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REVIEW ARTICLE OPEN ACCESS

On the Relationship Between Financial Distress and ESG Scores

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ABSTRACT

This empirical study analyzes the relationship between a company's financial distress obtained from a bankruptcy prediction model and ESG scores from Refinitiv, MSCI, ESG Book, and Moody's ESG. Applying a nonparametric regression technique on panel data of listed US companies for 2003–2022 reveals a pronounced and statistically significant U-shaped relationship between financial distress and ESG scores. Financially distressed companies exhibit high ESG scores. Further empirical analysis shows that the most plausible interpretation is that companies anticipate their upcoming financial distress and intensify ESG-supporting disclosures to manage their ESG scores upward. The empirical results underline the importance of including the financial health of a company in ESG assessments. Only by taking into account both the ESG performance and the financial sustainability of a company is it possible to assess responsible corporate governance.

JEL Classification: C33, G33, M41, Q56

1 | Introduction

There is an ongoing debate on the informativeness of ESG scores that measure the ESG activities of a company. This debate also includes the effective relationship between a company's financial performance and ESG scores. Thereby, the latter constructed by various ESG rating agencies are used in business to inform operational corporate and long-term investment decisions (e.g., investment decisions by ESG funds; Raghunandan and Rajgopal 2022) and in science for empirical research. The present study contributes to this research line by introducing the measure of bankruptcy risk as a new variable related to ESG scores. The measure of bankruptcy risk is the result of a bankruptcy prediction model and indicates the level of a company's financial distress. The present study analyzes the effective relationship between the measure of bankruptcy risk and ESG scores from Refinitiv, MSCI, ESG Book, and Moody's ESG by applying a nonparametric regression technique on panel data of listed US companies from 2003 to 2022.

The analysis reveals a pronounced and statistically significant U-shaped relationship between the level of financial distress and ESG scores at the company level. An increase in the measure of bankruptcy risk above a certain threshold is associated with increasing ESG scores. As a result, financially distressed companies exhibit ESG scores comparable to ESG scores from financially healthy companies. This empirical finding is robust as it is observable across the four different ESG scores from Refinitiv, MSCI, ESG Book, and Moody's ESG. However, one challenge of the analysis is to identify sufficiently strong evidence for the causality between financial distress and ESG scores. We address concerns related to reverse causality by applying a set of alternative variables. Based on our analysis, the most plausible explanation for the observed U-shaped relationship between financial distress and ESG scores is that companies anticipate financial distress and focus on cost-effective ESG activities, such as ESG-supporting disclosures, to increase their ESG scores. We add to the existing literature by showing that managing ESG scores by the group of financially distressed companies reduces

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the validity and credibility of ESG scores and makes them less reliable. Therefore, it is imperative to consider a company's financial situation when interpreting ESG scores.

The empirical findings to date document a negative linear relationship between the level of financial distress and ESG scores (e.g., Zheng et al. 2019; Boubaker et al. 2020; Aslan et al. 2021; Badayi et al. 2021; Truong et al. 2025). These empirical findings support two lines of argument that postulate a negative linear relationship between the level of financial distress and ESG scores. The first line of argument is that financially unconstrained companies have more financial resources than financially constrained companies to pursue ESG objectives and invest in projects demonstrating corporate goodness. The second line of argument relates to the predominantly positive relationship between financial performance and the ESG activities of a company. If increasing financial distress of a company is generally associated with lower financial performance, there should be a negative relationship between the level of financial distress and ESG scores.

However, the previous results that show a consistently negative relationship between the level of financial distress and ESG scores are only reliable to a limited extent as these studies (e.g., Zheng et al. 2019; Boubaker et al. 2020; Aslan et al. 2021; Badayi et al. 2021; Truong et al. 2025) exclusively use linear regression techniques and thus exclude a possible nonlinear relationship in the data from the outset although there are three good reasons for at least a partially positive relationship in the case of financially distressed companies. First, financially distressed companies have a solid interest in achieving high ESG scores to obtain equity and debt capital at relatively low cost as they rely on the low cost of capital to avoid or at least delay bankruptcy. Second, financially distressed companies may conceal information about the company's failures and opportunistically pursue ESG objectives to distract from their financial distress. Third, the intracompany incentive system may set incentives to achieve ESG objectives rather than financial ones that are particularly difficult to achieve in the case of financially distressed companies. To identify the effective and unrestricted relationship between the level of financial distress and ESG scores, a comprehensive empirical study has to apply a nonparametric regression technique to the available panel data.

The interpretation of the revealed U-shaped relationship between the level of financial distress and ESG scores has to address the problem of reverse causality (Gow et al. 2016). On the one hand, financial distress could be the cause, and a high ESG score could be the effect. In this case, one interpretation could be that financially distressed companies intensify ESG-supporting disclosures and manage their ESG scores upward, very likely to decrease the cost of capital, improve the financial conditions, and distract from their financial failure. Another reason for that observation could be the incentive system and the desire of management to increase personal benefits by achieving stakeholder-oriented ESG objectives rather than shareholder-oriented financial objectives. On the other hand, measures that lead to a high ESG score could be the cause, and financial distress could be the financial consequence of these measures. Such a relationship would be more likely to be observed with ESG investments, which have a greater impact on cash flows and corporate

finances, than operational measures or ESG-supporting disclosures. We narrowed down the problem of reverse causality by conducting several extensions of empirical analysis.

Based on the results of the empirical analysis, the most plausible interpretation of the revealed U-shaped relationship between the level of financial distress and ESG scores is that companies anticipate their upcoming financial distress and intensify cost-effective ESG activities such as ESG-supporting disclosures to manage their ESG scores upward. This interpretation is also consistent with empirical findings that emphasize the importance of the quantity of ESG disclosures and consider the content of these ESG disclosures to be of secondary importance (Lyon and Maxwell 2011; Marquis et al. 2016). ESG scores are presumably influenced to a greater extent by the existence of ESG disclosures and less by their content (Drempetic et al. 2020; Lopez-de-Silanes et al. 2020). ESG scores are also enhanced by excessive and over-expectant disclosures on diversity, equity, and inclusion (Baker et al. 2024), and ESG funds pay more attention to the existence and less to the content of ESG disclosures (Raghuandan and Rajgopal 2022). The empirically observable, systematic management of ESG scores by the group of financially distressed companies makes it imperative to consider the degree of a company's financial distress when interpreting ESG scores.

The paper is structured as follows: In the next section, we provide an overview of the literature and clarify the arguments in favor of a negative and positive relationship between financial distress and ESG scores. On the basis of these arguments, we formulate a hypothesis that is subsequently tested empirically. In Section 3, we provide details on the applied data and describe the variables used for the main analysis. Section 4 presents the empirical results on the estimated nonlinear relationship between the level of financial distress and ESG scores. This section also includes insights into the three ESG subfactors and applied control variables. In Section 5, we extend the empirical analysis to address the problem of reverse causality and discuss the robustness of the results. Section 6 concludes the paper with an overview of our findings and discusses the implications of the results.

2 | Literature Review

The analysis of the relationship between financial distress and ESG scores refers to two strands of literature. The first strand of literature relates to the construction and significance of the measure of bankruptcy risk. Powerful, empirical bankruptcy prediction models (e.g., Beaver et al. 2005; Balcaen and Ooghe 2006; Bellovary et al. 2007; Campbell et al. 2008; Jones 2017; Lohmann et al. 2023) can validly estimate the measure of bankruptcy risk. In contrast to periodic accounting indicators, such as return on equity and return on assets, and value-based indicators, such as market value of equity, the measure of bankruptcy risk, which includes a large set of accounting-based, market-based, company-specific, and macroeconomic variables, enables a valid and robust estimation of a company's financial situation. The measure of bankruptcy risk is a forward-looking indicator as it predicts an impending bankruptcy within the forecast horizon of the bankruptcy prediction model. Empirical findings show

that professional investors likely apply bankruptcy prediction models to optimize their risk position as professional investors sell the shares of financially distressed companies that file for bankruptcy at an early stage and retain the shares of financially distressed peer companies that remain solvent (Lohmann and Möllenhoff 2023a). As a result, the measure of bankruptcy risk is very well suited to measuring the sustainable financial situation of a company and, thus, making a valid statement about its continued existence.

The second strand of literature relates to the relationship between financial distress and ESG scores and the arguments in favor of a negative or positive relationship. The empirical findings to date document a negative linear relationship between financial distress and ESG scores. Particularly, Zheng et al. (2019) show a negative relationship between the Z score and the ESG score from MSCI, Boubaker et al. (2020) show a negative relationship between the Z score and measure of corporate social responsibility (CSR) that is based on the qualitative dimensions of the MSCI ESG index, Aslan et al. (2021) show a negative relationship between the S&P Credit Rating and the ESG score from Refinitiv, Badayi et al. (2021) show a negative relationship between the Z score and the ESG score from Refinitiv, and Truong et al. (2025) show a negative relationship between the Z score and the ESG rating from MSCI. Lisin et al. (2022) and Cohen (2023) provide further empirical evidence on negative and mixed correlations between a company's financial distress and ESG scores. However, the informativeness of the cited empirical studies is limited, as they only use one ESG score and less developed bankruptcy risk measures such as the Z score and apply linear regression technique to analyze older datasets that are smaller in size and do not include firm-year observations from more recent years. Nevertheless, the empirical findings on a negative linear relationship between financial distress and ESG scores can be justified by two lines of argument.

The first line of argument refers to the financial constraints of a company. A negative relationship between financial distress and ESG scores is expected for financially constrained companies. Hong et al. (2012) and Xu and Taehyun (2022) find that financially unconstrained companies have more resources than financially constrained ones to pursue social and environmental objectives and invest in projects showing corporate status. A company in financial distress should have severe financial constraints and will have less freely available financial resources to invest in ESG-related projects. In addition, there is empirical evidence that financially distressed companies prefer operational and investment decisions that place less strain on the current cash flow and have a positive impact on short-term financial performance indicators (e.g., Eisfeldt and Rampini 2007; Ma et al. 2022; Thomas et al. 2022). Such short-sighted decisions address the financial constraints of a financially distressed company. ESG investments are likely to be associated with uncertainties regarding their impact on future cash flows and should therefore not be suitable for easing financial constraints in the short term. As a result, short-sighted decisions in the context of financial distress are expected to be associated with an effective reduction in ESG performance.

The second line of argument refers to the financial performance of a company. Lower financial performance is generally associated

with the increasing financial distress of a company. The relationship between a company's financial performance and ESG scores has been extensively studied by applying predominantly linear regression techniques. A significant four-digit number of individual studies and over a dozen meta-studies (e.g., Friede et al. 2015; Del Mar Miras-Rodríguez et al. 2015; Hou et al. 2016; Lu and Taylor 2016; Wang et al. 2016; Jeong and Harrison 2017; Plewnia and Guenther 2017; Rost and Ehrmann 2017; Busch and Friede 2018; Hoobler et al. 2018; López-Arceiz et al. 2018; Gallardo-Vázquez et al. 2019; Hang et al. 2019; Vishwanathan et al. 2020) found a predominantly positive relationship between the financial performance figures, mainly including variables such as return on equity, return on assets, and market value of equity, and the ESG activities of a company, which were very often considered in ESG scores' quantified form. The positive relationship between a company's financial performance and these scores suggests that there should also be a negative relationship between the level of financial distress and ESG scores.

The empirical evidence on the relationship between a company's financial performance and ESG ratings is ambiguous and does not allow for a clear interpretation. Previous studies on this relationship apply linear regression models to a large extent; however, the estimated coefficients fluctuate considerably (e.g., the meta-study of Del Mar Miras-Rodríguez et al. 2015) and sometimes even show a negative correlation (e.g., the meta-study of Rost and Ehrmann 2017). In addition to using different samples that differ in country, time, and company characteristics, an explanation for these only partially consistent results could be an effective nonlinear relationship between a company's financial performance and ESG scores. However, the latter are also inconclusive as there is empirical evidence for a U-shaped relationship (e.g., Nollet et al. 2016; Nuber et al. 2020; Naimy et al. 2021; Agarwala et al. 2024) and an inverted U-shaped relationship (e.g., Buallay et al. 2022; Teng et al. 2022; El Khoury et al. 2023; Pu 2023). As a result, an effective nonpositive or nonlinear relationship between a company's financial performance and ESG scores may indicate an effective nonnegative or nonlinear relationship between financial distress and ESG scores.

