europe 600 firms.

First, high governance efforts increased FDR in our sample. One argument for this relation is that high efforts reduce the capacity and focus of management on the core business. This, in turn, would lead to distractions from value creation that could lower FDR (Fabrizi et al. 2014; Habermann and Fischer 2023; Y. Kim et al. 2012; Lin and Dong 2018).

Second, high environmental efforts also appear to increase FDR among STOXX Europe 600 firms. We explain this finding with claims that implementing environmental actions may increase FDR due to potentially long-term-oriented and costly activities such as waste disposal, emissions treatment and remediation costs (e.g., Chollet and Sandwidi 2018; Orlitzky and Benjamin 2001; Shi et al. 2023). This is similar to prior research, which has found that investments in carbon emissions reduction and water consumption enhancements do not mitigate financial instability (Ding et al. 2024).

Third, for the social pillar status, most analyses observed no association with FDR. One argument is that the costs and benefits of these activities may offset each other for STOXX Europe 600 firms, ultimately yielding insignificant results. For the FDR sample, we explain the beneficial decreasing FDR effect of high social pillar status by its turnaround measure characteristic, such as effectively promoting internal and external stakeholder relations (Habermann and Fischer 2023). However, additional social investments (*SOC_delta*) indicate increasing FDR in the upswing sample and for non-FDR sample firms. One might argue that the underlying turnaround measure mechanism is ineffective in the upswing and non-FDR sample cases because social investments' costs exceed benefits under these conditions.

7 | Limitations and Future Research

Like most research, our paper is not free of limitations. First, our findings are limited to the European capital market and its jurisdictions from 2016 to 2022. Because Europe is one of the world's most significant economic areas, a future study covering different economic areas and further jurisdictions would be interesting. Further, our sample consisted of firms from different European countries with different jurisdictions and country-specific peculiarities that may have influenced results. Because our study covers the period from 2016 to 2022, general economic conditions in the study period may have influenced results (especially default risk data).

The second limitation is the potential for heterogeneity across European countries, which may impact the generalisation of our findings. The diversity in economic structures and cultural factors across the countries included in our sample presents a significant challenge in that such differences could lead to variations in how SP impacts FDR. Although EU regulations aim to harmonise sustainability reporting standards, country-specific factors may nevertheless influence the results. Although we addressed this heterogeneity by incorporating fixed effects for countries in our regression models, it is important to recognise that fixed effects cannot entirely eliminate potential biases from unobserved heterogeneity. Therefore, our results should be interpreted cautiously, especially when generalising to contexts outside the EU. Future research could benefit from more granular analysis, exploring country-specific dynamics in greater detail to better understand the nuances of the SP–FDR relationship.

Third, our study relies on external data for SP from LSEG Data & Analytics. Because this approach is widely used in academic research (e.g., Cheng et al. 2014; Dyck et al. 2019; Habermann and Fischer 2023), we assumed that the LSEG Data & Analytics ESG scores would reflect firms' SP. However, because some doubts persist around this approach, it represents another limitation of our research. Hence, using different metrics for SP might have extended the scope of this study, and would do so for any future research building upon our contributions. Further, LSEG Data & Analytics ESG data are available only for listed firms. It would be interesting to extend this type of study to nonlisted firms in future research. Similarly, because the scope of this study was the 600 largest European listed firms, extending the sample to smaller listed firms may yield new insights and be an interesting extension of this study.

Fourth, similar to prior studies (e.g., Boubaker et al. 2020; Habermann and Fischer 2023; Suganda and Kim 2023), we used *ZSCORE*, *OSCORE* and *XSCORE* as measures for default risk. Hence, instead of data on actual financial failure, we used proxies that predict the likelihood of default. Using actual data on financial failure or different measures of default risk may extend this study by potentially enhancing the predictive validity of our findings by capturing real-world outcomes. Similarly, altering the proxies of FDR metrics may yield different results.

Fifth, studies on the relationship between SP and FDR have been subject to reverse causality concerns, which we addressed using a two-model approach (Habermann and Fischer 2023; Suganda and Kim 2023). Further, we tested three different FDR scores as robustness checks (Suganda and Kim 2023) and used lagging independent variables to account for simultaneity and endogeneity concerns (Fernando et al. 2017; Flammer 2015; Habermann and Fischer 2023). We also followed Boubaker et al. (2020) by implementing sample splits, such as economic swings and a GMM approach.

