Nijmegen School of Management
Department of Economics and Business Economics
Master's Thesis in Economics (MAN-MTHEC)

The Price of Being Sustainable: ESG Scores and the Financial Risk Appetite of Firms

By YOUP LICHTENBERG (s1076795)

Nijmegen, 30 June 2025

This paper examines how corporate ESG performance influences financial risk-taking, with a focus on the moderating role of firm size. Using a two-way fixed effects panel regression on a dataset of 859 publicly listed U.S. and European firms over 2010-2023, the study finds that higher ESG scores are generally associated with lower financial risk-taking, especially among larger firms. In contrast, for smaller firms, ESG engagement may increase risk-taking, potentially reflecting symbolic or reputation-driven adaptation of sustainability practices. Robustness checks with alternative risk proxies and subgroup analyses across ESG pillars and industries confirm that ESG's risk impact is highly context dependent. These results suggest that while ESG can function as a form of reputational or moral insurance that stabilizes corporate behavior, its effects vary depending on firm size and implementation sincerity. The findings offer valuable implications for investors, policymakers, and corporate managers seeking to align sustainable practices with prudent financial strategies in mature markets.

Program: Master's Program in Economics
Specialization: Financial Economics
Supervisor: Olexiy Kyrychenko

Radboud Universiteit

List of contents

1 Introduction

Over the past decade, Environmental, Social, and Governance (ESG) factors have gained significant attention in mainstream finance amid rising investor demand and regulatory pressure. Investors and regulators increasingly view strong ESG performance as a signal of responsible management and long-term value creation. According to Bao et al. (2024), global ESG investments have grown from $6.5 trillion in 2006 to over $121 trillion in 2021, highlighting the market's growing emphasis on sustainability. Firms across industries have set ambitious ESG goals, driven by both ethical considerations and financial incentives (Eccles et al., 2014). Today, ESG is seen not only as an ethical choice but also as a practical framework for managing risk through greater transparency, stakeholder trust, and regulatory compliance (Ali et al., 2023).

However, despite these benefits, it remains unclear what "price" companies might pay for pursuing sustainability in terms of their financial risk appetite. Financial risk-taking plays a central role in shaping corporate investment, financing, and strategic choices, as it directly influences a firm's capacity to innovate, expand, and generate returns (Bagh et al., 2024). Yet excessive risk-taking can also result in financial distress, stock volatility, and broader systemic consequences (Pozo, 2024). Understanding how ESG engagement alters this balance is essential for anticipating firm behavior, investor outcomes, and overall market stability.

Given these unresolved questions, this ambiguity gives rise to the central research question of this thesis: "To what extent does ESG performance influence corporate financial risk-taking, and to what extent does this relationship vary by firm size?" Addressing this question provides important insights into whether sustainability initiatives promote prudent financial management or mask more aggressive risk-taking under the guise of a reputable image.

1.1 Practical Relevance

ESG performance reflects how effectively firms manage sustainability-related issues (Rahman & Alsayegh, 2021). In contrast, financial risk-taking refers to strategic decisions, such as taking on leverage, investing in uncertain projects, or pursuing aggressive growth, that increase return variability or the likelihood of financial distress (Guest, 2011). Understanding how these two concepts interact is highly relevant for practitioners, as they directly shape corporate behavior, investor confidence, and financial market stability.

In capital markets, ESG scores are often viewed as indicators of sound management and future performance (Wong & Li, 2024). If companies with high ESG scores adopt more

conservative financial strategies, as suggested by Wu et al. (2024), who find that ESG leaders tend to show lower volatility and downside risk, then investors may need to adjust portfolio construction and asset pricing to reflect this reduced risk. Conversely, if ESG engagement encourages bolder investments supported by stakeholder trust (Godfrey, 2005), investors must account for this possibility in their risk assessments to avoid underestimating the true risk of firms labeled as "sustainable."

The issue also carries broader societal implications. Firms are not only economic actors but also stewards of social and environmental welfare, meaning their risk-taking behavior affects employees, communities, and the planet (Tian & Chen, 2024). Excessive corporate risk-taking can trigger crises or scandals, while excessive risk-aversion might hinder innovation. ESG initiatives are often promoted as a path to sustainable growth, yet it remains uncertain whether they truly reduce financial risk or merely alter how that risk is managed. This uncertainty is especially relevant given recent global policy developments, as governments and regulators worldwide are increasingly encouraging ESG disclosure and investment to enhance market stability and societal outcomes (Frecautaun & Nita, 2022). If widespread ESG engagement leads firms to adopt more conservative financial strategies, this could provide an unintended benefit for financial stability. If not, stronger oversight may be needed to ensure that firms pursuing sustainability goals still manage their overall risk effectively.

Beyond these societal considerations, organizational characteristics such as firm size also influence practical relevance. Larger firms often have the scale, public visibility, and formalized governance structures to absorb ESG-related costs and integrate sustainability into their operations more effectively (Drempetic et al., 2020). Their ESG practices are typically more institutionalized and closely monitored, which can strengthen their impact on reducing financial risk-taking. In contrast, smaller firms may face financial and resource constraints that shape how ESG engagement influences their risk behavior. They might adopt ESG practices in a more ad hoc or symbolic way, reducing their influence on strategic risk decisions. Understanding these differences is essential for designing targeted regulatory and managerial responses. Ultimately, the findings of this research may inform investment decisions, corporate strategy, and policymaking to promote sustainable yet financially stable business practices.

1.2 Academic Relevance

From a scholarly perspective, prior research has shown that ESG performance is not merely a secondary consideration but can materially influence firm outcomes (Matuszewska-Pierzynka, 2024; Ng et al., 2020). Whelan et al. (2021), for example, reviewed over 1,000

studies and concluded that sound ESG practices can enhance firms' risk-adjusted returns and lower their cost of capital, largely through improved reputation and stronger stakeholder relations. However, the effect of ESG on corporate risk-taking remains contested. Some studies suggest that strong ESG performance reduces corporate risk-taking by increasing transparency and stakeholder trust (Ali et al., 2024; He et al., 2023). Others, in contrast, argue that ESG can create "reputational slack", allowing firms to justify bolder, riskier strategies (Faccio et al., 2016). This tension highlights an unresolved theoretical debate: does ESG engagement encourage more cautious financial behavior, or can it instead promote increased risk-taking?