Besides the empirical arguments for a negative relationship between the level of financial distress and ESG scores, there are also three lines of argument that can justify a positive relationship. The first line of argument is based on the empirical observation that higher ESG scores are associated with a lower cost of capital. Companies that implement the ESG principles and, in particular, are considered to be highly environmentally friendly can reduce their cost of capital relative to environmentally harmful companies that do not comply with ESG principles (e.g., Chava 2014; van der Beck 2023; Pástor et al. 2022; Kacperczyk and Peydro 2024; Aron-Dine et al. 2024; Green and Vallee 2024). The difference in the cost of capital between compliant and non-compliant ESG companies is difficult to estimate; however, an analysis of quarterly earnings conference calls of US companies for the period 2016–2021 revealed that the difference in the cost of capital could be in the range of 2%–3% (Gormsen et al. 2023). As financially distressed companies aim to keep the cost of capital as low as possible to ease financial constraints or to avoid or delay bankruptcy, they have a solid interest in achieving high ESG scores to obtain equity and debt capital at relatively low costs. The negative relationship between ESG scores and the

cost of capital incentivizes financially distressed companies to strive for high ESG scores. As a result, there could be a positive relationship between the level of financial distress and ESG scores, at least for financially distressed companies that have to lower their cost of capital to increase the probability of survival.

In a second line of argument, the “management obfuscation hypothesis” supports a positive relationship between the level of financial distress and ESG scores. Bloomfield (2002) introduced the management obfuscation hypothesis and argued that managers have incentives to provide clear information about the company’s successes and to obfuscate information about the company’s failures. Several studies provide empirical evidence that the management obfuscation hypothesis is valid concerning information on a company’s performance and earnings (e.g., Lang and Lundholm 1993; DeFond and Jiambalvo 1994; Schrand and Walther 2000; Jaggi and Lee 2002; Li 2010). The empirical evidence on the management obfuscation hypothesis is less conclusive about bankruptcy risk information in annual reports. Holder-Webb and Cohen (2007) doubt that the annual reports of financially distressed companies are informative, as self-interested managers are incentivized to delay the disclosure of severe risks to the continued existence of their company as a going concern. Mayew et al. (2015) analyzed a large sample of listed US companies and found that the management obfuscation hypothesis is largely invalid. On the contrary, Lohmann and Ohliger (2020) provided empirical evidence that supports it as the annual reports of companies that eventually went bankrupt contain, on average, longer and relatively more complex risk reports and generally exhibit a less negative linguistic tone than the reports of financially distressed companies that remained solvent. As imminent bankruptcy risks are complex and challenging to communicate (Bloomfield 2008), the high linguistic complexity may result from both obfuscation and complex information (Bushee et al. 2018).

Another option to obfuscate a company’s financial distress is to focus on disclosed information about nonfinancial ESG objectives. If the company management pursues ESG objectives, financial objectives become less critical. Corporate governance and monitoring target achievement are complex, as ESG objectives are often qualitative and can only be measured subjectively. The increased complexity of such a multidimensional objective system could be useful to distract from financial objectives or conceal poor financial performance (Bebchuk and Tallarita 2020; Karpoff 2021). As financial distress mounts, the need to explain complex financial information increases, unless the focus can be placed on ESG objectives and their achievement. The required explanation of financial information can be interpreted as transaction costs that the company management aims to minimize. This argument is reinforced by empirical evidence on the positive relationship between CSR and ESG activities and earnings management (e.g., Patten and Trompeter 2003; Gargouri et al. 2010; Yip et al. 2011; Muttakin et al. 2015; Martínez-Ferrero et al. 2016; Jordaan et al. 2018; Buertey et al. 2020; Yu et al. 2020; Pasko et al. 2021; Zhang et al. 2021) that is in line with the stakeholder agency theory (Jensen and Meckling 1976; Hill and Jones 1992). Thereby, the positive relationship between ESG activities and earnings management is enhanced by a company’s financial distress (Almubarak et al. 2023). Another empirical finding that supports the validity of the management

obfuscation hypothesis is the fact that the existence and scope of ESG disclosures are particularly relevant rather than the real circumstances reflected in the ESG disclosures (Lyon and Maxwell 2011; Marquis et al. 2016; Dremptic et al. 2020; Lopez-de-Silanes et al. 2020; Raghunandan and Rajgopal 2022).

Recently, Flugum and Souther (2025) analyzed the company communication after quarterly earnings reports and provided empirical evidence that the management distracts from missing earning expectations by highlighting nonfinancial ESG objectives. One conclusion might be that companies that report, particularly, extensively on their ESG activities and prioritize ESG objectives in a publicity-effective manner are financially underperforming (Bhagat 2022). It is conceivable that financially distressed companies will also show an affinity with ESG objectives to distract from their financial distress. As the financial resources of a financially distressed company are likely to be very scarce regularly (Myers 1977), an improvement in ESG scores is more likely to result from cost-effective extensions of ESG-supporting disclosure rather than ESG investments, which require upfront capital expenditures and will only lead to positive cash flows in the long term. Thereby, extensions of ESG-supporting disclosure should be effective as ESG scores are presumably influenced to a greater extent by the existence of ESG disclosures and less by their content (Dremptic et al. 2020; Lopez-de-Silanes et al. 2020) and investors such as ESG funds focus on the existence and less to the content of ESG disclosures (Raghunandan and Rajgopal 2022). Suppose the management obfuscation hypothesis about stakeholder-oriented ESG objectives and associated ESG disclosures is valid. In that case, there should be a positive relationship between the level of financial distress and ESG scores, at least for financially distressed companies incentivized to obfuscate their financial failure.

The third line of argument relates to the intracompany incentive system. In addition to financial objectives, ESG objectives are also pursued and implemented within the intracompany incentive system, whereby the design options are still very heterogeneous (Reda 2022). Recent analyses show a growing share of listed US companies that incorporate ESG measures in annual incentive plans (e.g., Salzbank et al. 2023; Kuk et al. 2023). A company’s management likely allocates the available resources to maximize the remuneration based on financial and ESG objectives. Cohen et al. (2023) provide empirical evidence that ESG-based incentives increase ESG performance and the associated ESG scores, while ESG-based incentives tend to lead to poorer financial performance. Chang et al. (2015) analyzed the relationship between financial distress risk and the incentive-based compensation of new CEOs. They found new CEOs receive more equity-based incentives to ensure that the company’s financial position is improved. As a result, the choice and design of incentive-based remuneration significantly influence management decisions and the achievement of both financial and ESG objectives.

Furthermore, the difficulty of achieving the target must be taken into account. It may be possible that ESG objectives can be achieved more easily than financial objectives; this is the case for companies that do not have enough resources to recover from their financial distress and regularly fall short of financial objectives. If resources are scarce, it would be rational

to pursue the more easily achievable ESG objectives first and maximize the associated remuneration components. In addition to increasing variable remuneration, management could follow alternative career paths (Song and Thakor 2006; Zhang 2021) or reputational objectives (Jiang et al. 2016) that are promoted by achieving the highest possible ESG scores. The priority allocation of scarce resources to achieve ESG objectives is a further argument for a positive relationship between the level of financial distress and ESG scores that could be observed for financially distressed companies.

Both the negative and positive relationship between financial distress and ESG scores can be valid simultaneously but for different companies. A negative relationship might be proper for financially healthy companies, and a positive one might be valid for financially distressed companies. The lines of argument from the existing literature can be summarized in the following hypothesis:

The relationship between financial distress and ESG scores should have a U-shaped progression, where not only financially healthy companies, but also financially distressed companies should have a high ESG score.

While a high ESG score for financially healthy companies underpins the positive relationship between a company's ESG activities and financial performance, a high ESG score for financially distressed companies would call into question the meaningfulness of ESG scores for this group of companies. Therefore, nonparametric regression models must be used to reveal the actual relationship between the level of financial distress and ESG scores (Hastie and Tibshirani 1990, 1995; Wood 2017) and interpreted accordingly. However, a U-shaped relationship between financial distress and ESG scores has not yet been empirically documented, as the findings to date exclusively use linear regression techniques and thus exclude a possible nonlinear relationship in the data from the outset.

3 | Data, Variables, and Descriptive Statistics

3.1 | Raw Data, Final Dataset, and Final Samples

The starting point of our empirical analysis is a merged database of listed US companies. This database includes accounting and market data from the CRSP/Compustat database, ownership data derived from Form 13F and Form 13D(/A) filings, and data on financial distress from BRAINKRUPTCY. Overall, the database of listed US companies includes 71,794 firm-year observations for the period 2003–2022.

The bankruptcy prediction model of BRAINKRUPTCY was recently described in detail by Lohmann and Möllenhoff (2023b), and the bankruptcy predictions were applied by Lohmann and Möllenhoff (2023c). The bankruptcy prediction model uses numerous variables proven informative for financial distress and prospective corporate bankruptcy (e.g., the explanatory variables introduced by Campbell et al. 2008) and is available for all listed US companies. BRAINKRUPTCY estimates the measure of bankruptcy risk by using a logistic bankruptcy prediction

model and a gradient-boosting model. The out-of-time validations of the annually updated bankruptcy prediction models provide empirical evidence that the classifications based on the measure of bankruptcy risk are accurate. The AUC values for the annual out-of-time validations fluctuate within a small range of around 0.9. In comparison, the out-of-time validity of a reestimated bankruptcy prediction model that includes the variables of the Z score (Altman 1968, 2013) achieves only an AUC value of 0.716 (Lohmann et al. 2023). Our main analysis applies the measure of bankruptcy risk based on a logistic bankruptcy prediction model; the measure of bankruptcy risk based on a gradient-boosting model is used for a robustness check.

In the next step, databases on ESG scores from Refinitiv, MSCI, ESG Book, and Moody's ESG were matched to the merged database of listed US companies. An empirical analysis of ESG has to consider that the content of ESG and the associated ESG scores are heterogeneous (e.g., Meuer et al. 2019). Although ESG rating agencies claim their scores are a reliable indicator of a company's ESG activities, research on ESG rating disagreement shows that the ESG scores of different ESG rating agencies can differ considerably (Chatterji et al. 2016; Dimson et al. 2020; Billio et al. 2021; Berg et al. 2022). In addition, there are indications of a deliberate distortion of ESG scores by ESG rating agencies if the ESG rating agencies are subject to a conflict of interest and generate significant revenue from ESG score-based indices (Agrawal et al. 2023). Nevertheless, the ESG scores are positively correlated with each other, and therefore, corporate activities such as new ESG investments, additional ESG-related operations, and the provision of ESG information will likely increase all ESG scores. As a result, valid empirical findings must be reproducible for all material ESG scores, or the empirical results must not contradict each other, at least for different ESG scores.

Overall, after matching the databases on ESG scores from Refinitiv, MSCI, ESG Book, and Moody's ESG to our merged database of listed US companies, we ended up with 34,723 firm-year observations with at least one ESG score. One hundred forty-six firm-year observations (or 0.42% of the 34,723 firm-year observations, respectively) were eliminated due to missing control variables; 142 firm-year observations did not include the dividend yield, and the stock return volatility was missing in four firm-year observations. As a result, the final dataset includes 34,577 firm-year observations with at least one ESG score and all other applied control variables. We further processed the final dataset by winsorizing variables that we consider in the empirical analysis at the 1st and 99th percentiles if a variable has no natural limit and exhibits recognizable outliers.

Four samples of four different ESG scores applied as dependent variables were extracted from the final dataset. Table 1 provides information on the sample sizes, the number of firm-year observations for which a pair of ESG scores is available, and the correlations between the ESG scores. The ESG scores from Refinitiv, MSCI, and ESG Book form the basis for the larger samples, whereas the ESG scores from Moody's ESG form the basis for the smaller sample. The larger samples include a large share of firm-year observations from the smaller sample. The pairwise correlations of the ESG scores range between 0.254 and 0.673. Very similar correlations can be determined if the

TABLE 1 | Summary statistics on the four samples of four different ESG scores.

Sample	Firm-year observations	Refinitiv	MSCI	ESG Book	Moody's ESG
Refinitiv	23,980		0.383	0.489	0.673
MSCI	26,657	17,634		0.254	0.417
ESG Book	25,217	20,170	19,722		0.432
Moody's ESG	8157	7208	7639	7925	

Note: The table reports the final sample sizes (Column 2), overlapping firm-year observations with at least two specific ESG scores (lower section in Columns 3–5), and the respective pairwise correlations between the ESG scores (upper section in Columns 4–6).