8 | Conclusion

Recognising the growing significance of SP while acknowledging its increasingly nuanced link to economic performance, this study examined the SP–FDR nexus in a multi-country European context. Specifically, we used exclusive SP data for the largest listed European firms (STOXX Europe 600 index) from 2016 to 2022 and calculated FDR using different measurement methods for financial distress (Altman Z-score, Ohlson O-score and Zmijewski X-score). The results of our main model provided evidence that not all SP dimensions are equally associated with FDR. Although we found that environmental and governance SP dimensions increase FDR, we identified no such association between the social SP dimension and FDR in most analyses performed. Overall, although the ESG factors appear to have some influence on *ZSCORE*, their economic significance may be relatively modest compared to that of other variables in the models. Our results remained significant under various robustness checks (e.g., *OSCORE*, *XSCORE* and different industry classifications). This research extends the literature on the nexus between SP and FDR to the case of the largest European listed firms. Our results have theoretical, practical and regulatory implications for firms, investors or creditors, as well as regulators and market authorities.

8.1 | Theoretical Implications

From a theoretical perspective, our results indicate a positive association between SP and default risk, supporting shareholder theory. This contrasts with most prior research, apart from firms with a higher likelihood of default, such as Cohen (2022), Lisin et al. (2022) and Suganda and Kim (2023). For firms with a higher likelihood of default under FDR, we found evidence that SP and default risk are negatively associated, supporting stakeholder theory in line with much of the extant research (e.g., Boubaker et al. 2020; Cooper and Uzun 2019; Habermann and Fischer 2023; Lin and Dong 2018). Thus, the existing level of FDR may be an

important determinant of the SP–FDR nexus, as Habermann and Fischer (2023) proposed. Our comprehensive multi-country study on the SP–credit risk nexus yielded significant results. Further, we extend the literature by examining the SP–FDR association both comprehensively and individually by SP dimension (i.e., environmental, social and governance).

8.2 | Practical and Managerial Implications

Our results support the notion that sustainability is beyond redemption (e.g., Damodaran 2023) and that firms must critically assess investment in SP. Specifically, investing in environmental and governance SP may increase FDR.

From the perspective of an investor or creditor, our results indicate that investments to increase SP can be costly and may increase FDR. Moreover, investor demands for higher SP could weaken a firm's financial resilience by pulling resources away from other essential business areas, potentially reducing overall investment performance. However, for firms under FDR, superior SP may signal lower default risk. This finding may be of particular interest to creditors due to their asymmetrical risk/return profile compared to shareholders.

For managers, the strategic management of capital allocation is a crucial responsibility; it also accounts for capital allocation into SP. Previous research has indicated that SP can reduce FDR for financially distressed firms. However, this may not be the case for firms in stronger financial shape (e.g., Godfrey 2005; Lin and Dong 2018). Thus, managers of large listed European firms must be cautious about overinvesting in SP. Our results indicate that simply increasing SP, especially when a firm already has high sustainability levels, does not necessarily reduce FDR and may even be counterproductive. Therefore, managers must be aware of their firm's FDR status. Investments in SP should be considered against this background and therefore focus on the sustainability pillars with the highest impact. Interestingly, our findings show that SP investment decisions are primarily decoupled from economic cycles, indicating that managers must continuously evaluate the marginal benefit of SP investments to avoid diminishing returns. Thus, managers must exercise control, make informed decisions about capital allocation into SP and ensure that sustainability efforts do not undermine financial stability, especially in times of crisis. The proper dosage of SP investments is critical for long-term firm sustainability and financial health.

8.3 | Regulatory Implications

From the perspective of a regulator or market authority, the results provide new insights for developing future regulations to promote sustainable development and improve financial market stability because they enhance the understanding of the SP–FDR nexus. Our results indicate that SP is mostly costly and results in increased FDR for STOXX Europe 600 firms. Further, the results of a negative association of SP on FDR for firms in financial distress may support regulations and initiatives designed

to increase SP to enhance financial market stability and reduce risk for capital market participants.