Despite growing interest in this issue, two key gaps in the literature remain. First, the role of firm size as a moderator of the ESG-risk relationship has rarely been examined. Most studies rely on pooled samples of firms, implicitly assuming that ESG affects all companies in the same way. However, firm size is a fundamental structural factor that can shape corporate behavior (Drempetic et al., 2020), and this heterogeneity remains largely unexplored. Second, much of the empirical literature has focused on non-Western contexts, particularly on Asian economies such as China and Taiwan, and often targets specific high-tech or controversial industries. Although these studies provide valuable insights, they are rooted in institutional environments that differ substantially from those in the U.S. and Europe. As a result, their findings may not be fully generalizable to Western economies with well-developed governance structures. Overall, empirical research in Western markets remains relatively scarce. This thesis may provide a more nuanced and context-sensitive understanding of the ESG-risk relationship.

1.3 Methodological Approach

To investigate these questions empirically, this study applies a two-way fixed effects panel regression model to investigate the relationship, controlling for both firm-specific and year-specific effects. The analysis uses firm-level data from LSEG Workspace, covering 859 publicly listed companies included in the S&P 500 and STOXX Europe 600 over the 2010-2023 period. ESG scores serve as the main explanatory variable, with net leverage used as a standard proxy for financial risk-taking. Firm size is incorporated both as a control variable and as a moderating factor.

Preliminary results indicate that higher ESG performance is generally associated with lower financial risk-taking among larger firms, whereas smaller firms may experience a positive relationship. These findings underscore that ESG's influence on corporate risk appetite is highly context-dependent, challenging one-size-fits-all assumptions in the literature. In this way, the study aims to enrich current debates on sustainable finance.

The remainder of this thesis is structured as follows: Section 2 reviews the literature, Section 3 describes the methodology in detail, Section 4 presents the empirical results, and Section 5 concludes with a discussion of the findings and their implications.

2 Literature review

To examine whether ESG engagement affects financial risk-taking differently across firms of varying sizes, it is first necessary to establish the nature of the ESG-risk relationship. Although this relationship has attracted substantial scholarly attention, empirical findings have remained mixed. These inconsistencies highlight the need to better understand the mechanisms behind ESG's influence on risk and the conditions under which this effect occurs. This literature review synthesizes three main strands of research: studies identifying a negative, positive, or nonlinear relationship between ESG and corporate financial risk-taking. Table 1 provides a concise overview of the relevant papers and their reported relationships. Building on this framework, the review introduces firm size as a potential moderating factor that may help explain these conflicting findings. In doing so, it lays the foundation for the development of two hypotheses.

Table 1. Literature on the Relationship between ESG and Financial Risk-Taking

#	Sign of the coefficients	Year of Study	Authors
1	↓	2023	He et al.
2	↓	2012	Jo and Na
3	↓	2012	Bouslah et al.
4	↓	2005	Godfrey
5	↓	2016	Kim et al.
6	↓	2014	Borghesi et al.
7	↑	2016	Faccio et al.
8	↑	2020	Dunbar et al.
9	↑	2014	Krüger
10	↑↓	2023	Teng et al.

2.1 Risk-Reducing Perspective

The first and most widely supported perspective in the literature suggests a negative relationship between ESG performance and corporate financial risk-taking. He et al. (2023), for example, use a panel dataset of 3,000 Chinese firms from 2005 to 2020 and apply a fixed-effects regression model, finding that a one-unit increase in ESG score is associated with a 0.5% reduction in financial risk-taking. High-ESG firms also exhibit lower earnings volatility and more conservative investment patterns. Similarly, Jo and Na (2012) analyze 440 firms in the controversial industries such as tobacco, alcohol, and gambling, and document that increased corporate social responsibility (CSR) engagement, a component of ESG, is linked to lower firm risk. Their study shows that a one-standard-deviation increase in CSR engagement is associated with a 12% reduction in stock return volatility, reinforcing CSR's stabilizing role. In these sensitive industries, acting responsibly provides protection against reputational damage, which in turn deters excessive risk-taking (Bouslah et al., 2012). Taken together, these studies support the view that ESG activities stabilize corporate behavior and encourage more prudent financial strategies.

To explain how this stabilizing effect emerges, researchers have proposed several mechanisms why ESG engagement can reduce risk-taking. One prominent explanation is the creation of *moral capital*, which acts as an insurance-like buffer through strong stakeholder relationships (Godfrey, 2005). Firms that invest in ESG build goodwill with stakeholders such as customers, employees, and regulators, providing a safety net during times of crisis. Godfrey et al. (2008) argue that this accumulated moral capital shields firms from the financial consequences of adverse events or shocks. As a result, firms with strong stakeholder relationships may feel less pressure to pursue high-risk, short-term profits and instead focus on long-term stability (Monteduro et al., 2020). Consistent with this view, Jo and Na (2012) find that CSR initiatives serve as a reputational buffer, encouraging more cautious corporate behavior.

Another complementary mechanism suggests that high ESG performance reflects stronger corporate governance and internal controls, which naturally curb excessive risk-taking (Kim et al., 2016). Companies excelling on ESG metrics typically have more transparent reporting, rigorous compliance systems, and accountable management structures, all of which help mitigate agency conflicts between managers and shareholders (He et al., 2023). With reduced information asymmetry, managers are less able and inclined to pursue reckless investments for personal gain, resulting in a lower overall risk profile (Godfrey, 2005). Even when managers

engage in ESG activities primarily for reputational or personal reasons, the increased scrutiny and stakeholder engagement can indirectly pressure them to avoid high-risk projects (He et al., 2023). Borghesi et al. (2014) suggest that when executives adopt ESG activities for self-serving motives, firms often still experience reduced risk, as managers seek to preserve a stable public image. In short, even non-altruistic ESG motives can contribute to risk-reducing outcomes.

High ESG engagement can also strengthen a firm's competitive position and resilience, thereby reducing the need for risky strategies. Albuquerque et al. (2018) propose that firms with superior ESG performance cultivate strong customer loyalty and brand value, making demand for their products less sensitive to price changes. As a result, ESG-oriented firms may benefit from more stable cash flows and a lower likelihood of financial distress during economic downturns, reducing the pressure to adopt risky strategies to maintain performance. Empirical evidence supports this view, with several studies indicating that firms with strong sustainability practices exhibit lower stock return volatility and reduced exposure to downside risk. For example, Godfrey et al. (2008) and Albuquerque et al. (2018) report that robust ESG or CSR engagement is associated with decreased stock price variance and a lower probability of extreme negative financial outcomes. These findings suggest that ESG practices enhance a firm's financial resilience by promoting greater stability in risk management.