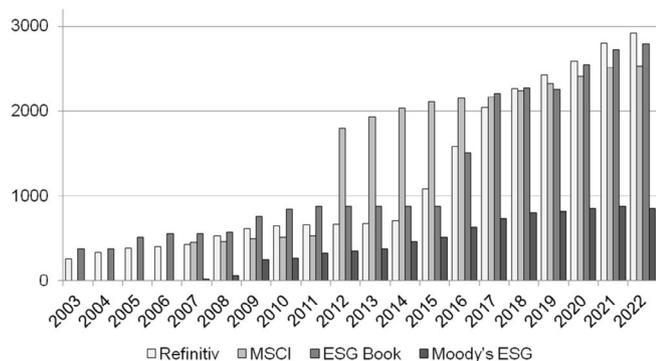


FIGURE 1 | Panel data structure of the final samples of four different ESG scores. This figure shows the number of companies for which ESG scores are available over time after cross-checking against our merged database of listed US companies. Our empirical analysis considers ESG scores from Refinitiv, MSCI, ESG Book, and Moody's ESG. While Refinitiv and ESG Book cover companies for the entire history up to 2003, MSCI and Moody's ESG data are available since 2007.

quantile ranks of the various ESG scores are taken into account. That empirical finding is consistent with Chatterji et al. (2016), who showed that the pairwise correlations between CSR ratings of different rating agencies are generally low and mostly below 0.5, and Berg et al. (2022), who showed that the average pairwise correlation between prominent ESG scores ranges between 0.38 and 0.71.

Figure 1 shows the number of companies for which the ESG scores were available over time. The ESG databases are distinguished from each other in terms of the history of data availability and the number of companies covered. The ESG scores from Refinitiv, MSCI, and ESG Book cover a more significant number of companies. Hence, the ESG scores from Refinitiv, MSCI, and ESG Book also provide data on smaller companies that receive less attention from investors and stakeholders. Nevertheless, Refinitiv, MSCI, ESG Book, and Moody's ESG provide large ESG databases that include long-term ESG information.

3.2 | Applied Variables and Descriptive Statistics

The relationship between financial distress and ESG scores is analyzed using linear and nonparametric regression techniques. Four ESG rating agencies provide the dependent variables for the regressions, while a comprehensive set of company-related independent variables is used. The ESG data were obtained from Refinitiv, MSCI, ESG Book, and Moody's ESG, and each includes

a company's overall ESG score and the respective E-S-G subfactors. As a result, we apply four overall ESG scores as dependent variables in the principal analysis and 12 E-S-G subfactors as dependent variables in additional regressions.

The independent variable of interest is the measure of bankruptcy risk that BRAINKRUPTCY provides. A company's level of financial distress is indicated by the measure of bankruptcy risk. The measure of bankruptcy risk is the outcome of a logistic bankruptcy prediction model calibrated for listed US companies and can be interpreted as the probability of bankruptcy. The measure of bankruptcy risk ranges in the interval [0, 1].

Table 2 provides the definitions of the applied dependent and independent variables. Besides the dependent variables on ESG scores and the measure of bankruptcy risk, the regression analysis considers 14 control variables on company fundamentals and ownership. Additionally, the regression analysis controls for year-fixed, industry-fixed, and company-fixed effects in the panel data.

Table 3 reports the descriptive statistics on the dependent and independent variables of the four final samples. The mean and the standard deviation of the ESG scores from Moody's ESG are lower as the value range is [0, 10] instead of [0, 100] for all other applied ESG scores. The larger samples based on ESG scores from Refinitiv, MSCI, and ESG Book include a more significant number of firm-year observations from smaller companies than the smaller sample based on ESG scores from Moody's ESG. This difference between the four final samples becomes apparent in the mean of the independent variables. The larger samples are associated with lower mean values of total assets, market value of equity, return on equity, and return on assets. Regarding the other independent variables, the final samples have comparable characteristics and do not differ significantly.

Table 4 shows the correlations between the independent variables when considering the final dataset of 34,723 firm-year observations. The measure of bankruptcy risk shows no meaningful correlation with any other independent variable. In unreported results, we find similar correlations in the four final samples and for the case where the quantile ranks of the independent variables are considered in the correlation analysis. There are meaningful correlations between two independent variables if the variables are comparable in content. This applies to the pairing total assets and market value of equity, Tobin's Q and market value to book value, and return on equity and return on assets. We address these correlations by examining the variance inflation factors of the independent variables used in the

TABLE 2 | Definitions of the applied dependent and independent variables.

Variable	Definition
ESG variables	
<i>ESG score Refinitiv</i> _(j,a)	Company <i>j</i> 's ESG score from Refinitiv at the end of the fiscal year <i>a</i> .
<i>E subfactor Refinitiv</i> _(j,a)	Company <i>j</i> 's E subfactor from Refinitiv at the end of the fiscal year <i>a</i> .
<i>S subfactor Refinitiv</i> _(j,a)	Company <i>j</i> 's S subfactor from Refinitiv at the end of the fiscal year <i>a</i> .
<i>G subfactor Refinitiv</i> _(j,a)	Company <i>j</i> 's G subfactor from Refinitiv at the end of the fiscal year <i>a</i> .
<i>ESG score MSCI</i> _(j,a)	Company <i>j</i> 's ESG score from MSCI at the end of the fiscal year <i>a</i> .
<i>E subfactor MSCI</i> _(j,a)	Company <i>j</i> 's E subfactor from MSCI at the end of the fiscal year <i>a</i> .
<i>S subfactor MSCI</i> _(j,a)	Company <i>j</i> 's S subfactor from MSCI at the end of the fiscal year <i>a</i> .
<i>G subfactor MSCI</i> _(j,a)	Company <i>j</i> 's G subfactor from MSCI at the end of the fiscal year <i>a</i> .
<i>ESG score ESG Book</i> _(j,a)	Company <i>j</i> 's ESG score from ESG Book at the end of the fiscal year <i>a</i> .
<i>E subfactor ESG Book</i> _(j,a)	Company <i>j</i> 's E subfactor from ESG Book at the end of the fiscal year <i>a</i> .
<i>S subfactor ESG Book</i> _(j,a)	Company <i>j</i> 's S subfactor from ESG Book at the end of the fiscal year <i>a</i> .
<i>G subfactor ESG Book</i> _(j,a)	Company <i>j</i> 's G subfactor from ESG Book at the end of the fiscal year <i>a</i> .
<i>ESG score Moody's ESG</i> _(j,a)	Company <i>j</i> 's ESG score from Moody's ESG at the end of the fiscal year <i>a</i> .
<i>E subfactor Moody's ESG</i> _(j,a)	Company <i>j</i> 's E subfactor from Moody's ESG at the end of the fiscal year <i>a</i> .
<i>S subfactor Moody's ESG</i> _(j,a)	Company <i>j</i> 's S subfactor from Moody's ESG at the end of the fiscal year <i>a</i> .
<i>G subfactor Moody's ESG</i> _(j,a)	Company <i>j</i> 's G subfactor from Moody's ESG at the end of the fiscal year <i>a</i> .
Company variables	
<i>Measure of bankruptcy risk</i> _(j,a)	Company <i>j</i> 's measure of bankruptcy risk from BRAINKRUPTCY based on a logistic bankruptcy prediction model at the end of the fiscal year <i>a</i> .
<i>Total assets</i> _(j,a)	Company <i>j</i> 's total assets in fiscal year <i>a</i> , winsorized at the 99th percentile.
<i>B&h stock return</i> _(j,a)	Company <i>j</i> 's buy-and-hold stock return in fiscal year <i>a</i> , winsorized at the 99th percentile.
<i>Stock return volatility</i> _(j,a)	Company <i>j</i> 's annualized stock return volatility in fiscal year <i>a</i> , winsorized at the 99th percentile.
<i>Tobin's Q</i> _(j,a)	Company <i>j</i> 's market value of equity plus its book value of total assets, minus its book value of equity, divided by its book value of total assets in fiscal year <i>a</i> , winsorized at the 99th percentile.
<i>Market value of equity</i> _(j,a)	Company <i>j</i> 's market value of equity in fiscal year <i>a</i> , winsorized at the 99th percentile.
<i>Market value to book value</i> _(j,a)	Company <i>j</i> 's market value of equity divided by its book value of equity in fiscal year <i>a</i> , winsorized at the 99th percentile.
<i>Leverage</i> _(j,a)	Company <i>j</i> 's total debt divided by its total assets in fiscal year <i>a</i> , winsorized at the 99th percentile.
<i>Return on equity</i> _(j,a)	Company <i>j</i> 's earnings before tax divided by its book value of equity in fiscal year <i>a</i> , winsorized at the 1st and 99th percentiles.
<i>Return on assets</i> _(j,a)	Company <i>j</i> 's earnings before interest, tax, depreciation and amortization (EBITDA) divided by its total assets in fiscal year <i>a</i> , winsorized at the 1st and 99th percentiles.
<i>CapEx</i> _(j,a)	Company <i>j</i> 's capital expenditures (CapEx) divided by its total assets in fiscal year <i>a</i> , winsorized at the 99th percentile.
<i>R&D</i> _(j,a)	Company <i>j</i> 's research and development expenditures (R&D) divided by its total assets in fiscal year <i>a</i> , winsorized at the 99th percentile.

(Continues)

TABLE 2 | (Continued)

Variable	Definition
<i>Dividend yield</i> _(j,a)	Company <i>j</i> 's total annual dividend divided by its market value of equity in fiscal year <i>a</i> , winsorized at the 1st and 99th percentiles.
<i>Active ownership</i> _(j,a)	The total active ownership of company <i>j</i> , based on Form 13D(/A) filings at the end of the fiscal year <i>a</i> .
<i>Institutional ownership</i> _(j,a)	The share of institutional ownership of company <i>j</i> , based on Form 13F filings at the end of the fiscal year <i>a</i> .
<i>Industry</i> _{<i>j</i>}	Company <i>j</i> 's Standard Industrial Classification (SIC) code: SIC1–SIC9

Note: This table presents and defines the variables we used. We include ESG scores and E-S-G subfactors from Refinitiv, MSCI, ESG Book, and Moody's ESG as dependent variables. Furthermore, we derived the measure of bankruptcy risk from BRAINKRUPTCY, further company variables from the CRSP and Compustat databases, active ownership from 13D(/A) filings, and institutional ownership from 13F filings.

linear regression models and by checking the robustness of the results by varying the independent variables. However, we apply all control variables in the regressions presented in the results section.

4 | Empirical Results

4.1 | Linear Regression Results

The linear regression models estimate a linear relationship between the independent and dependent variables. Table 5 shows the results of the linear regression models LRM1–LRM4 in terms of the estimated regression coefficients of the metric independent variables. The linear regression models apply different ESG scores as dependent variables. In the ESG scores applied, there are differences in the samples used with regard to the available firm-year observations. Based on the applied ESG scores, there are also differences in the applied samples with regard to the available firm-year observations. However, all four linear regression models use the same independent variables, and we estimated all regressions with standard errors clustered at the company level. The linear regression models estimate a negative and statistically significant relationship between the measure of bankruptcy risk and the ESG scores; there is always a negative coefficient. The coefficient of the linear regression model LRM2 is much smaller as the ESG score from MSCI is in the value range [0, 10] instead of [0, 100] for all other applied ESG scores. Based on the linear regression models, we can conclude that, *ceteris paribus*, the ESG score decreases if a company's financial distress increases. This result is fully consistent with comparable studies using a linear regression technique (e.g., Zheng et al. 2019; Boubaker et al. 2020; Aslan et al. 2021; Badayi et al. 2021; Truong et al. 2025).

Overall, the linear regression models show mixed results concerning the metric control variables. The sign of the estimated coefficient or its statistical significance often changes when the results of a specific control variable are compared for the linear regression models LRM1–LRM4. The heterogeneity of the results is to be expected and can be explained by the low correlation between the various ESG scores. As expected, the estimated coefficients differ significantly in magnitude, as the control variables have a different range of values (see the descriptive

statistics in Table 3). Numerically large control variables have very small coefficients, and numerically small control variables have very large coefficients.