We found no evidence to suggest that policies should differentiate between firm size regarding the impact of SP on FDR: Regardless of size, the effect of SP on FDR remained consistent. Nevertheless, we identified that a firm's financial health, particularly its FDR status, plays a substantial role. Thus, policymakers should concentrate on firms with a higher FDR level when drafting sustainability-related policies to provide adequate outcomes.

Our results differ from those of studies like Habermann and Fischer (2023), Suganda and Kim (2023) and Vivel-Búa et al. (2023) by deriving mixed results on the SP–FDR nexus, which emphasises that various geographic regions inherit different economic conditions and ESG adoption levels, implying that a 'one-size-fits-all' guideline is inadequate. Consequently, policymakers should integrate geographic factors that account for regional economic conditions into policy generation.

Finally, it is not the substance of SP investments that causes issues for firms, but rather the 'dose'. Excessive SP investment can drain resources from other critical business areas, potentially weakening overall firm resilience, especially for those at high risk of financial distress. Policymakers should be mindful of the trade-offs that SP investments may entail, including the potential harm to a company's core financial stability. Thus, a key question for regulators is: How much regulation is optimal without jeopardising broader financial goals?

Author Contributions

Marcel Seefloth, Florian Siedler, Christoph Kayser and Benedikt T. Retsch were jointly responsible for the conceptualization of this manuscript and for writing the original draft. Particularly, Marcel Seefloth and Benedikt T. Retsch were predominantly responsible for writing the introduction, and Marcel Seefloth was predominantly responsible for writing the literature review. Florian Siedler and Christoph Kayser were both responsible for the data management and the (empirical) methodology for this manuscript. Florian Siedler coded and executed the empirical analysis and Christoph Kayser was responsible for reviewing and challenging the different stages. Furthermore, Marcel Seefloth, Florian Siedler and Christoph Kayser were predominantly responsible for describing the results and writing the conclusion. Benedikt T. Retsch supported the preparation of the results and was responsible for writing the dependent variable section. Prof. Dr. Henning Zülch was responsible for the supervision, reviewing and challenging of this manuscript.

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Endnotes

¹ The term 'SP' is used as an umbrella term for corporate social responsibility performance; corporate social performance; and environmental, social, governance performance.

²The term 'FDR' is used as an umbrella term for financial distress risks, default risk, firm risk and credit quality.

³In the following, the term sustainability is used as an umbrella term for corporate social responsibility (CSR); corporate sustainability (CS); and environmental, social and governance (ESG).

⁴Overall, the constituents have a relatively stable representation of previous years. In 2022, the match by companies was 94%. For earlier years, matching ranged from 94% to 65% in 2016.

⁵Standard Industrial Classification (SIC).

⁶Fama–French 12-Industries Classification (FF12).

⁷Datastream Industrial Sector Classification (INDM).

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Appendix

TABLE A1 | Sample definition.

Step		Obs.	Unit
1	STOXX Europe 600 firms, index constituents as of 9 December 2023, that is, 600 firms over the 8 years 2015 through 2022	4800	Firm-years
2	Reduction caused by excluding financial industry in data collection	–1064	Firm-years
3	Reduction caused by missing data of FDR scores	–958	Firm-years
4	Reduction caused by missing data of ESG absolute scores	–162	Firm-years
5	Reduction caused by missing data of ESG delta scores	–108	Firm-years
6	Reduction caused by missing data of controls	–1297	Firm-years
7	Final sample size	1211	Firm-years

TABLE A2 | Variable definitions.