This perception of ESG has shaped not only firm behavior but also how investors evaluate corporate performance in recent decades. Market participants have increasingly recognized the value of strong ESG practices as signals of effective governance and long-term stability. Ioannou and Serafeim (2015) document a shift in analysts' attitudes. In the 1990s, analysts often viewed CSR expenditures as agency costs that could harm performance, but by the 2000s, they began to see strong ESG performance as a positive indicator of effective management and sustainable value creation. Companies with a reputation for sustainability started to receive more favorable recommendations, reflecting the market's appreciation for ESG-oriented firms with stable, forward-looking management. This evolving investor sentiment reinforces the idea that ESG engagement and prudent risk management are complementary (Ioannou & Serafeim, 2015). Overall, this strand of literature supports the view that ESG acts as a safeguard, fostering trust, transparency, and long-term orientation, which in turn reduces financial risk-taking.

2.2 Risk-Enhancing Perspective

However, an alternative body of research challenges this conclusion by arguing that ESG may, under certain circumstances, increase risk-taking. A significant body of research highlights conditions under which strong ESG performance may actually coincide with

increased financial risk-taking. This positive relationship is typically attributed to behavioral and strategic mechanisms. These encourage bolder decision-making once a firm has established a strong ESG reputation. One explanation centers on managerial behavior, which Faccio et al. (2016) describe as the accumulation of *reputational slack*. Managers who have built up a reservoir of goodwill through ESG achievements may feel they have earned greater freedom to take risks, believing that their strong reputation or stakeholder support will shield them from criticism or severe consequences if a risky venture fails. To some extent, this contradicts Godfrey's (2005) argument that moral capital primarily reduces risk by suggesting it may instead encourage greater risk-taking. He et al. (2023) refer to a similar idea as a potential *risk compensation* effect. When firms devote substantial resources to ESG activities, which can create costs or distract from immediate profits, managers may compensate by pursuing high-risk, high-reward investments to balance out the perceived cost of "doing good." In this view, ESG engagement provides managerial confidence or stakeholder approval necessary to green-light ambitious ventures that might otherwise be avoided. As a result, the firm's overall risk-taking behavior may increase, driven by the belief that ESG credibility will protect it from the full consequences of failure.

This perspective is supported by research on executive incentives. Dunbar et al. (2020) find that U.S. companies with high ESG scores tend to grant their CEOs more risk-inducing incentives, such as stock options. Using firm-level data from 2007 to 2018, they estimate that a one-standard-deviation improvement in ESG score increases the proportion of CEO stock option compensation by roughly 15%, reflecting a significant shift in risk incentives. They describe this as the *risk capacity* effect of ESG. When a firm's ESG excellence lowers its downside risk through the mechanisms described earlier, owners and boards may encourage management to exploit this increased risk-bearing capacity (Thomas et al., 2022). In Dubar et al.'s (2020) study, stronger ESG performance is consistently associated with higher levels of option-based CEO pay, suggesting a deliberate adjustment of incentives to promote more aggressive strategies. This implies that firms view ESG excellence as a buffer that justifies greater strategic risk-taking. High ESG performers may leverage their strong reputation to take risks more freely, pursuing ambitious expansions or innovations while relying on their ESG credibility as a safeguard if things go wrong. This again contradicts earlier arguments by Godfrey (2005), who suggested that moral capital primarily serves to reduce corporate risk-taking rather than encourage it.

Importantly, this positive relationship is often found to be conditional in the literature and may not apply universally. Researchers emphasize that such effects typically emerge in specific

contexts (Hirshleifer & Thakor, 1992). The underlying mechanisms are rooted in agency and behavioral theories. Managers might overestimate the protection provided by ESG goodwill, or they might use ESG as a cover for pursuing personal ambitions (Albuquerque et al., 2018). Krüger (2014), for example, argues that managers use CSR initiatives to pursue personal agendas, such as expansion or diversification projects, which can increase firm risk. His event study of 2,000 firms suggests that while ESG controversies can temporarily heighten risk perceptions, ongoing CSR efforts may give managers greater freedom to engage in riskier projects over time. Executives, believing that socially responsible behavior provides moral cover, might assume stakeholders will tolerate bolder decisions. In such cases, ESG engagement may reflect managerial overconfidence or moral licensing, ultimately leading to higher risk exposure (Dunbar et al., 2020). Although much of the literature suggests that ESG reduces risk, this perspective highlights that under certain conditions, ESG can also embolden firms to take greater risks.

2.3 Nonlinear and Conditional Perspectives

To reconcile these conflicting findings, recent studies have proposed that the relationship may, in fact, be nonlinear or conditional. This emerging perspective frames ESG as a *double-edged sword* (Teng et al., 2023). In a study of 1,500 high-tech firms from 2010 to 2020, Teng et al. (2023) find evidence of a curvilinear relationship, where risk initially declines with ESG improvements but rises again beyond a certain threshold. The authors attribute this pattern to the nature of a firm's ESG commitment. When ESG efforts are genuine, deeply integrated into corporate strategy, and aligned with stakeholder expectations, ESG becomes a strategic asset that management can leverage. This credibility can provide the confidence and support needed to take calculated risks and pursue innovation, especially when stakeholders trust the company and are more willing to tolerate bold initiatives (Teng et al., 2023).

However, the other side of this "double-edged sword" appears when ESG engagement is less genuine or purely symbolic. Teng et al. (2023) and Dunbar et al. (2020) suggest that firms using ESG as a marketing tool or regulatory façade, without meaningful integration, may suffer from inefficiencies or become overly cautious in key strategic areas. Such superficial initiatives can misallocate resources, create a false sense of security, and fail to build genuine stakeholder trust. In Teng et al.'s (2023) study, firms that engaged in risk-taking based on an inflated ESG image often lacked the internal alignment or stakeholder support needed to implement bold strategies effectively, thereby increasing the potential for costly missteps.

The literature on nonlinear effects indicates that ESG's influence on risk-taking is not uniform but depends on both the intensity and authenticity of ESG engagement. This curvilinear pattern highlights the complexity of the relationship, suggesting that multiple factors interact to shape its direction and magnitude.