We calculated and reviewed the variance inflation factors of the independent variables that are applied in the linear regression models LRM1–LRM4 to check for multicollinearity caused by the correlations between the independent variables. The independent variable *Stock return volatility* has the highest variance inflation factor in each regression; this lies between 2.00 (LRM2) and 2.41 (LRM4). All other variance inflation factors are always below 2 and mostly close to 1. Multicollinearity is therefore only present to a negligible extent and there is no indication that the linear regression results and the following additive regression analysis are distorted by multicollinearity.

4.2 | Additive Regression Results

The basic assumption of a linear regression model is that there are linear relationships whose slopes (i.e., coefficients) are estimated by the model. As we need to know whether there are linear relationships, a linear regression model will produce misleading results if nonlinear relationships exist between the independent and dependent variables. To overcome this shortcoming of a linear regression model, we have to apply additive regression models that estimate the effective relationship in terms of an unspecified function, which could be linear or nonlinear (Stone 1985; Hastie and Tibshirani 1990). We apply penalized splines (see for an application in business research, e.g., Lohmann and Ohliger 2017; Lohmann et al. 2023) to model the nonlinear relationships between independent variables, including the measure of bankruptcy risk and a set of control variables, and dependent variables consisting of several ESG scores and their E-S-G subfactors. We put each spline function in concrete terms by using seven equidistant intervals and polynomials of rank $g = 3$ for each penalized spline. The minimum of the generalized cross-validation criterion determines the smoothing parameter (Eilers and Marx 1996; Green and Silverman 1994).

Table 6 shows the results of the additive regression models ARM1–ARM4. The output value for the metric independent variables is the equivalent degree of freedom. The equivalent degree of freedom indicates the nonlinearity in the estimated spline function. An equivalent degree of freedom $df_j = 1.000$

TABLE 3 | Descriptive statistics on the dependent and independent variables of the four final samples.

Sample		Refinitiv	MSCI	ESG Book	Moody's ESG
Firm-year observations		23,980	26,657	25,217	8157
<i>ESG score</i>	Mean	39.539	4.293	49.853	31.223
	SD	19.207	1.990	8.323	8.170
<i>E subfactor</i>	Mean	25.246	4.612	45.820	24.377
	SD	27.075	2.136	12.877	15.826
<i>S subfactor</i>	Mean	41.868	4.303	50.547	26.165
	SD	20.971	1.534	8.664	8.380
<i>G subfactor</i>	Mean	48.101	5.444	51.063	44.873
	SD	22.506	1.832	13.575	7.876
<i>Measure of bankruptcy risk</i>	Mean	0.051	0.047	0.052	0.046
	SD	0.098	0.095	0.095	0.082
<i>Total assets</i>	Mean	17,051.936	14,367.784	17,690.893	37,695.481
	SD	42,317.615	38,587.545	42,312.129	61,323.368
<i>B&h stock return</i>	Mean	0.119	0.115	0.117	0.125
	SD	0.483	0.458	0.454	0.374
<i>Stock return volatility</i>	Mean	0.434	0.416	0.414	0.347
	SD	0.257	0.233	0.240	0.193
<i>Tobin's Q</i>	Mean	2.155	2.119	2.095	2.183
	SD	1.744	1.676	1.623	1.675
<i>Market value of equity</i>	Mean	12,711.082	10,680.725	13,184.463	29,063.073
	SD	28,568.253	25,996.766	28,347.789	40,666.186
<i>Market value to book value</i>	Mean	3.979	3.937	3.926	4.665
	SD	5.949	5.924	5.830	6.956
<i>Leverage</i>	Mean	0.604	0.597	0.610	0.660
	SD	0.260	0.259	0.252	0.225
<i>Return on equity</i>	Mean	0.017	0.025	0.038	0.126
	SD	0.453	0.426	0.428	0.351
<i>Return on assets</i>	Mean	0.057	0.068	0.073	0.113
	SD	0.193	0.169	0.172	0.104
<i>CapEx</i>	Mean	0.033	0.035	0.034	0.036
	SD	0.041	0.043	0.041	0.040
<i>R&D</i>	Mean	0.044	0.043	0.040	0.024
	SD	0.105	0.097	0.095	0.056
<i>Dividend yield</i>	Mean	0.011	0.011	0.011	0.014
	SD	0.015	0.015	0.015	0.014
<i>Active ownership</i>	Mean	0.183	0.180	0.171	0.136
	SD	0.278	0.270	0.267	0.239
<i>Institutional ownership</i>	Mean	0.342	0.401	0.359	0.358

(Continues)

TABLE 3 | (Continued)

Sample		Refinitiv	MSCI	ESG Book	Moody's ESG
	SD	0.229	0.223	0.229	0.218
Percentage of companies within an Industry defined by the first digit of the SIC code	SIC1	0.056	0.056	0.055	0.069
	SIC2	0.179	0.170	0.178	0.138
	SIC3	0.206	0.213	0.207	0.212
	SIC4	0.088	0.085	0.092	0.131
	SIC5	0.086	0.093	0.089	0.082
	SIC6	0.240	0.222	0.227	0.222
	SIC7	0.111	0.126	0.119	0.121
	SIC8	0.032	0.034	0.031	0.021
	SIC9	0.003	0.002	0.002	0.004

Note: This table shows the mean and the standard deviation (SD) of the independent and dependent variables of the four final samples. The table also shows the distribution of industries defined by the first digit of the Standard Industrial Classification (SIC). The samples based on the available ESG scores from Refinitiv, MSCI, and ESG Book include a larger number of firm-year observations from smaller companies. Thus, the larger samples are associated with lower mean values of total assets, market value of equity, return on equity, and return on assets.

represents a linear function, and an increasing equivalent degree of freedom ($df_f > 1.000$) indicates increasing nonlinearity in the estimated spline function. All four estimated spline functions (ARM1–ARM4) of the independent variable *Measure of bankruptcy risk* show a meaningful nonlinearity ($2.848 \leq df_f \leq 2.966$), which is statistically significant in all cases. Except for the independent variable *Market value of equity*, the other independent variables do not exhibit meaningful and statistically significant nonlinearities ($df_f \geq 2.000$) in all additive regression models ARM1–ARM4.

The spline function estimates the relationship between the independent and dependent variable. However, we must analyze the spline patterns in detail to describe the relationship's direction. Figure 2 depicts the spline patterns of the independent variable *Measure of bankruptcy risk* for the additive regression models ARM1–ARM4, which include the four ESG scores from various data providers as dependent variables. To compare the estimated spline patterns with the estimated linear functions, we inserted the estimations of the linear regression models LRM1–LRM4 as dashed lines. We centered the estimated linear functions with the estimated spline patterns at the function value 0.

Figure 2 displays pronounced and almost identical U-shaped relationships between the measure of bankruptcy risk and all four ESG scores from Refinitiv, MSCI, ESG Book, and Moody's ESG. The turning point of the U-shaped relationships is about 0.25, meaning that a company's measure of bankruptcy risk exceeds the mean of the measure of bankruptcy risk by 0.25. If a company is financially healthy, there is a negative relationship between the measure of bankruptcy risk and the ESG score. Since an OLS estimator fits the linear function based on the firm-year observations of mostly financially healthy companies, the estimated linear function of the linear regression models LRM1–LRM4 largely corresponds to the negative slope of the estimated spline function. The estimated spline function exhibits a positive slope if a company is sufficiently financially distressed. As a result, the additive regression analysis reveals a positive relationship between the measure of bankruptcy risk

and the ESG score in the case of financially distressed companies. Financially distressed companies are associated with high ESG scores. That empirical finding is valid and holds for all applied ESG scores.

Figure 2 also shows that the 95% confidence bands are very narrow when the estimated spline functions exhibit a positive slope. That observation provides an initial insight into causality. We expect narrow confidence bands if most financially distressed companies manage their ESG scores upward. ESG investments or operational ESG measures may also cause financial deterioration as a side effect. In that case, narrow 95% confidence bands would only appear if ESG activities were the only significant cause of financial distress. However, this is the much less likely case, as the failure of the business model, management failure, frictions on the sales and procurement markets, and difficulties in corporate financing can be seen as further important causes of financial distress. As a result, the narrow 95% confidence bands in Figure 2 indicate that financially distressed companies likely manage their ESG scores upward.

The spline patterns for the relationship between the market value of equity and the ESG scores are shown in Figure 3 and reveal further meaningful insights. The x axis plots the difference between a company's market value of equity and the company's mean market value of equity. As a result, negative values indicate a shrunken market value of equity, and positive values indicate an increased market value of equity. Overall, the peripheral areas deviate from the estimated positive linear relationship to a large extent. That empirical finding is valid and holds for all applied ESG scores. A negative ESG divergence could occur in a financially healthy company with a high market value of equity and high current and future growth, while a positive ESG divergence could occur in a financially distressed company with a declining market value of equity. These interpretations, while plausible, should be approached with caution. The relationships between the market value of equity and the ESG scores and the associated interpretation

TABLE 4 | Correlations between the independent variables based on the final dataset.

	Measure of bankruptcy risk	Total assets	B&h stock return	Stock return volatility	Tobin's Q
<i>Total assets</i>	0.052				
<i>B&h stock return</i>	-0.356	-0.003			
<i>Stock return volatility</i>	0.351	-0.157	-0.108		
<i>Tobin's Q</i>	-0.225	-0.125	0.290	0.103	
<i>Market value of equity</i>	-0.043	0.660	0.056	-0.209	0.117
<i>Market value to book value</i>	-0.130	-0.059	0.189	0.032	0.608
<i>Leverage</i>	0.241	0.201	-0.029	-0.070	-0.170
<i>Return on equity</i>	-0.262	0.096	0.171	-0.451	-0.078
<i>Return on assets</i>	-0.208	0.051	0.176	-0.493	-0.095
<i>CapEx</i>	0.118	-0.059	-0.024	0.011	0.032
<i>R&D</i>	0.067	-0.121	-0.088	0.407	0.372
<i>Dividend yield</i>	0.006	0.118	-0.069	-0.227	-0.178
<i>Active ownership</i>	0.095	-0.108	-0.007	0.193	-0.005
<i>Institutional ownership</i>	-0.146	-0.054	0.043	-0.079	-0.011
	Market value of equity	Market value to book value	Leverage	Return on equity	Return on assets
<i>Market value to book value</i>	0.137				
<i>Leverage</i>	0.062	0.061			
<i>Return on equity</i>	0.164	-0.079	0.051		
<i>Return on assets</i>	0.163	-0.026	0.048	0.666	
<i>CapEx</i>	0.022	0.025	-0.071	0.047	0.192
<i>R&D</i>	-0.066	0.197	-0.191	-0.510	-0.715
<i>Dividend yield</i>	0.093	-0.081	0.203	0.167	0.167
<i>Active ownership</i>	-0.132	-0.014	0.022	-0.102	-0.109
<i>Institutional ownership</i>	-0.099	-0.003	-0.027	0.045	0.079
	CapEx	R&D	Dividend yield	Active ownership	
<i>R&D</i>	-0.103				
<i>Dividend yield</i>	-0.081	-0.239			
<i>Active ownership</i>	0.042	0.035	-0.027		
<i>Institutional ownership</i>	0.005	-0.039	-0.101	-0.109	

Note: This table reports the correlations between the applied independent variables. There are meaningful correlations between two independent variables if the variables are comparable in content.

complete the results presented in Figure 2. If the companies with a shrunken market value of equity were not associated with higher ESG scores, this would refute our empirical finding regarding the relationship between the measure of bankruptcy risk and ESG scores. Instead, the empirical observation that companies with a shrunken market value of equity are associated with high ESG scores completes the overall picture. It is an additional sign that financially distressed companies are indeed associated with high ESG scores.

4.3 | Additive Regression Results for the ESG Subfactor

Each ESG score analyzed consists of three E-S-G subfactors: the environmental (E) subfactor, the social (S) subfactor, and the governance (G) subfactor. We repeated the linear and additive regression analyses for the three subfactors from each ESG score to reveal the relationships between the measure of bankruptcy risk and the E-S-G subfactors in more detail. We

TABLE 5 | Results of the linear regression models LRM1–LRM4.