Variable	Source	Scale	LSEG Data & Analytics code	Definition
Dependent variables				
<i>ZSCORE</i>	Manual	Metric	Derived from X1: (WC02201 – WC03101) / WC02999 X2: WC034950 / WC02999 X3: WC18191 / WC02999 X4: WC08001 / WC03351 X5: WC01001 / WC02999	Altman's Z-score is a formula used to predict the likelihood of a company going bankrupt within 2 years. It combines five financial ratios into a single score: working capital/total assets, retained earnings/total assets, earnings before interest and taxes/total assets, market value of equity/total liabilities and sales/total assets. A Z-score below 1.88 suggests high bankruptcy risk, while a score above 2.99 indicates low risk.
<i>OSCORE</i>	Manual	Metric	Derived from Y1: ln (WC02999 / gross national product) Y2: WC03351 / WC02999 Y3: WC03151 / WC02999 Y4: WC03101 / WC02201 Y5: WC03351, WC02999 Y6: WC01551 / WC02999 Y7: WC04201 / WC03351 Y8: WC01551 Y9: WC01551	Ohlson's OSCORE is a model used to assess a company's probability of bankruptcy. It uses a logistic regression equation based on several financial variables: size, profitability, liquidity, and leverage. The score provides a probability estimate of financial distress, with higher values indicating greater risk of bankruptcy.
<i>XSCORE</i>	Manual	Metric	Derived from X3: WC07250 / WC02999 X5: WC03351 / WC02999 X7: WC02201 / WC03101	Zmijewski's XSCORE is a model designed to predict bankruptcy using a logistic regression approach. It incorporates three financial variables: profitability (return on assets), leverage (total liabilities divided by total assets) and liquidity (current assets divided by current liabilities). The resulting score estimates the likelihood of a firm facing financial distress, with higher scores indicating a greater probability of bankruptcy.
Variables of interest				
<i>ESG_LAG1</i>	LSEG Data & Analytics	Metric	TRESGS	LSEG Data & Analytics lagged ESG overall company score by one period.
<i>ESG_delta</i>	LSEG Data & Analytics	Metric	Derived from TRESGS	Annual percentage change of ESG overall company score
<i>ENV_LAG1</i>	LSEG Data & Analytics	Metric	ENSCORE	LSEG Data & Analytics lagged environmental company score by one period.
<i>ENV_delta</i>	LSEG Data & Analytics	Metric	Derived from ENSCORE	Annual percentage change of environmental company score
<i>SOC_LAG1</i>	LSEG Data & Analytics	Metric	SOSCORE	LSEG Data & Analytics lagged social company score by one period.
<i>SOC_delta</i>	LSEG Data & Analytics	Metric	Derived from SOSCORE	Annual percentage change of social company score
<i>GOV_LAG1</i>	LSEG Data & Analytics	Metric	CGSCORE	LSEG Data & Analytics lagged governance company score by one period.
<i>GOV_delta</i>	LSEG Data & Analytics	Metric	Derived from CGSCORE	Annual percentage change of social company score

(Continues)

TABLE A2 | (Continued)

Variable	Source	Scale	LSEG Data & Analytics code	Definition
Control variables				
<i>MTBV</i>	LSEG Data & Analytics	Metric	MTBV	The market-to-book value ratio compares a company's current market value of equity to its book value of equity. It is calculated by dividing the market value per share by the book value per share. A ratio greater than 1 indicates that the market values the company higher than its book value, suggesting positive growth expectations, while a ratio less than 1 suggests a lower market valuation relative to the book value. This ratio helps assess investor perceptions and company valuation relative to its accounting value.
<i>VOL</i>	Manual	Metric	Derived from LSEG Data & Analytics Price closed (P)	Volatility: standard deviation of monthly stock returns over the year
<i>RET</i>	Manual	Metric	Derived from LSEG Data & Analytics Price closed (P)	Mean of monthly stock returns over the year
<i>CCE2TA</i>	Manual	Metric	Derived from WC02005/WC02999	Measures the proportion of a company's total assets that are held in cash and cash equivalents. It is calculated by dividing cash and cash equivalents by a firm's total balance sheet assets. A higher ratio indicates greater liquidity and financial flexibility, while a lower ratio suggests lower immediate liquidity. This ratio helps assess a company's ability to cover short-term obligations and manage unexpected expenses.
<i>LNSIZE</i>	Manual	Metric	Derived from WC02999	Natural logarithm of the firm's total balance sheet assets
<i>FA2TA</i>	Manual	Metric	Derived from WC02501/WC02999	Measures the proportion of a company's total assets that are invested in fixed assets, such as property, plant and equipment. It is calculated by dividing total fixed assets by total balance sheet assets and multiplying by 100 to express the result as a percentage. A higher percentage indicates a greater investment in fixed assets, which may suggest a capital-intensive business model, while a lower percentage indicates a lower reliance on fixed assets. This ratio helps assess the company's asset structure and investment in long-term assets.
<i>TL2TA</i>	Manual	Metric	Derived from WC03351/WC02999	This ratio measures the proportion of a company's total assets that is financed by total debt. It is calculated by dividing total debt by total balance sheet assets and multiplying by 100 to express the result as a percentage. A higher percentage indicates a greater reliance on debt for financing, which may suggest higher financial risk, while a lower percentage indicates lower leverage and potentially lower financial risk. This ratio helps assess the company's capital structure and overall financial stability.
<i>ROA</i>	LSEG Data & Analytics	Metric	WC08326	Return on assets (ROA) measures a company's profitability relative to its total assets. It is calculated by dividing net income by total assets and is expressed as a percentage. A higher ROA indicates more efficient use of assets in generating profit, while a lower ROA suggests less efficient asset utilisation. This ratio helps assess how well a company is using its assets to produce earnings.