Together, these three strands of literature, highlighting negative, positive, and nonlinear effects, underscore the complexity of this relationship. They demonstrate that ESG engagement can either mitigate or amplify risk depending on underlying mechanisms and contextual factors. However, the dominant view in the literature remains that ESG tends to reduce risk. Given that nonlinear and conditional findings remain less dominant, this thesis proposes the following hypothesis: Higher ESG performance is negatively associated with firm-level financial risk-taking. This hypothesis is grounded in the idea that ESG acts as a form of moral and reputational insurance, fostering stakeholder trust and long-term orientation, thereby limiting firms' exposure to downside risk (He et al., 2023; Jo & Na, 2012).

2.4 The Role of Firm Size

To understand under which circumstances the risk-reducing effect of ESG is most likely to occur, researchers have increasingly focused on potential moderating factors. Among these, firm size has emerged as particularly relevant. Firm size fundamentally shapes a company's strategy, resource availability, and stakeholder visibility (Drempetic et al., 2020), all of which can influence how ESG performance translates into risk-taking behavior. Large firms typically possess greater financial and organizational capacity, enabling them to manage both ESG initiatives and risky investments more effectively. Additionally, larger firms operate under greater public scrutiny and often maintain more formalized governance structures (Gallo & Christensen, 2011). Their high visibility means that missteps, whether ESG failures or financial risks, can attract significant media and stakeholder attention (Lewin & Warren, 2024). To manage this, large firms tend to implement robust compliance systems and risk management practices. These characteristics suggest that ESG engagement in large firms may be more institutionalized and closely monitored, which could enhance its risk-reducing potential.

These characteristics might lead large corporations to experience the ESG-risk relationship differently than small or mid-sized firms. Drempetic et al. (2020) argue that large companies tend to achieve higher ESG scores due to superior reporting resources, not necessarily because of more sustainable practices. Analyzing ESG data from over 1,800 European firms, they show that reporting capabilities, rather than actual sustainability outcomes, explain a large share of ESG score variation across firm sizes. Because of their greater resources, large firms can afford

comprehensive sustainability reporting, boosting their ESG ratings without necessarily improving actual sustainability performance. In other words, they are simply better at measuring and communicating what they do (Drempetic et al., 2020). This creates a potential bias, where ESG ratings may partly reflect firm size and reporting effort. In fact, when measuring real outcomes like carbon emissions per unit of output, large firms often perform similarly or even worse than smaller firms (Gallo & Christensen, 2011). This suggests that large firms may benefit from ESG reputational advantages without changing their underlying risk-taking behavior. For such firms, ESG could build stakeholder trust even as they continue pursuing bold investments or expansion plans (Faccio et al., 2016).

In contrast, smaller firms often have fewer resources and are more vulnerable to individual shocks. When small firms choose to invest in ESG, it tends to be a more strategically significant decision (Drempetic et al., 2020). They may need to reallocate part of their budget or shift management priorities, signaling a deeper commitment to stakeholder values (Postiglione et al., 2025). As a result, ESG engagement in smaller firms may be more likely to reduce financial risk-taking, for example, by discouraging aggressive growth strategies or high leverage (Martínez et al., 2024).

Meanwhile, large firms often integrate ESG into their broader strategic initiatives, treating sustainability as a routine part of operations rather than as a stand-alone commitment. For these firms, ESG becomes a *business-as-usual* strategy that runs alongside more aggressive growth plans and risk-taking in other areas (Bissoondoyal-Bheenick et al., 2023). Some large firms may use ESG to hedge against risks in specific areas, such as environmental or social issues, while continuing to pursue high-risk projects like international expansions or technological innovation (Gallo & Christensen, 2011). At the same time, their public visibility increases the potential reputational damage from ESG-related failures. As a result, high-ESG large firms might be especially motivated to avoid highly visible risks, such as environmental accidents or governance scandals, to protect their public image. However, they may still engage in financial risk-taking in areas that attract less scrutiny, such as mergers, acquisitions, or R&D investments (Drempetic et al., 2020). Overall, both theoretical reasoning and early evidence suggest that firm size plays a key role in shaping how ESG performance relates to financial risk-taking.

Yet, this moderating role remains underexplored. Most existing studies either analyze firms collectively or include firm size only as a control variable, rather than treating it as a central factor of interest. Yet firm size fundamentally affects strategic capacity, resource availability, and stakeholder visibility, factors that are likely to condition how ESG initiatives are implemented and perceived. This leaves a gap in the literature that this thesis aims to address.

To fill this gap, the thesis proposes the following second hypothesis: The negative effect of ESG on risk-taking is stronger for large firms than for small firms.

3 Methodology

This chapter outlines the methodological framework for examining the relationship between ESG performance and corporate financial risk-taking. A two-way fixed effects panel regression model is applied to control for unobserved firm-specific characteristics and year-specific shocks. The dependent variable in the analysis is financial risk-taking, with ESG performance as the main explanatory variable. Firm size is incorporated both as an independent control variable and as a moderator through an interaction term. The chapter also describes variable construction, data sources, and explains the strategies used to ensure robustness. The formal specification of the model is presented below:

$$(1)\ RiskTaking_{it} = \beta_1 ESG_{it-1} + \beta_2 Size_{it} + \beta_3 (ESG_{it-1} * Size_{it}) + \beta_4 Age_{it} + \beta_5 ROA_{it} + \beta_6 MTB_{it} + \alpha_i + \delta_t + \varepsilon_{it}$$

3.1 Data

$RiskTaking_{it}$ captures the financial risk-taking behavior of firm i in year t. Based on preliminary tests, net leverage was selected as the primary proxy for risk-taking, expressed as a decimal ratio. Although the cash ratio was initially considered as an alternative proxy, it was excluded due to its lack of significance in early analyses. ESG_{it-1} denotes the one-year lagged ESG score for firm i. Firm size ($Size_{it}$) is measured as the natural logarithm of total assets. The interaction term ($ESG_{it-1} * Size_{it}$) is included to test whether the effect of ESG varies depending on firm size. Three control variables are added to account for firm-level heterogeneity. Age_{it} refers to the number of years since firm i's founding. ROA_{it} captures profitability, expressed as return on assets in decimal form. MTB_{it} represents the market-to-book ratio. All control variables are measured at the firm-year level. Finally, α_i captures time-invariant firm-specific effects, δ_t accounts for year-specific shocks common across firms, and ε_{it} denotes the idiosyncratic error term.