Regression model	LRM1	LRM2	LRM3	LRM4
Dependent variable	ESG score Refinitiv	ESG score MSCI	ESG score ESG book	ESG score Moody's ESG
<i>Measure of bankruptcy risk</i>	-8.855***	-0.811***	-3.965**	-3.226*
<i>Total assets</i>	0.000***	0.000	-0.000	-0.000*
<i>B&h stock return</i>	-1.724***	-0.166***	-0.876***	-0.372*
<i>Stock return volatility</i>	0.995	0.246**	-0.782*	1.964**
<i>Tobin's Q</i>	0.238	0.039*	0.761***	-0.101
<i>Market value of equity</i>	0.000***	0.000**	0.000	0.000***
<i>Market value to book value</i>	-0.003	0.001	-0.014	-0.002
<i>Leverage</i>	6.171***	0.193	-6.815***	1.612
<i>Return on equity</i>	0.157	0.067*	0.142	-0.037
<i>Return on assets</i>	-0.476	0.039	2.551**	-1.068
<i>CapEx</i>	-29.01***	-0.122	-12.21***	-16.30***
<i>R&D</i>	-5.490*	-0.178	8.051***	-5.825
<i>Dividend yield</i>	47.08***	0.911	26.66***	19.11*
<i>Active ownership</i>	3.670*	-0.290	2.174*	0.837
<i>Institutional ownership</i>	6.632***	-0.059	0.605	0.601
Year-fixed effects	Yes	Yes	Yes	Yes
Industry-fixed effects	Yes	Yes	Yes	Yes
Firm-fixed effects	Yes	Yes	Yes	Yes
<i>N</i>	23,980	26,657	25,217	8157
Adjusted <i>R</i> ²	0.367	0.091	0.088	0.296

Note: This table shows the results (i.e., estimated coefficients) of the linear regression models LRM1–LRM4, where different ESG scores are applied as the dependent variable. The independent variables include the company variables that are defined in Table 2. All linear regression models take into account year-fixed, industry-fixed, and firm-fixed effects. All standard errors are clustered at the company level. *, **, and *** represent significance levels of 0.05 [or 5%], 0.01 [or 1%], and 0.001 [or 0.1%], respectively.

*p-value < 0.05.

**p-value < 0.01.

***p-value < 0.001.

estimated 12 linear and 12 additive regression models that apply the E-S-G subfactors as dependent variables. The results of these 24 regressions are condensed in Figure 4, which depicts the estimated linear and nonlinear relationships between the measure of bankruptcy risk and the E-S-G subfactors from each ESG score. A pronounced U-shaped relationship between the measure of bankruptcy risk and the environmental subfactor can be observed in all additive regression models. Figure 4 also shows U-shaped relationships between the measure of bankruptcy risk and the social and governance subfactors. However, the U-shaped relationships between the measure of bankruptcy risk and the social and governance subfactors do not occur in every additive regression model and are less pronounced.

The most crucial subfactor in all ESG scores is the environmental subfactor, followed by the social and governance subfactor. The environmental subfactor and its components have the greatest weighting within the ESG score. A high correlation between the environmental subfactor and ESG scores, along with high

intercorrelations with the social and governance subfactors, demonstrates the significance of the environmental subfactor for the ESG score (Billio et al. 2024). The individual components of an ESG score are often qualitative, and the evaluation made by ESG rating agencies can only be objectively verified to a limited extent. The subjective selection and evaluation of very often qualitative components of an ESG score explain a very large part of ESG disagreements among ESG rating agencies. Berg et al. (2022) found that the inconsistencies in ESG ratings are mainly due to the scope of the ESG definition applied and the criteria selected to measure a company's ESG activities rather than the weighting of these criteria. Companies have extensive opportunities to influence the ESG score through real facts and ESG-supporting disclosures. ESG-supporting disclosures are crucial in shaping ESG scores, as they offer a cost-effective way for companies to impact their ESG standing, often outweighing their content (Drempetic et al. 2020; Lopez-de-Silanes et al. 2020). Since the phenomenon of “greenwashing” has been studied more extensively than “social washing” or “governance

TABLE 6 | Results of the additive regression models ARM1–ARM4.

Regression model	ARM1	ARM2	ARM3	ARM4
Dependent variable	ESG score Refinitiv	ESG score MSCI	ESG score ESG book	ESG score Moody's ESG
<i>Measure of bankruptcy risk</i>	2.971***	2.971***	2.966***	2.972***
<i>Total assets</i>	2.983***	2.898**	1.910**	1.000***
<i>B&h stock return</i>	2.955***	1.000***	1.558***	1.207**
<i>Stock return volatility</i>	2.912***	1.684***	2.105***	2.276***
<i>Tobin's Q</i>	1.000	1.000**	2.966***	2.849**
<i>Market value of equity</i>	2.991***	2.990***	2.942***	2.989***
<i>Market value to book value</i>	1.579	2.021*	1.000	1.715
<i>Leverage</i>	1.000***	1.000**	1.818***	1.808***
<i>Return on equity</i>	1.000	1.351	1.423	1.455
<i>Return on assets</i>	1.000	1.000	2.972***	2.809
<i>CapEx</i>	1.000***	2.693	2.844***	1.652***
<i>R&D</i>	2.042***	1.000	2.964***	1.000
<i>Dividend yield</i>	2.973***	2.739	1.469***	2.758***
<i>Active ownership</i>	2.877***	1.124*	2.747**	1.000
<i>Institutional ownership</i>	1.000***	1.000	1.623	2.881*
Year-fixed effects	Yes	Yes	Yes	Yes
Industry-fixed effects	Yes	Yes	Yes	Yes
Firm-fixed effects	Yes	Yes	Yes	Yes
<i>N</i>	23,980	26,657	25,217	8157
Adjusted <i>R</i> ²	0.379	0.097	0.098	0.305

Note: This table shows the results (i.e., equivalent degrees of freedom) of the additive regression models ARM1–ARM4 where different ESG scores are applied as the dependent variable. The independent variables include the company variables that are defined in Table 2. All additive regression models take into account year-fixed, industry-fixed, and firm-fixed effects. *, **, and *** represent significance levels of 0.05 [or 5%], 0.01 [or 1%], and 0.001 [or 0.1%], respectively.

**p*-value < 0.05.

***p*-value < 0.01.

****p*-value < 0.001.

washing” and can be regarded as empirically confirmed (e.g., Kirk and Vincent 2014; Marquis et al. 2016; Yu et al. 2020), it can be assumed that ESG-supporting disclosures primarily relate to the components of the environmental subfactor.

If ESG-supporting disclosures are used to manage the ESG score upward, we can expect a pronounced U-shaped relationship between the measure of bankruptcy risk and the environmental subfactor. This expectation is met as the U-shaped relationships between the measure of bankruptcy risk and the ESG scores from Refinitiv, MSCI, ESG Book, and Moody's ESG are primarily based on the environmental subfactor. Additionally, constructing the E-S-G subfactors can lead to the social and governance subfactors reinforcing the U-shaped relationship between the measure of bankruptcy risk and the ESG scores. That is especially true for the ESG scores from Refinitiv and ESG Book.

The nonlinear relationships between the market value of equity and the environmental subfactors are very similar to those between the market value of equity and ESG scores. There is a

positive divergence in all four environmental subfactors from Refinitiv, MSCI, ESG Book, and Moody's ESG for companies with an already declining market value of equity. The empirical observation that companies with a shrunken market value of equity are associated with high values of the environmental subfactor provides a further sign that financially distressed companies are indeed associated with high values of the environmental subfactor.

5 | Extensions and Robustness of the Regression Analysis

5.1 | Regression Results With Shareholder-Stakeholder Orientation as Dependent and Independent Variable

We conducted several extensions of the regression analysis to gain a greater understanding of the causality between financial distress and ESG scores. The first extension confirms the interpretation that financially distressed companies manage their

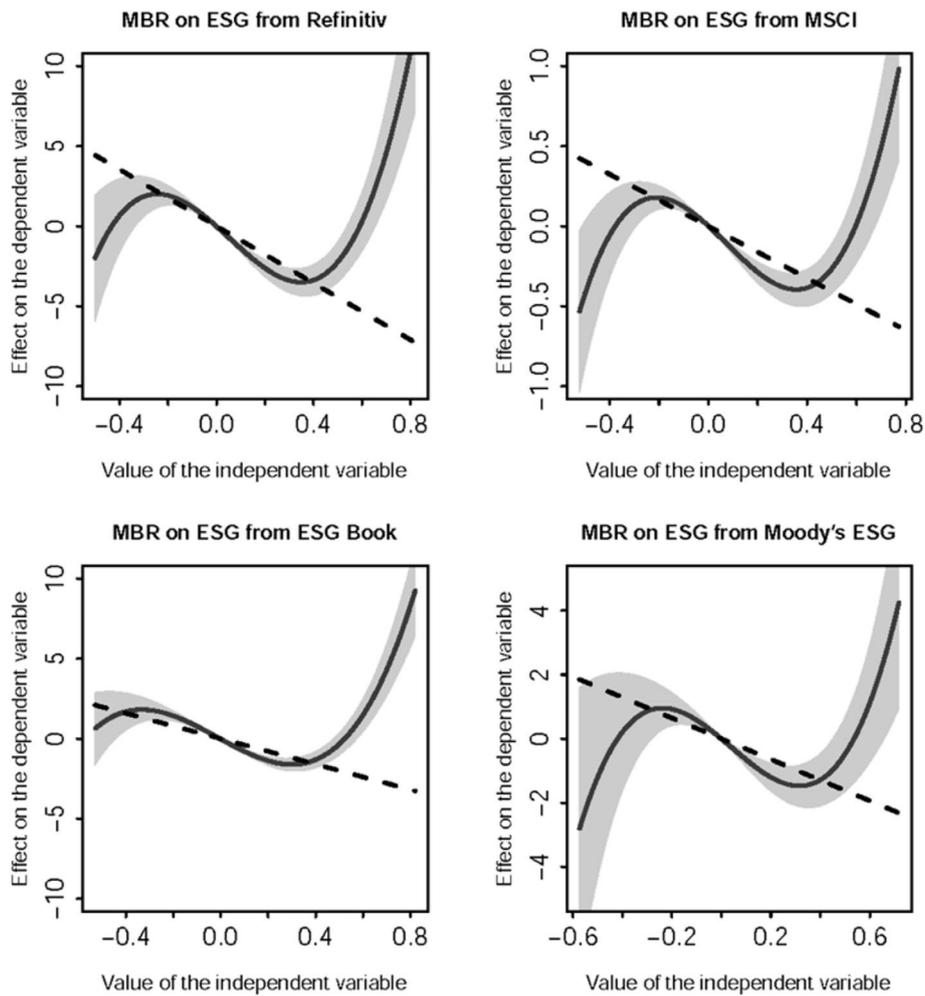


FIGURE 2 | The U-shaped relationship between the measure of bankruptcy risk (MBR) and the ESG scores from Refinitiv, MSCI, ESG Book, and Moody's ESG. This figure shows the statistically significant spline patterns for the relationship between the measure of bankruptcy risk and the ESG scores from Refinitiv, MSCI, ESG Book, and Moody's ESG. The measure of bankruptcy risk is plotted on the x axis, and the ESG score on the y axis. Due to the within transformation, the values on the axes represent deviations from the company mean value. The bold black line represents the estimated spline function, and the dashed line represents the estimated linear function. The 95% confidence band is shaded gray.

ESG scores upward by intensifying cost-effective ESG activities such as ESG-supporting disclosures. The narrow 95% confidence bands in Figure 2 strongly indicate this causality. In order to validate this interpretation even more robustly, we introduce the *Shareholder-stakeholder orientation* as a further dependent variable. The variable *Shareholder-stakeholder orientation* is determined and used for the first time in this study. The variable *Shareholder-stakeholder orientation* is based on the number of words “shareholder” and “stakeholder” that were counted in the 10-K filings and is calculated according to Equation (1).

$$\begin{aligned} & \text{Shareholder-stakeholder orientation} \\ &= \frac{\text{Count “stakeholder”} - \text{Count “shareholder”}}{\text{Count “stakeholder”} + \text{Count “shareholder”} + 1} \quad (1) \end{aligned}$$

The variable *Shareholder-stakeholder orientation* assumes a value in the interval. [Correction added on 4 July 2025, after first on-line publication: Equation 1 has been corrected in this version.]