TABLE A3 | Multivariate regression results—*OSCORE*.

Model	81	82	83	84	85	86	87	88	89	90
Dependent variables	<i>OSCORE</i>									
Variables of interest										
<i>ESG_LAG1</i>	0.010									
	0.224									
<i>ESG_delta</i>		0.013*								
		0.053								
<i>ENV_LAG1</i>			0.009*						0.009	
			0.094						0.101	
<i>ENV_delta</i>				−0.002						−0.005
				0.648						0.314
<i>SOC_LAG1</i>					0.005				−0.001	
					0.268				0.893	
<i>SOC_delta</i>						0.011				0.011
						0.136				0.129
<i>GOV_LAG1</i>							0.004		0.003	
							0.398		0.516	
<i>GOV_delta</i>								0.005**		0.005**
								0.037		0.045
Control variables										
<i>MTBV</i>	0.014	0.016	0.015	0.015	0.014	0.017	0.016	0.015	0.015	0.016
	0.559	0.496	0.539	0.515	0.552	0.491	0.496	0.509	0.508	0.495
<i>VOL</i>	9.287***	9.136***	9.236***	9.105***	9.312***	9.046***	9.186***	9.165***	9.268***	9.085***
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
<i>RET</i>	−7.462***	−8.004***	−7.671***	−7.853***	−7.667***	−7.941***	−7.626***	−7.979***	−7.529***	−8.075***
	0.004	0.002	0.004	0.002	0.002	0.002	0.004	0.002	0.005	0.002
<i>CCE2TA</i>	−1.382	−1.370	−1.359	−1.341	−1.343	−1.365	−1.398	−1.361	−1.399	−1.377
	0.262	0.279	0.280	0.288	0.285	0.282	0.251	0.280	0.247	0.280
<i>LNSIZE</i>	0.020	0.085	0.009	0.076	0.050	0.083	0.060	0.080	0.000	0.082
	0.800	0.407	0.907	0.456	0.556	0.418	0.510	0.420	0.996	0.426
<i>FA2TA</i>	−1.568**	−1.487**	−1.694**	−1.486**	−1.530**	−1.476**	−1.470**	−1.498**	−1.674**	−1.491**
	0.017	0.024	0.014	0.023	0.022	0.025	0.026	0.022	0.016	0.024
<i>_cons</i>	−3.339*	−3.757*	−3.048*	−3.583*	−3.549*	−3.732*	−3.561*	−3.661*	−3.026*	−3.713*
	0.071	0.064	0.069	0.073	0.069	0.067	0.070	0.061	0.077	0.068
Year-fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry-fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country-fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
<i>N</i>	1211	1211	1211	1211	1211	1211	1211	1211	1211	1211

(Continues)

TABLE A3 | (Continued)

Model	81	82	83	84	85	86	87	88	89	90
<i>r</i> ²	0.237	0.233	0.241	0.231	0.233	0.233	0.233	0.232	0.242	0.234
<i>r</i> ² _{<i>a</i>}	0.219	0.214	0.223	0.213	0.215	0.215	0.215	0.214	0.223	0.215
Mean VIF	1.22	1.13	1.23	1.13	1.19	1.13	1.15	1.13	1.35	1.12

Note: All metric variables are winsorized at the 1st and 99th percentiles. For variable definitions, see Table A1. OLS regressions are run with standard errors clustered by firm. All regressions include a constant term. *p*-values are displayed below the respective variable.