To empirically test the model, firm-level data were obtained from the LSEG Workspace database, which provides comprehensive information on financial indicators, ESG scores, and firm characteristics for publicly listed companies worldwide. To address gaps in the literature,

the analysis focused on firms headquartered in Western economies, specifically the United States and Europe. The initial sample includes all constituents of the S&P 500 and the STOXX Europe 600 indices, totaling 1,100 firms. This selection ensures broad coverage of publicly traded companies that are more likely to consistently report ESG data and influence financial risk-taking at the market level. Annual data from 2010 to 2023 were used, matching standard ESG and financial reporting frequencies (Bourne et al., 2024). Although data collection began in 2008, the analysis starts in 2010, when ESG reporting practices became more standardized. The earlier years were retained for constructing lagged and differenced variables. To improve comparability, firms in the financial and utility sectors were excluded, as industry-specific regulations could distort both capital structures and ESG disclosures (He et al., 2023). This exclusion reduces the sample to 859 unique firms. Only firms with more than one observation were included to guarantee sufficient within-firm variation for fixed effects estimation. Missing ESG scores were relatively common, especially in the earlier years, often due to delayed coverage for newly listed or restructured firms (Wu et al., 2024). These firms were retained in the main analysis to preserve sample size and minimize selection bias, with a robustness check excluding firms with missing ESG data. Results of this check are discussed in the robustness section. Constructing the firm age variable was occasionally complicated by mergers, spin-offs, or name changes. However, this had a minimal impact, as ESG data typically became available only after a firm is established under its current legal identity. In rare cases, founding years were imputed based on an economic predecessor.

Table 2. Descriptive Statistics

Variable	N	Mean	Std. Dev.	Min	Pctl. 25	Pctl. 50	Pctl. 75	Max
NetLeverage	10355	0.434	0.234	-0.91	0.322	0.471	0.587	0.994
ESG_1	10355	59.787	19.231	0.6	46.66	62.75	74.76	97.56
FirmSize	10355	0.272	1.352	-5.234	-0.652	0.224	1.196	4.43
AGE	10355	73.48	54.013	0	30	58	110	355
ROA	10355	0.069	0.103	-1.227	0.031	0.06	0.098	2.634
MTB	10355	1.201	0.914	-1.649	0.595	1.109	1.704	7.163

Table 2 presents descriptive statistics for the key variables used in the analysis. Net leverage has a mean of 0.434, with most firms ranging between 0.322 and 0.587, consistent with the findings from He et al. (2023). Although the full range spans from -0.91 to 0.994, most observations are tightly clustered around the mean, indicating broadly similar capital structure behavior across firms. The average ESG score is 59.8, with values ranging from 0.6 to 97.6. This wide distribution reflects substantial variation in sustainability engagement, with the 75th percentile approaching 75, suggesting that many firms report relatively strong ESG performance. As noted by Bao et al. (2024), such patterns were expected in developed economies, where regulatory pressure and investor expectations increasingly promote ESG reporting. Firm size, measured as the natural logarithm of total assets, has a mean of 0.27, with a broad range indicating large differences among companies. Firm age ranges from 0 to 355 years, with a mean of 73, reflecting a mix of newly listed and long-established companies. ROA and MTB exhibit means of 0.069 and 1.20, respectively, with pronounced right-skewed distributions, as indicated by their high maximum values. Having described the data and variable distributions, the next section details the statistical model used to test the study's hypotheses.

3.2 Model Specification

To establish temporal precedence and reduce concerns about reverse causality, ESG performance is lagged by one year. This approach helps mitigate simultaneity bias, since a firm's risk-taking behavior could otherwise influence its ESG engagement. The use of a one-year lag is consistent with established practices in ESG-focused empirical research (Ali et al., 2023). Firm size is included both as a direct explanatory variable and as a moderating factor through an interaction term with ESG performance. Consistent with Kim et al. (2016), a negative relationship is expected between firm size and financial risk-taking, reflecting the stronger governance structures, greater stakeholder scrutiny, and reputational pressures that typically constrain riskier behavior in larger firms.

The interaction term is designed to test whether the effect of ESG depends on firm size. Specifically, it captures how the influence of the lagged ESG score on risk-taking varies according to the firm's contemporaneous size. The total marginal effect of ESG is represented by the partial derivative of $RiskTaking_{it}$ with respect to ESG_{it-1}, which can be expressed as:

$$(2) \quad \frac{d(RiskTaking_{it})}{d(ESG_{it-1})} = \beta_1 + \beta_3 Size_{it}$$

This expression indicates that the total effect of ESG is composed of its direct coefficient (β_1), adjusted by the interaction term (β_3) multiplied by firm size. A significant β_3 suggests that the impact of ESG on risk-taking systematically varies with firm size. To interpret this interaction meaningfully, it is essential to first establish the base effect of ESG (β_1). Only then can the additional explanatory power of the interaction term be properly evaluated. This element directly addresses one of the thesis's sub-questions and hypotheses.

In addition to the interaction effects, the model includes the three control variables. These controls are grounded in prior literature that consistently associates with financial risk-taking (Faccio et al., 2011; Krüger, 2014; He et al., 2023). Firm age serves as a measure of maturity and is expected to be negatively related to risk-taking, as older firms generally adopt more conservative strategies and place greater emphasis on reputation (He et al., 2023). ROA acts as a proxy for profitability, with more profitable firms typically showing lower risk-taking behavior (Krüger, 2014; He et al., 2023). MTB reflects market expectations and growth opportunities. Consistent with Faccio et al. (2011), a positive relationship is anticipated, since firms with high growth prospects are more likely to pursue riskier financial strategies. Together, these control variables help isolate the effect of ESG performance and mitigate the risk of omitted variable bias.

Panel data is well-suited for this research because it combines cross-sectional and time-series dimensions, thereby enhancing estimation efficiency and enabling the inclusion of fixed effects to control for unobserved heterogeneity and macroeconomic shocks (Torres-Reyna, 2007). By differencing out time-invariant firm characteristics, the model reduces omitted variable bias, while the time dimension captures dynamic effects and improves the overall quality of the estimates.

The model employed two-way fixed effects, including both firm and year fixed effects. Firm fixed effects control all time-invariant characteristics at the firm level, while year fixed effects absorb common shocks to all firms each year, such as macroeconomic cycles or regulatory changes. Because the fixed effects absorb the constant term, a separate intercept is omitted. This specification improved the reliability and internal consistency of the estimated ESG-risk relationship. A random effects model was not applied, as it relies on the assumption that heterogeneity is uncorrelated with the regressors, which is unlikely to hold in this context.