[-1, 1]. Lower values show a stronger shareholder orientation in corporate reporting, and higher values show a stronger

stakeholder orientation. The variable *Shareholder-stakeholder orientation* shows the importance of stakeholders' (ESG) objectives in relation to the importance of shareholders' predominantly financial objectives in the 10-K filings and can be interpreted as a proxy variable for ESG-supporting disclosure. We eliminated all firm-year observations when the variable *Shareholder-stakeholder orientation* takes the value of 0 due to word counts of 0. The variable *Shareholder-stakeholder orientation* was matched to the final dataset of 34,577 firm-year observations. Overall, there are 30,329 firm-year observations with the variable *Shareholder-stakeholder orientation* and all other applied control variables.

To provide additional empirical evidence for causality that financially distressed companies manage their ESG score upward by intensifying ESG-supportive disclosures, we need to show how financially distressed companies influence their ESG score. If there is a cause-effect relationship between the measure of bankruptcy risk and ESG scores and ESG-supportive disclosures are an important instrument for achieving high ESG scores, we would expect three empirical observations: First,

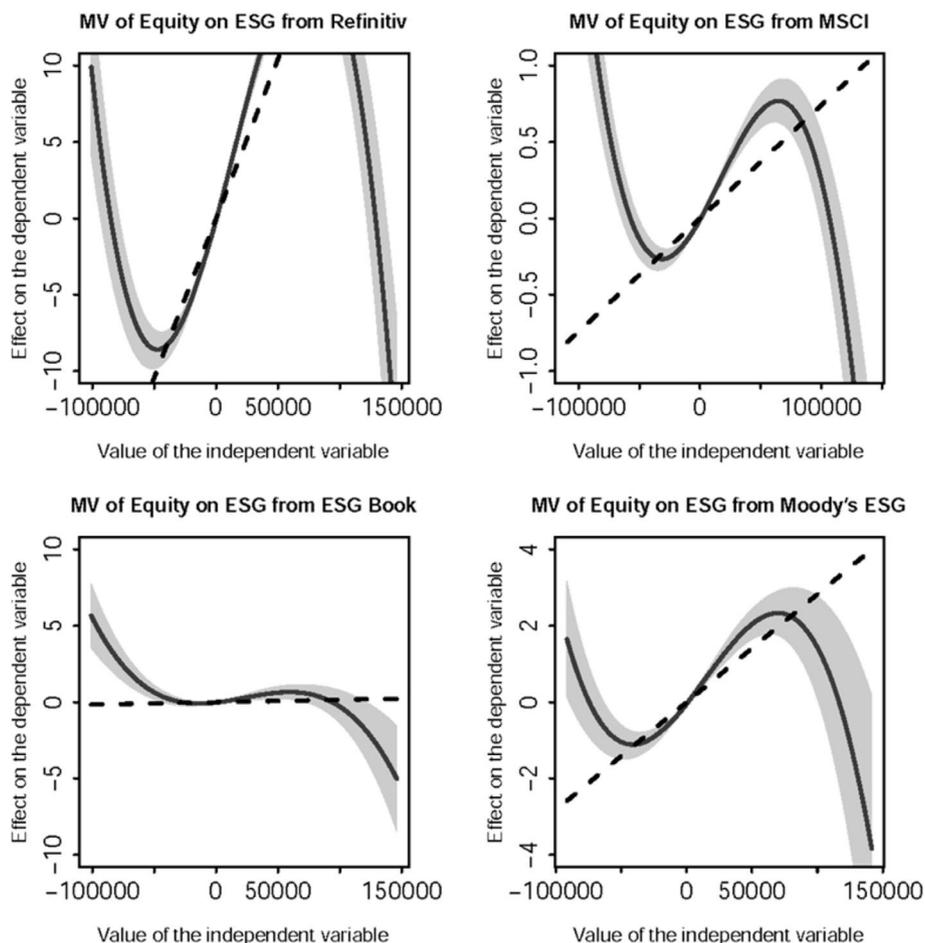


FIGURE 3 | The nonlinear relationship between the market value (MV) of equity and the ESG scores from Refinitiv, MSCI, ESG Book, and Moody's ESG. This figure shows the statistically significant spline patterns for the relationship between the market value of equity and the ESG scores from Refinitiv, MSCI, ESG Book, and Moody's ESG. The market value of equity is plotted on the x axis, and the ESG score is plotted on the y axis. Due to the within transformation, the values on the axes represent deviations from the company mean value. The bold black line represents the estimated spline function and the dashed line represents the estimated linear function. The 95% confidence band is shaded gray.

there should be a U-shaped relationship between the measure of bankruptcy risk and the variable *Shareholder-stakeholder orientation* that is comparable to the U-shaped relationship between the measure of bankruptcy risk and the ESG scores from Refinitiv, MSCI, ESG Book, and Moody's ESG. Second, there should be no correlation between the variable *Shareholder-stakeholder orientation* and the residuals of the additive regression models ARM1-ARM4 presented in Table 6. Third, the variable *Shareholder-stakeholder orientation* should be able to explain the variance of the ESG scores to a similar extent as the variable *Measure of bankruptcy risk* and should show a positive, statistically significant, and almost linear relationship with the ESG scores from Refinitiv, MSCI, ESG Book, and Moody's ESG.

Table 7 shows the results of the linear regression model LRM-SSO and the additive regression model ARM-SSO when the variable *Shareholder-stakeholder orientation* is applied as the dependent variable. The linear regression model indicates a negative and statistically significant linear relationship between the measure of bankruptcy risk and a company's stakeholder orientation. On the contrary, the additive regression model reveals a statistically significant nonlinear relationship between the measure of bankruptcy risk and a company's stakeholder

orientation, depicted in Figure 5. The nonlinear relationship between the *measure of bankruptcy risk* and the *Shareholder-stakeholder orientation* can be described by a U-shaped relationship comparable to the relationships between the measure of bankruptcy risk and ESG scores in Figure 2. Financially distressed companies generally exhibit a high stakeholder orientation, although all management efforts should be directed toward preserving the company and protecting the shareholders' equity. The comprehensive stakeholder orientation is consistent with the financially distressed companies' high ESG scores.

Table 8 shows the correlations between the variable *Shareholder-stakeholder orientation* and the residuals of the additive regression models ARM1-ARM4 presented in Table 6. No anomalies were found in the review of the correlations. The residuals of the additive regression models ARM1-ARM4 are not correlated with the variable *Shareholder-stakeholder orientation*. The variable *Shareholder-stakeholder orientation* does not explain any variance in the ESG scores that is not explained by the additive regression models ARM1-ARM4. When the variable *Shareholder-stakeholder orientation* replaces the variable *Measure of bankruptcy risk*, and there is a

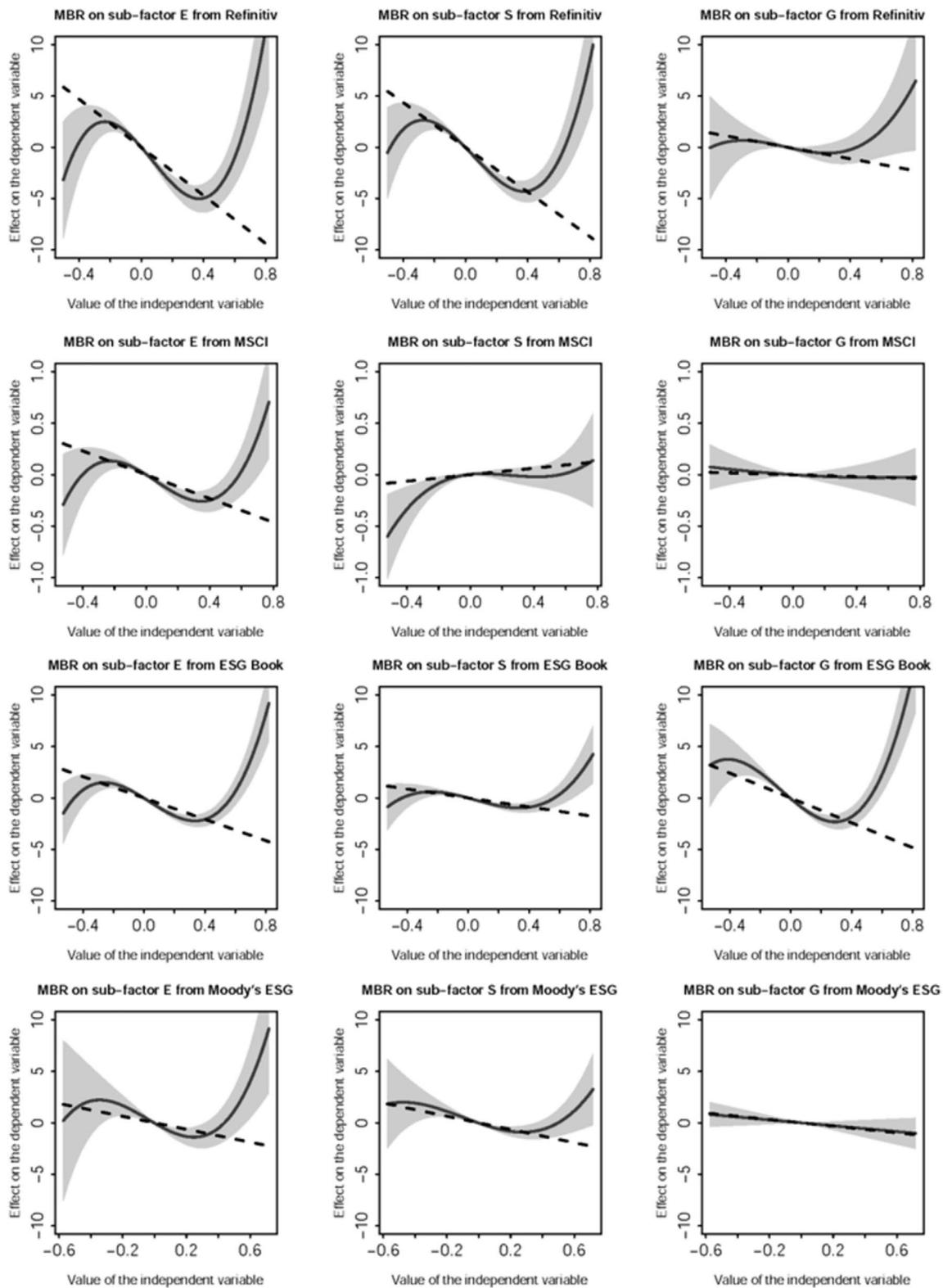


FIGURE 4 | Relationships between the measure of bankruptcy risk (MBR) and the E-S-G subfactors from Refinitiv, MSCI, ESG Book, and Moody's ESG. This figure shows the spline patterns for the relationship between the measure of bankruptcy risk and the E-S-G subfactors from Refinitiv, MSCI, ESG Book, and Moody's ESG. The measure of bankruptcy risk is plotted on the x axis, and the E-S-G subfactors are plotted on the y axis. Due to the within transformation, the values on the axes represent deviations from the company mean value. The bold black line represents the estimated spline function, and the dashed line represents the estimated linear function. The 95% confidence band is shaded gray.

statistically significant positive relationship between the variable *Shareholder-stakeholder orientation* and the ESG scores, we provide empirical evidence that financially distressed companies

mimic the stakeholder-oriented behavior of financially healthy companies by emphasizing stakeholder-oriented ESG objectives and intensifying ESG-supporting disclosures.

TABLE 7 | Results of the linear regression model LRM-SSO and the additive regression model ARM-SSO with the dependent variable *Shareholder-stakeholder orientation* (SSO).