*, ** and *** indicate significance at the 10%, 5% and 1% level, respectively.

TABLE A4 | Multivariate regression results—*XSCORE*.

Model	91	92	93	94	95	96	97	98	99	100
Dependent variables	<i>XSCORE</i>									
Variables of interest										
<i>ESG_LAG1</i>	0.009									
	0.115									
<i>ESG_delta</i>		0.003								
		0.518								
<i>ENV_LAG1</i>			0.007*						0.007**	
			0.054						0.044	
<i>ENV_delta</i>				−0.005						−0.007
				0.221						0.112
<i>SOC_LAG1</i>					0.005				0.001	
					0.147				0.646	
<i>SOC_delta</i>						0.005				0.005
						0.377				0.271
<i>GOV_LAG1</i>							0.002		0.001	
							0.365		0.608	
<i>GOV_delta</i>								0.003**		0.003**
								0.036		0.037
Control variables										
<i>MTBV</i>	0.029**	0.030**	0.030**	0.030**	0.029**	0.031**	0.030**	0.030**	0.030**	0.030**
	0.048	0.034	0.041	0.033	0.048	0.034	0.028	0.031	0.037	0.034
<i>VOL</i>	6.781***	6.632***	6.730***	6.613***	6.832***	6.599***	6.674***	6.661***	6.791***	6.614***
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
<i>RET</i>	−4.791***	−5.170***	−4.984***	−5.139***	−4.944***	−5.168***	−4.989***	−5.213***	−4.874***	−5.271***
	0.003	0.001	0.002	0.001	0.001	0.001	0.002	0.001	0.003	0.001
<i>CCE2TA</i>	−0.494	−0.467	−0.472	−0.454	−0.46	−0.469	−0.494	−0.471	−0.492	−0.474
	0.611	0.639	0.633	0.648	0.641	0.638	0.609	0.635	0.606	0.635
<i>LNSIZE</i>	0.293***	0.346***	0.287***	0.340***	0.316***	0.346***	0.333***	0.345***	0.280***	0.343***
	0.003	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002
<i>FA2TA</i>	−0.753	−0.681	−0.852	−0.684	−0.727	−0.677	−0.671	−0.688	−0.841	−0.689
	0.170	0.233	0.138	0.228	0.200	0.237	0.241	0.228	0.149	0.230
<i>_cons</i>	−7.100***	−7.377***	−6.875***	−7.263***	−7.275***	−7.389***	−7.308***	−7.371***	−6.881***	−7.333***
	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Year-fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry-fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country-fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
<i>N</i>	1211	1211	1211	1211	1211	1211	1211	1211	1211	1211

(Continues)

TABLE A4 | (Continued)

Model	91	92	93	94	95	96	97	98	99	100
<i>r</i> ²	0.280	0.272	0.284	0.272	0.276	0.272	0.273	0.272	0.285	0.274
<i>r</i> ² _{<i>a</i>}	0.263	0.254	0.267	0.255	0.259	0.255	0.256	0.255	0.267	0.256
Mean VIF	1.26	1.18	1.26	1.17	1.23	1.17	1.19	1.17	1.37	1.16

Note: All metric variables are winsorized at the 1st and 99th percentiles. For variable definitions, see Table A1. OLS regressions are run with standard errors clustered by firm. All regressions include a constant term. *p*-values are displayed below the respective variable.

*, ** and *** indicate significance at the 10%, 5% and 1% level, respectively.

TABLE A5 | Multivariate regression results—Habermann and Fischer—ZSCORE.