Although fixed effects models cannot estimate time-invariant predictors, this is not a concern here because all key variables exhibit sufficient variation over time, as confirmed by within-firm standard deviation checks. This supports the validity of the fixed effects approach and mitigates potential identification issues. Although fixed effects may reduce explanatory power,

this trade-off is acceptable due to gains in internal validity and consistency of the resulting estimates.

To improve the reliability of the results, standard errors were clustered at the firm level. This accounts for potential patterns in the data such as heteroskedasticity and correlation of errors within firms over time. In addition, standard diagnostic tests were conducted to validate the model. Panel unit root tests confirmed the stationarity of key variables, while the Wooldridge test detected only mild autocorrelation. Variance inflation factors indicated no multicollinearity [1] concerns beyond expected correlations. None of these checks revealed irregularities that would compromise the reliability of the results.

3.3 Robustness and Heterogeneity Analyses

To ensure the reliability of the results, several robustness checks and heterogeneity tests were conducted. First, the core regression was re-estimated using the volatility of ROA as an alternative proxy for financial risk-taking. This metric, widely used in previous research (John et al., 2008; Teng et al., 2023), captures a different aspect of risk behavior and serves as a valuable sensitivity check. Specifically, ROA volatility is measured as the standard deviation of ROA over a rolling five-year window, requiring at least three non-missing ROA observations within each window to ensure reliable estimation. Observations lacking sufficient data were excluded.

Additional robustness tests include re-estimating the model with contemporaneous ESG scores and with ESG scores lagged by two years, allowing an assessment of result stability under different temporal assumptions. Furthermore, results from the full sample were compared to those from a restricted sample excluding firms with missing ESG data to examine potential selection bias.

Beyond these robustness checks, heterogeneity analyses were conducted to assess whether the ESG-risk relationship varies across individual ESG pillars and industry sectors. These additional tests offer deeper insights into the mechanisms behind the observed effects and strengthen the generalizability of the findings. Finally, to ensure transparency and reproducibility, the operationalization of each variable is described in detail below.

[1] See Table 3 in the Appendix

3.4 Variable Operationalization

Net leverage is calculated as total liabilities minus cash and short-term investments, scaled by total assets. Total liabilities include both short- and long-term financial obligations, while cash and short-term investments reflect each pillar of a firm's liquidity buffer. Total assets capture the overall size and resource capacity of the firm. This measure, following Faccio et al. (2011), Bernile et al. (2017), and He et al. (2023), reflects a firm's reliance on debt financing relative to its liquidity and asset base.

ESG performance is measured using the Refinitiv ESG score, which aggregates a firm's self-reported environmental, social, and governance data into an annual composite score. The overall score is derived from three pillar scores. The environmental pillar includes indicators like emissions, resource management, and innovation. The social pillar encompasses human rights, community involvement, product responsibility, and workforce practices. The governance pillar assesses management structure, shareholder rights, CSR strategy, and transparency. Each pillar is weighted relative to industry peers, in line with academic standards (Drempetic et al., 2020).

Firm size is measured as the natural logarithm of total assets, a standard approach that reduces skewness and facilitates comparability across firms (Drempetic et al., 2020; Martinez et al., 2024). To aid interpretation and mitigate multicollinearity in the interaction term, the log-transformed firm size variable is mean-centered. The interaction term is then constructed by multiplying the ESG score by the centered firm size variable.

Firm age is measured as years since founding and left untransformed for interpretability, with each unit representing a one-year increase in maturity. A log transformation was avoided due to the substantial presence of firms with an age of zero, which would result in undefined values. The wide range of firm ages supports estimation without transformation.

ROA is calculated as net income divided by total assets, serving as a measure of profitability and operational efficiency. Net income is measured before extraordinary items and preferred dividends to ensure consistency across firms.

The market-to-book (MTB) ratio serves as a proxy for growth opportunities and is calculated by dividing market capitalization by the book value of common equity. Market capitalization is the total value of outstanding shares at fiscal year-end, while book value includes common stock, retained earnings, and capital surplus. To reduce skewness and limit the influence of outliers, the MTB ratio is log-transformed to improve comparability and interpretability in the regression analysis.

4 Results

This chapter presents the empirical findings of the regression analysis, examining the relationship between ESG performance and corporate financial risk-taking. It reports the statistical significance and economic relevance of the estimated coefficients, with a particular focus on the interaction between ESG performance and firm size. The results are organized into three sections: baseline regressions, robustness checks, and heterogeneity analyses. They are interpreted in light of existing literature and their policy implications.

4.1 Baseline Regression Results

Table 4 presents the results of two fixed-effects regression models. Model (1) estimated the baseline relationship between ESG performance and financial risk-taking, while Model (2) extended this specification by including an interaction term between ESG performance and firm size.

Table 4. Two-Way Fixed Effects Estimation Result

	Dependent variable:	
	Net Leverage	
	(1)	(2)
ESG_1	-0.005***	-0.001**
	(0.0002)	(0.0003)
Firm Size	-0.062***	-0.059***
	(0.009)	(0.005)
Inter_1		-0.007**
		(0.001)
AGE	-0.173***	-0.173***
	(0.015)	(0.015)
ROA	-0.473***	-0.472***
	(0.138)	(0.139)
MTB	0.106***	0.106***
	(0.005)	(0.005)
Observations	10,355	10,355
R2	0.213	0.214
Adjusted R2	0.143	0.143
Note:	*p**p***p<0.01	

The one-year lagged ESG score showed a negative and statistically significant association with financial risk-taking in both Model (1) and Model (2). In Model (1), which excluded the interaction term, the coefficient on ESG is approximately -0.005, suggesting that firms with stronger ESG performance tended to adopt more conservative financial strategies by maintaining lower levels of net leverage. A 10-point increase in ESG score was associated with a reduction in net leverage of approximately 5 percentage points. Given the sample average net leverage of 0.434, this represented a considerable decline in risk exposure.

In Model (2), which includes the interaction term, the main effect of ESG remained negative but was smaller in magnitude. Because firm size was mean-centered, this coefficient reflected the effect on an average-sized firm. The reduction from -0.005 to -0.001 suggests part of ESG's effect operated through its interaction with firm size. This is analyzed in greater detail below.