Regression model	LRM-SSO	ARM-SSO
	Shareholder-stakeholder orientation	Shareholder-stakeholder orientation
Dependent variable		
<i>Measure of bankruptcy risk</i>	-0.085**	2.892***
<i>Total assets</i>	0.000	2.983***
<i>B&h stock return</i>	-0.016***	1.000***
<i>Stock return volatility</i>	0.064***	2.773***
<i>Tobin's Q</i>	0.005	1.000**
<i>Market value of equity</i>	0.000***	1.000***
<i>Market value to book value</i>	0.001	1.813**
<i>Leverage</i>	0.095***	1.000***
<i>Return on equity</i>	0.013*	1.000**
<i>Return on assets</i>	-0.022	1.000
<i>CapEx</i>	-0.173	1.000**
<i>R&D</i>	-0.153*	1.366**
<i>Dividend yield</i>	-0.257	1.000*
<i>Active ownership</i>	0.064*	1.000***
<i>Institutional ownership</i>	-0.016	2.864*
Year-fixed effects	Yes	Yes
Industry-fixed effects	Yes	Yes
Firm-fixed effects	Yes	Yes
<i>N</i>	30,329	30,329
Adjusted <i>R</i> ²	0.09	0.09

Note: This table shows the results of the linear regression model LRM-SSO (i.e., estimated coefficients) and the additive regression model ARM-SSO (i.e., equivalent degrees of freedom) where *Shareholder-stakeholder orientation* is applied as the dependent variable. The independent variables include the company variables that are defined in Table 2. Both regression models take into account year-fixed, industry-fixed, and firm-fixed effects. All standard errors of the linear regression model LRM-SSO are clustered at the company level. *, **, and *** represent significance levels of 0.05 [or 5%], 0.01 [or 1%], and 0.001 [or 0.1%], respectively.
 *p-value < 0.05.
 **p-value < 0.01.
 ***p-value < 0.001.

Table 9 shows the results of the additive regression models ARM1-SSO-ARM4-SSO, where the variable *Shareholder-stakeholder orientation* replaces the variable *Measure of bankruptcy risk*. There is a statistically significant relationship between the variable *Shareholder-stakeholder orientation* and the ESG scores from Refinitiv, MSCI, ESG Book, and Moody's ESG. Furthermore, the adjusted *R*² of the additive regression models ARM1-SSO-ARM4-SSO is comparable to the adjusted *R*² of the additive regression models ARM1-ARM4 presented in Table 6. The independent variable *Shareholder-stakeholder*

MBR on Shareholder-Stakeholder-Orientation

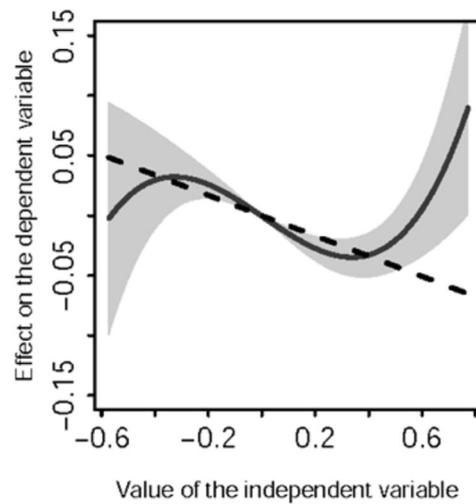


FIGURE 5 | The U-shaped relationship between the measure of bankruptcy risk (MBR) and the *Shareholder-stakeholder orientation*. This figure shows the statistically significant spline patterns for the relationship between the measure of bankruptcy risk and the *Shareholder-stakeholder orientation*. The measure of bankruptcy risk is plotted on the x-axis, and the *Shareholder-stakeholder orientation* is plotted on the y-axis. Due to the within transformation, the values on the axes represent deviations from the company mean value. The bold black line represents the estimated spline function of the additive regression model ARM-SSO, and the dashed line represents the estimated linear function of the linear regression model LRM-SSO. The 95% confidence band is shaded gray.

TABLE 8 | Correlations between the variable *Shareholder-stakeholder orientation* and the residuals from the additive regression models ARM1-ARM4.

	Shareholder-stakeholder orientation	Number of observations
Residuals from ARM1	0.017	21,088
Residuals from ARM2	0.012	23,208
Residuals from ARM3	0.016	21,936
Residuals from ARM4	0.029	7406

Note: This table shows the correlations between the variable *Shareholder-stakeholder orientation* and the residuals from the additive regression models ARM1-ARM4.

orientation explains the variance of the ESG scores to a similar extent as the independent variable *Measure of bankruptcy risk*.

Figure 6 depicts the spline patterns of the independent variable *Shareholder-stakeholder orientation* for the additive regression models ARM1-SSO-ARM4-SSO that consider four different ESG scores as dependent variables. Figure 6 reveals a positive and almost linear relationship between the independent variable *Shareholder-stakeholder orientation* and the ESG scores from Refinitiv, MSCI, ESG Book, and Moody's ESG. The 95% confidence bands are very narrow and do not allow any other conclusion. As a result, the most plausible interpretation of the

TABLE 9 | Results of the additive regression models ARM1-SSO–ARM4-SSO.

Regression model	ARM1-SSO	ARM2-SSO	ARM3-SSO	ARM4-SSO
Dependent variable	ESG score Refinitiv	ESG score MSCI	ESG score ESG book	ESG score Moody's ESG
<i>Shareholder-stakeholder orientation</i>	1.374***	2.920***	2.535***	2.797***
<i>Total assets</i>	2.981***	2.884**	1.921*	1.000***
<i>B&h stock return</i>	2.943***	1.000***	1.000***	1.000
<i>Stock return volatility</i>	2.856*	1.000**	1.916***	2.362***
<i>Tobin's Q</i>	1.000	1.000	2.970***	2.866***
<i>Market value of equity</i>	2.990***	2.990***	2.923***	2.988***
<i>Market value to book value</i>	1.294	1.910*	1.000**	1.307
<i>Leverage</i>	1.000***	1.000	1.830***	1.760*
<i>Return on equity</i>	1.000	1.000*	2.519	1.000
<i>Return on assets</i>	1.000	1.000*	2.984***	2.839*
<i>CapEx</i>	1.000***	2.715	2.765***	1.273***
<i>R&D</i>	2.047***	1.000	2.931***	2.258
<i>Dividend yield</i>	2.957***	2.827**	1.550***	2.575***
<i>Active ownership</i>	1.000***	1.000*	2.797***	1.000
<i>Institutional ownership</i>	1.000***	1.000	1.470*	1.000
Year-fixed effects	Yes	Yes	Yes	Yes
Industry-fixed effects	Yes	Yes	Yes	Yes
Firm-fixed effects	Yes	Yes	Yes	Yes
<i>N</i>	21,318	23,450	22,356	7437
Adjusted <i>R</i> ²	0.379	0.101	0.095	0.309

Note: This table shows the results (i.e., equivalent degrees of freedom) of the additive regression models ARM1-SSO–ARM4-SSO, where different ESG scores are applied as the dependent variable. The independent variables include the company variables that are defined in Table 2; the variable *Shareholder-stakeholder orientation* replaces the variable *Measure of bankruptcy risk*. All additive regression models take into account year-fixed, industry-fixed, and firm-fixed effects. *, **, and *** represent significance levels of 0.05 [or 5%], 0.01 [or 1%], and 0.001 [or 0.1%], respectively.

*p-value < 0.05.

**p-value < 0.01.

***p-value < 0.001.

revealed U-shaped relationship between the measure of bankruptcy risk and ESG scores is that companies anticipate their upcoming financial distress and mimic the stakeholder-oriented behavior of financially healthy companies by emphasizing ESG objectives and intensifying ESG-supporting disclosures. The empirical finding suggests that financially distressed companies manage their ESG scores upward by intensifying their stakeholder-oriented reporting, expressed by the groups addressed in the 10-K filings.

5.2 | Further Extensions

We carried out three further extensions of the regression analysis, the results of which are worth mentioning. The first extension is a regression analysis that takes into account multiyear capital expenditures and R&D expenditures. The idea behind this extension is that company-related measures that lead to a high ESG score could induce financial consequences that increase the measure of

bankruptcy risk. Such a relationship should be particularly evident in ESG investments, as these impact a company's financial position more than operational measures or ESG-supporting disclosures. It is a plausible argument that past cash flow-effective ESG investments can increase a company's current ESG score while worsening its current financial position. A previous increase in capital and R&D expenditures with a subsequent increase in the ESG score would indicate this cause-effect relationship. We tested this hypothesis by taking into account the capital expenditures of the previous 2 and 3 years when we calculated the independent variable $CapEx_{(j,a)}$ and the R&D expenditures of the previous 2 and 3 years when we calculated the independent variable $R\&D_{(j,a)}$. The results of the extended regression analyses are comparable to Table 6 and remain almost unchanged, demonstrating the robustness of our research.

As a second extension, we applied the CDP (formerly the Carbon Disclosure Project) database to analyze investments to reduce greenhouse gas emissions in more detail. Based on a subsample

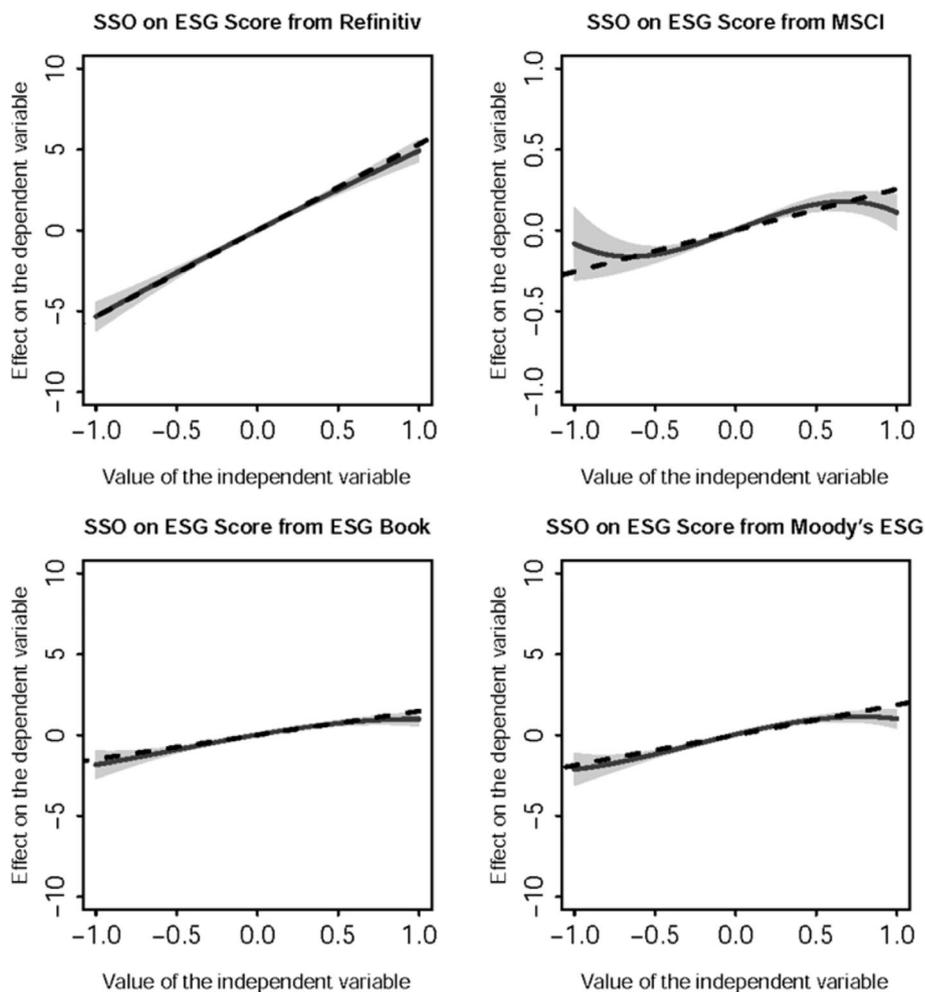


FIGURE 6 | The linear relationship between the *Shareholder-stakeholder orientation* (SSO) and the ESG scores from Refinitiv, MSCI, ESG Book, and Moody's ESG. This figure shows the statistically significant spline patterns for the relationship between the *Shareholder-stakeholder orientation* and the ESG scores from Refinitiv, MSCI, ESG Book, and Moody's ESG. *Shareholder-stakeholder orientation* is plotted on the x axis, and the ESG score is plotted on the y axis. The values on the axes are deviations from the company mean value due to the within transformation. For better comparability, the value range of the x axis was limited to $[-1, 1]$. The bold black line represents the estimated spline function, and the dashed line represents the estimated linear function from unreported linear regression model. The 95% confidence band is shaded gray.

of 2877 analyzable firm-year observations, all conducted regression analyses show that there is no statistically significant relationship between the investments to reduce greenhouse gas emissions and the measure of bankruptcy risk. Consequently, the hypothesis that past ESG investments worsen a company's current financial situation and, at the same time, increase the current ESG scores must be rejected with a probability bordering on certainty.