Model	101	102	103	104	105	106	107	108	109	110
ZSCORE										
Dependent variables										
Variables of interest										
<i>ESG_LAG1</i>	-0.042									
	0.130									
<i>ESG_delta</i>		-0.016								
		0.405								
<i>ENV_LAG1</i>			-0.027						-0.024**	
			0.108						0.034	
<i>ENV_delta</i>				-0.018*						-0.016*
				0.053						0.069
<i>SOC_LAG1</i>					-0.019				0.000	
					0.349				0.985	
<i>SOC_delta</i>						-0.021				-0.019
						0.319				0.380
<i>GOV_LAG1</i>							-0.025*		-0.023*	
							0.097		0.062	
<i>GOV_delta</i>								0.008		0.009
								0.444		0.382
Control variables										
<i>CCE2TA</i>	9.839	9.846	9.667	9.835	9.729	9.869	10.182	9.798	10.016	9.861
	0.246	0.247	0.249	0.246	0.257	0.245	0.231	0.250	0.235	0.246
<i>LNSIZE</i>	0.051	-0.189	0.008	-0.191	-0.087	-0.192	-0.063	-0.176	0.093	-0.195
	0.764	0.242	0.961	0.249	0.534	0.261	0.687	0.273	0.603	0.243
<i>TL2TA</i>	-13.338***	-13.805***	-13.381***	-13.838***	-13.605***	-13.788***	-13.579***	-13.807***	-13.229***	-13.834***
	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
<i>ROA</i>	0.158**	0.153**	0.157**	0.152**	0.156**	0.152**	0.154**	0.153**	0.157**	0.151**
	0.014	0.017	0.014	0.018	0.019	0.016	0.015	0.017	0.013	0.017

(Continues)

TABLE A5 | (Continued)

Model	101	102	103	104	105	106	107	108	109	110
_cons	11.181***	12.574***	10.829***	12.638***	12.114***	12.634***	11.851***	12.315***	10.507***	12.737***
Year-fixed effects	0.002	0.001	0.002	0.002	0.002	0.002	0.003	0.002	0.004	0.002
Industry-fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country-fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	1211	1211	1211	1211	1211	1211	1211	1211	1211	1211
r ²	0.533	0.525	0.532	0.525	0.527	0.526	0.532	0.525	0.538	0.526
r ² _a	0.523	0.515	0.521	0.515	0.517	0.515	0.522	0.515	0.527	0.515
Mean VIF	1.52	1.40	1.53	1.39	1.47	1.39	1.42	1.39	1.59	1.31

Note: All metric variables are winsorized at the 1st and 99th percentiles. For variable definitions, see Table A1. OLS regressions are run with standard errors clustered by firm. All regressions include a constant term. *p*-values are displayed below the respective variable.

*, ** and *** indicate significance at the 10%, 5% and 1% level, respectively.

TABLE A6 | Multivariate regression results—Habermann and Fischer—*OSCORE*.

Model	111	112	113	114	115	116	117	118	119	120
Dependent variables										
Variables of interest										
<i>ESG_LAG1</i>	−0.003 0.236									
<i>ESG_delta</i>		0.010* 0.065								
<i>ENV_LAG1</i>			−0.001 0.693						0.000 0.919	
<i>ENV_delta</i>				0.004 0.346						0.003 0.480
<i>SOC_LAG1</i>					−0.004** 0.012				−0.004 0.273	
<i>SOC_delta</i>						0.006* 0.093				0.006 0.123
<i>GOV_LAG1</i>							0.000 0.980		0.001 0.825	
<i>GOV_delta</i>								0.002 0.327		0.001 0.443
Control variables										
<i>CCE2TA</i>	0.109 0.612	0.088 0.696	0.101 0.648	0.102 0.643	0.091 0.679	0.091 0.693	0.106 0.640	0.103 0.643	0.084 0.726	0.086 0.706
<i>LNSIZE</i>	−0.291*** 0.000	−0.302*** 0.000	−0.300*** 0.000	−0.305*** 0.000	−0.289*** 0.000	−0.304*** 0.000	−0.308*** 0.000	−0.306*** 0.000	−0.293*** 0.000	−0.302*** 0.000
<i>TL2TA</i>	6.779*** 0.000	6.750*** 0.000	6.764*** 0.000	6.756*** 0.000	6.784*** 0.000	6.743*** 0.000	6.746*** 0.000	6.744*** 0.000	6.776*** 0.000	6.749*** 0.000
<i>ROA</i>	−0.0333*** 0.003	−0.0344*** 0.004	−0.034*** 0.003	−0.034*** 0.004	−0.033*** 0.005	−0.033*** 0.004	−0.034*** 0.004	−0.034*** 0.004	−0.033*** 0.005	−0.033*** 0.004

(Continues)

TABLE A6 | (Continued)

Model	111	112	113	114	115	116	117	118	119	120
_cons	-0.800**	-0.828**	-0.777*	-0.771*	-0.767*	-0.787*	-0.712*	-0.731*	-0.737**	-0.835*
Year-fixed effects	0.029	0.045	0.053	0.069	0.069	0.073	0.067	0.076	0.044	0.053
Industry-fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country-fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	1211	1211	1211	1211	1211	1211	1211	1211	1211	1211
r ²	0.722	0.723	0.722	0.722	0.723	0.723	0.722	0.722	0.723	0.723
r ² _a	0.716	0.717	0.716	0.716	0.717	0.717	0.716	0.716	0.717	0.716
Mean VIF	2.14	2.02	2.13	2.02	2.09	2.02	2.04	2.01	2.04	1.78

Note: All metric variables are winsorized at the 1st and 99th percentiles. For variable definitions, see Table A1. OLS regressions are run with standard errors clustered by firm. All regressions include a constant term. *p*-values are displayed below the respective variable.

*, ** and *** indicate significance at the 10%, 5% and 1% level, respectively.

TABLE A7 | Multivariate regression results—Habermann and Fischer—*XSCORE*.

Model	121	122	123	124	125	126	127	128	129	130
Dependent variables	<i>XSCORE</i>									
Variables of interest										
<i>ESG_LAG1</i>	−0.001									
	0.294									
<i>ESG_delta</i>		0.002								
		0.615								
<i>ENV_LAG1</i>			0.000						0.001	
			0.960						0.559	
<i>ENV_delta</i>				0.000						−0.001
				0.871						0.769
<i>SOC_LAG1</i>					−0.001*				−0.001	
					0.056				0.213	
<i>SOC_delta</i>						0.001				0.001
						0.651				0.616
<i>GOV_LAG1</i>							−0.001		−0.001	
							0.318		0.421	
<i>GOV_delta</i>								0.001		0.001
								0.299		0.314
Control variables										
<i>CCE2TA</i>	0.513**	0.510**	0.513**	0.513**	0.507**	0.510**	0.522**	0.510**	0.518**	0.509**
	0.042	0.048	0.047	0.046	0.045	0.048	0.041	0.045	0.050	0.050
<i>LNSIZE</i>	0.050***	0.045***	0.044***	0.044***	0.050***	0.045***	0.048***	0.045***	0.049***	0.045***
	0.001	0.006	0.009	0.007	0.003	0.006	0.001	0.005	0.001	0.007
<i>TL2TA</i>	5.275***	5.264***	5.263***	5.263***	5.276***	5.263***	5.270***	5.263***	5.273***	5.261***
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
<i>ROA</i>	−0.014***	−0.014***	−0.014***	−0.014***	−0.014***	−0.014***	−0.014***	−0.014***	−0.014***	−0.014***
	0.007	0.007	0.007	0.007	0.009	0.008	0.007	0.007	0.008	0.007
<i>_cons</i>	−5.042***	−5.028***	−5.008***	−5.005***	−5.028***	−5.021***	−5.025***	−5.020***	−5.003***	−5.021***
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Year-fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry-fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country-fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
<i>N</i>	1211	1211	1211	1211	1211	1211	1211	1211	1211	1211
<i>r</i> ²	0.816	0.816	0.815	0.815	0.816	0.816	0.816	0.816	0.816	0.816
<i>r</i> ² _a	0.812	0.811	0.811	0.811	0.812	0.811	0.812	0.812	0.812	0.811
Mean VIF	2.64	2.49	2.62	2.49	2.59	2.49	2.52	2.48	2.42	2.14

Note: All metric variables are winsorized at the 1st and 99th percentiles. For variable definitions, see Table A1. OLS regressions are run with standard errors clustered by firm. All regressions include a constant term. *p*-values are displayed below the respective variable.

*, ** and *** indicate significance at the 10%, 5% and 1% level, respectively.