The third extension is a regression analysis that takes into account a company's energy intensity. Company-related measures that lead to high ESG scores and an increase in financial distress do not necessarily require ESG investments. However, these measures should mainly affect the environmental subfactor, as the revealed U-shaped relationship is primarily based on this subfactor. An important indicator of a company's environmental footprint is the energy intensity of its value-added process. If company-related measures lead to a high ESG score and an increase in the measure of bankruptcy risk, we would expect a reversed U-shaped or at least negative relationship between a

company's energy intensity and the measure of bankruptcy risk. Financially distressed companies should have a smaller environmental footprint regarding their energy intensity. We sourced from the Refinitiv database a score that is based on the total direct and indirect energy consumption in gigajoules divided by net sales or revenue in US dollars. Based on a subsample of 6068 analyzable firm-year observations all conducted regression analyses show that neither the estimated linear nor the nonlinear relationship between a company's energy intensity and the measure of bankruptcy risk is statistically significant. As a result, it can be ruled out with sufficient certainty that financially distressed companies reduce their environmental footprint through real effective measures to an extent that plausibly explains the observed increase in the environmental subfactor.

5.3 | Robustness

The regression analysis revealed comparable U-shaped relationships between the measure of bankruptcy risk and four different

ESG scores from Refinitiv, MSCI, ESG Book, and Moody's ESG. The empirical analysis consistently documents that financially distressed companies are associated with higher ESG scores and that this finding is mainly based on the environmental subfactor. We substantiated the robustness of the empirical results in great detail by varying the applied data and the number of intervals for which each spline function was estimated.

A critical design element of additive regression models is the number of intervals for which each spline function was estimated. First, we checked the appropriateness of the applied number of intervals by performing the test recommended by Wood (2017, section 5.9). The test is based on randomly sampled data and produces a test statistic that may widely vary if the test is replicated. Therefore, we repeated the test 100 times for the additive regression models ARM1–ARM4 to make a valid statement about the robustness of the additive regression models. The evaluation of the test statistics shows that the applied number of intervals is appropriate to model the relationship between the measure of bankruptcy risk and the ESG scores. Nevertheless, we estimated the additive regression models using a larger number of intervals for all metric-independent variables. The U-shaped relationship between the measure of bankruptcy risk and the ESG scores is always recognizable and robust against any reasonable change in the number of intervals.

The applied final dataset and the derived final samples include firm-year observations from 2003 to 2022. We repeated the complete analysis for the periods 2003–2019 and 2011–2022. The analysis for the period 2003–2019 excluded from the dataset the last 3 years in which the COVID-19 pandemic occurred. The COVID-19 pandemic and the associated governmental measures to get the pandemic under control possibly led to distortions in the applied data. An additional advantage of the shorter observation period 2003–2019 is that we do not consider ESG scores from Refinitiv, which are still changing. If there is new ESG-relevant information from an earlier year, the ESG scores from Refinitiv are adjusted. This applies in particular to ESG scores of the more recent observation years. In the analysis for the period 2011–2022, the first 8 years in which the ESG ratings began were excluded from the dataset. Initial valuation difficulties and valuation inconsistencies possibly led to distortions in the early ESG scores. All linear and additive regressions with the ESG scores and the E-S-G subfactors as independent variables show similar relationships and thus confirm the robustness of the empirical results.

Another variation in the samples used was that we created a new sample in which the ESG scores from Refinitiv, MSCI, and ESG Book are available in all firm-year observations. This combined sample comprises a total of 16,184 firm-year observations. All linear and additive regressions with the ESG scores and the E-S-G subfactors as independent variables show similar relationships. The empirical results provide additional evidence for the robustness of the U-shaped relationship between the measure of bankruptcy risk and the ESG scores.

We examined the robustness of the regression models by varying the independent variable *Measure of bankruptcy risk*, and highly correlated independent variables. Thereby, the independent variable *Measure of bankruptcy risk* is varied by applying

an alternative measure of bankruptcy risk that results from a gradient-boosting model rather than a logistic bankruptcy prediction model. The results of the regression models are robust against this variation of the measure of bankruptcy risk. Furthermore, we observed that the U-shaped relationships between the measure of bankruptcy risk and the ESG scores and their subfactors (mainly, the environmental subfactor) are more pronounced if the number of control variables is reduced and/or if year-fixed and industry-fixed effects are not taken into account. However, as we do not want to exaggerate the empirical results, we have only presented the regression analyses with 14 independent (control) variables as well as year-fixed, industry-fixed, and firm-fixed effects.

We varied the procedure several times to refine the final dataset and analyze whether the applied procedure influenced the empirical results. We replaced missing values using the *k*-nearest neighbors algorithm, winsorized outliers at the 2nd and 98th percentiles, and eliminated outliers. The review showed that the empirical results are robust and not affected by the applied procedure to refine the final dataset.

6 | Conclusion

6.1 | Insights

The analysis provides empirical evidence of a U-shaped relationship between the level of financial distress measured by the measure of bankruptcy risk from BRAINKRUPTCY and the ESG scores from Refinitiv, MSCI, ESG Book, and Moody's ESG. Above a certain threshold, financially distressed companies are associated with high ESG scores. The study not only provides a concrete answer to the empirical relationship between financial distress and ESG scores, but also works out a concrete cause-effect relationship between financial distress and ESG scores. Severe financial distress is the cause, and a high ESG score is the effect. Financially distressed companies intensify their cost-effective ESG activities, such as ESG-supporting disclosures and manage their ESG scores upward.

The cause-effect relationship between financial distress and ESG scores has been elaborated by first invalidating the reverse cause-effect relationship, stating that measures leading to a high ESG score are the cause and financial distress is the financial consequence of these measures based on empirical evidence. The interpretation of the narrow confidence bands of the additive regression models ARM1–ARM4, the unchanged regression analyses with multi-year capital expenditures and R&D expenditures, and the empirically unverifiable relationship between the measure of bankruptcy risk and a company's energy intensity are significant arguments against a reverse cause-effect relationship. Subsequently, empirical evidence was presented to support the actual cause-effect relationship between financial distress and ESG scores. This empirical evidence consists of the interpretation of the narrow confidence bands of the additive regression models ARM1–ARM4 and the regression analyses with the variable *Shareholder-stakeholder orientation*. Overall, there is empirical evidence of a pronounced stakeholder orientation for the group of financially distressed companies.

In addition, further insights were gained, which are fundamentally neutral in terms of a cause-effect relationship. Particularly, the U-shaped relationship can be observed regarding the environmental subfactor of the analyzed ESG scores. Furthermore, there is a consistent finding that a negative relationship exists between the market value of equity and the ESG score when the market value of equity is below a company's mean value, indicating that companies with a shrunken market value of equity are associated with higher ESG scores.

An overall picture can be put together from the individual empirical results. Financially distressed companies systematically manage their ESG scores upward by reinforcing the perception of their ESG activities and intensifying ESG-supporting disclosures. We can rule out with a probability bordering on certainty that ESG investments or other ESG-related operational measures increase ESG scores and cause financial distress as a side effect. The intensification of ESG-supporting disclosures relates primarily to the environmental subfactor, meaning that the group of financially distressed companies can speak of systematic greenwashing.

The motivation for such behavior could be based on the need for a lower cost of capital and improved financing conditions that can be achieved through higher ESG scores, the management's desire to divert attention from financial failure, or the managerial incentive system which rewards ESG objectives that may be easier to achieve than financial objectives. In a follow-up study, the motivations behind the ESG disclosure policies of financially distressed companies need to be analyzed in more detail. Presumably, however, a mixture of arguments will be responsible for a U-shaped relationship between the level of financial distress and ESG scores.

One limitation of the analysis is that only listed US companies are taken into account. Although by far the largest stock market in the world is considered, this does not guarantee that the empirical results are transferable to other countries. However, it can be assumed with a high degree of probability that a similar U-shaped relationship between financial distress and ESG scores should also be observed in other western industrialized countries. In this context, the question arises as to whether an internationally composed sample could not also be empirically investigated. In our view, there are two main reasons against such an approach: First, the measure of bankruptcy risk based on a bankruptcy prediction model can only be accurately estimated for a specific country, as the legal definition of bankruptcy differs across countries. Second, ESG regulations, ESG practices and corporate culture may differ in different countries, which also has an impact on ESG ratings. For these two reasons, there is a trade-off between analyzing a consistent and unbiased sample of a single country and analyzing an inconsistent and potentially biased sample of multiple countries. We have chosen to analyze a consistent and unbiased sample of listed US companies.

6.2 | Implications

The management of ESG scores by the group of financially distressed companies reduces the validity and credibility of ESG

scores and makes them less reliable. Due to the observed management of ESG scores by the group of financially distressed companies, it is imperative to consider a company's financial situation when interpreting ESG scores. If ESG scores are viewed in isolation, they may lead to an incorrect evaluation of financially distressed companies. As a result, the methodology for determining ESG scores in particular and ESG performance in general must be scrutinized. A methodology must be designed so that extensive distortions, such as those practiced by the group of financially distressed companies, are not possible or are at least shown transparently. On the other hand, the incentives that lead to such opportunistic behavior by the group of financially distressed companies must be examined more closely.

The U-shaped relationship between the measure of bankruptcy risk and four different ESG scores shows some tension between ESG and the sustainable financial situation of a company when the company is financially distressed. Companies have to be sustainable in two respects: First, a company's activities have to be sustainable in terms of environmental, social, and governance aspects, measured by ESG scores. That is an overall objective of the company's stakeholders. Second, every company strives to ensure its continued existence and not become bankrupt. The viability of a company can be described by the measure of bankruptcy risk, which can be interpreted as the probability of bankruptcy if a logistic bankruptcy prediction model is applied. The company's shareholders have the objective that the company is financially healthy and that the continued existence of the company is not jeopardized. As a result, the company has to take into account ESG and its financial sustainability as two objectives at the same time.

A company's ESG activities and sustainable financial situation can be measured by two separate performance measures, such as an ESG score and the measure of bankruptcy risk. However, this separation, particularly, leads to two issues. First, the ranking of companies in relation to one of the two performance measures is inconsistent, as we observed increasing ESG scores when a company becomes more financially distressed. A consistent evaluation of a company's sustainability concerning both ESG and its financial situation requires a single measure of its overall sustainability, including the financial situation. Second, two company objectives and the associated performance measures, such as an ESG score and the measure of bankruptcy risk, may lead to severe incentive problems if variable remuneration or long-term career development depends on these performance measures. If both performance measures are additively linked, measures are first taken to increase the performance measure that leads to the most significant benefit with the least use of resources. It is plausible that a high ESG score can be achieved by corporate activities such as extensive ESG reporting rather than actual ESG investments. In that case, increasing an ESG score can be achieved easier than improving a company's financial situation, and a rational decision-maker is likely to focus first on a company's ESG score.

A company's ESG activities and sustainable financial situation can be measured by one overall sustainability score if the ESG score and the measure of bankruptcy risk are multiplicatively linked. If the measure of bankruptcy risk is interpreted as the probability of bankruptcy, the product of the ESG score and the

complementary probability that the company remains solvent can be interpreted as the expected ESG score. The expected ESG score assumes that the current ESG score represents the future period and additionally weights that ESG score with the complementary probability that the company remains solvent. This overall sustainability score provides a sustainability evaluation of a company that will likely become bankrupt in the foreseeable future. If a company is financially distressed and exhibits an increased measure of bankruptcy risk, the overall sustainability score is much smaller than the associated ESG score. The overall sustainability score of a financially distressed company will be decreased as a company on the verge of bankruptcy is not sustainable in any criteria.

The empirical analysis demonstrates a U-shaped relationship between the measure of bankruptcy risk and ESG scores. This finding leads to the implication that the environmental, social, and governance impacts of a company that are condensed in the ESG score and the financial sustainability that the measure of bankruptcy risk must be considered together, which applies, in particular, to financially distressed companies. If ESG scores are viewed in isolation, they may lead to an incorrect evaluation of financially distressed companies. In order to ensure the validity and informative value of ESG scores, including ESG scores for financially distressed companies, the ESG scores should be adjusted by incorporating the probability of bankruptcy or the complementary probability that the company remains solvent. This task is urgent, as an increasing proportion of listed US companies are experiencing financial difficulties (Lohmann and Möllenhoff 2023b). Notwithstanding this, the present study shows that stakeholders and ESG rating agencies should not be blinded by extensive ESG disclosure and that shareholders of financially distressed companies must insist that boards address financial matters first.

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