These baseline results aligned with theoretical expectations and prior evidence that positioned ESG as a risk-mitigating factor. In particular, they supported the risk-reduction perspective found in He et al. (2023) and Jo and Na (2012), who argued that higher ESG performance encourages more conservative risk-taking behavior. This is also consistent with Godfrey's (2005) concept of moral capital, wherein firms with strong ESG reputations build stakeholder goodwill that protects them against adverse shocks, thereby reducing the need for risky strategies. Nevertheless, while the direction of the effect was consistent with earlier studies, the estimated coefficient in this analysis was smaller than the 0.5% reduction in risk per ESG unit reported by He et al. (2023), suggesting a more modest effect of about 0.05% per unit. This smaller magnitude might reflect contextual differences, as U.S. and European firms typically operate in more mature ESG environments with well-established stakeholder expectations. These may moderate the incremental impact of ESG improvements.

The coefficient of Firm Size was negative and highly significant in both models, indicating that larger firms, all else equal, tended to maintain lower net leverage. As firm size increased, firms appeared to rely less on debt relative to their assets. This pattern is consistent with Faccio et al. (2011), who suggested that larger firms adopt a more conservative financial posture due to greater access to internal funds, enhanced financing capacity, and more diversified revenue streams. Within the ESG framework, Drempetic et al. (2020) argued that larger firms are also more likely to invest in sustainability initiatives. As a result, the negative association between firm size and net leverage not only confirmed the role of a firm's size as a determinant of financial conservatism but also complemented the ESG findings by demonstrating how structural firm characteristics influence risk behavior.

The control variables behaved as expected and were statistically significant across both specifications. Firm age had a negative coefficient, implying that older firms typically adopted more conservative capital structures. These more mature firms, with established reputations and stable earnings, were less reliant on debt financing and less inclined to pursue high-risk growth strategies. This was consistent with the findings of He et al. (2023). Return on assets (ROA) also showed a negative and significant relationship with net leverage, with an estimated coefficient of approximately -0.47, suggesting that more profitable firms took on less financial risk. Specifically, a one-percentage-point increase in ROA was associated with a 0.0047 decrease in net leverage, equating to roughly a half-percentage-point reduction. This supported the widely accepted notion that profitable firms rely more on internal resources and exhibit lower financial risk exposure (Krüger, 2014). By contrast, the market-to-book (MTB) ratio displayed a positive coefficient of 0.106, indicating that firms with higher growth opportunities or valuations tended to assume greater financial risk. In concrete terms, a one-unit increase in MTB was associated with a 0.106 increase in net leverage. This result reflected the idea that growth-oriented firms often use more leverage to finance expansion and operate with thinner cash buffers, consistent with Faccio et al. (2011). Overall, the significance of these controls reinforced the role of firm-level characteristics in explaining financial risk-taking, independent of ESG performance.

Building on these baseline findings, it is useful to interpret the role of the interaction term in more detail. The interaction term in Model (2) was negative and statistically significant, with a coefficient of -0.007. This confirmed that the relationship between ESG performance and financial risk-taking was moderated by firm size. In particular, as firm size increased, the negative effect of ESG on net leverage became stronger. In other words, while ESG engagement was generally associated with lower financial risk, this effect was more pronounced among larger firms. The marginal effect of ESG on net leverage could be expressed as:

$$(3)\ \frac{d(RiskTaking_{it})}{d(ESG_{it-1})} = \beta_1 + \beta_3 * Firm\ Size_{it}$$

Substituting the estimated coefficients yields:

$$(4)\ \frac{d(RiskTaking_{it})}{d(ESG_{it-1})} = -0.001 - 0.007 * Firm\ Size_{it}$$

This equation demonstrated that the marginal effect of ESG became increasingly negative with firm size. However, for firms smaller than average (i.e., with negative mean-centered size), the marginal effect turned positive. This unexpected result implied that, contrary to the risk-reducing role of ESG in larger firms, ESG engagement could actually encourage risk-taking in smaller firms.

Figure 1 visualizes this relationship by plotting the marginal effect of ESG on net leverage across the distribution of mean-centered firm size. The downward-sloping line shows that for smaller firms, ESG is associated with higher net leverage, while for larger firms, ESG has a progressively stronger risk-reducing effect. These findings underscore that the financial impact of ESG is highly contingent on firm size.

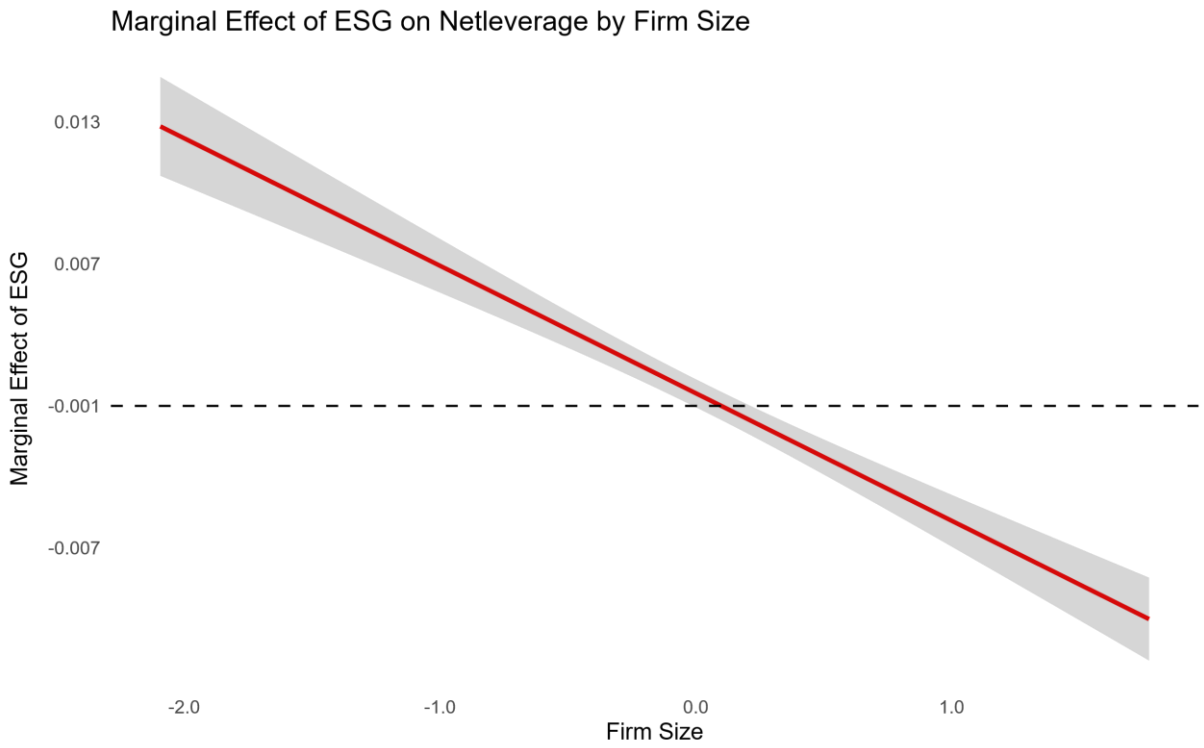

Figure 1. ESG Impact on Risk Across Firm Size

To evaluate the economic magnitude of this effect, the marginal effect was multiplied by the standard deviation of ESG in the sample (19.231), resulting in:

(5) $(\beta_1 + \beta_3 * Firm\ Size_{it}) * 19.231$

For an average-sized firm, a one-standard-deviation improvement in ESG reduced net leverage by 1.9 percentage points (-0.019), equivalent to about 4% of the sample mean. For a large firm (one standard deviation above the mean), the same ESG improvement was associated with a 20.4 percentage-point reduction in net leverage (-0.20), nearly half of the average leverage level. Conversely, for a small firm (one standard deviation below the mean), ESG increases net leverage by 16.1 percentage points (+0.16), indicating a risk-enhancing effect. These results revealed a steep gradient in ESG's financial consequences across the size distribution.

This conditional pattern supported the emerging view of ESG as a double-edged sword (Teng et al., 2023). Larger firms appeared to embed ESG more genuinely into their governance structures, reinforcing its risk-reducing function. In contrast, smaller firms might use ESG more symbolically to attract external capital or stakeholder approval rather than implementing substantive governance changes (Kruger, 2014). This echoed Dunbar et al.'s (2020) argument on ESG-enhanced risk capacity, where ESG credibility could embolden firms to pursue bolder financial strategies. In this sense, the positive marginal effects for smaller firms resembled a moral licensing mechanism, in which ESG engagement provides a reputational shield to justify higher leverage.

Overall, these results challenge the assumption that ESG universally reduces risk and highlight the context dependence of its effects. While the dominant view in the literature frames ESG as a risk-mitigating mechanism (He et al., 2023; Jo & Na, 2012), these findings indicated that this role is mainly relevant for larger firms. For smaller firms, ESG engagement may not only fail to reduce risk but may even incentivize more aggressive financial behavior. This underscores the importance of considering firm heterogeneity when evaluating ESG's financial implications.

Overall, the baseline results provide partial confirmation of Hypothesis 1 and strong support for Hypothesis 2. Specifically, higher ESG performance was associated with lower financial risk-taking among large firms, consistent with the idea that ESG serves as a risk-mitigating mechanism. This negative relationship echoes prior evidence that ESG and CSR practices can foster financial conservatism by strengthening stakeholder trust and reducing downside risk (He et al., 2023; Jo & Na, 2012).

However, for smaller firms, the findings revealed the opposite pattern, contradicting Hypothesis 1. This positive association supports arguments that ESG can act as a reputational shield, providing managers with the confidence or perceived moral license to pursue bolder, riskier financial strategies (Dunbar et al., 2020). These contrasting patterns between small and large firms highlight the context-dependent nature of ESG's impact on corporate risk-taking. This aligns with conditional and nonlinear perspectives in the literature.

One interpretation is that large firms engage in ESG more substantively, integrating sustainability into governance structures and thereby achieving risk reduction. In contrast, smaller firms may adopt ESG more symbolically, using sustainability credentials to attract investors or satisfy stakeholders while simultaneously increasing leverage or risk-taking elsewhere. Differences from previous studies, such as the strong negative ESG-risk relationship reported by He et al. (2023) versus the positive association identified by Dunbar et al. (2020),

could reflect variations in ESG implementation depth, institutional environments, and, crucially, firm size heterogeneity.

Taken together, these results contribute novel empirical insights by demonstrating that the relationship between ESG performance and financial risk-taking systematically varies across firm size. This challenges the dominant narrative in the ESG literature that sustainability practices universally reduce risk. Instead, the findings underscore that ESG's benefits depend on the sincerity of its implementation and on structural firm characteristics.

By bridging the negative, positive, and conditional perspectives reviewed earlier, this study emphasizes the importance of accounting for firm heterogeneity when evaluating ESG's role in financial risk-taking. Future research should explore these boundary conditions further, identifying when and why ESG engagement functions as a risk mitigant versus a risk amplifier.

4.2 Robustness Analysis

To verify the reliability of the baseline results, this section presents a series of robustness checks. These tests evaluate whether the observed relationship holds under alternative model specifications, sample restrictions, and risk proxies. Specifically, the analysis considers different ESG timing assumptions, excludes firms with missing ESG data, and applies an alternative risk measure based on ROA volatility. Together, these checks assess the consistency and generalizability of the main findings.

Table 5 reports the results of a robustness check examining the sensitivity of the ESG-risk relationship to different timing assumptions. Models (3) and (4) employ contemporaneous ESG scores (ESG_0), while Models (5) and (6) use ESG scores lagged by two years (ESG_2). For each timing variant, the interaction term with firm size was recalculated. This approach directly addresses potential reverse causality concerns and allows for the possibility that ESG effects may materialize over varying time horizons, as noted by Bao et al. (2024).

Table 5. Alternative ESG Timing Specifications

	Dependent variable:			
	Net Leverage			
	(3)	(4)	(5)	(6)
ESG_0	-0.0006*	0.0003		
	(0.0002)	(0.0002)		
ESG_2			-0.0004*	-0.0004
			(0.0002)	(0.0003)
Firm Size	-0.063***	-0.058***	-0.053***	-0.051***
	(0.011)	(0.014)	(0.009)	(0.012)
Inter_0		-0.0001		
		(0.0001)		
Inter_2				0.0005
				(0.0018)
AGE	-0.168***	-0.168***	-0.001	-0.001
	(0.015)	(0.015)	(0.071)	(0.072)
ROA	-0.471***	-0.470***	-0.499**	-0.499**
	(0.138)	(0.139)	(0.155)	(0.155)
MTB	0.106***	0.106***	0.109***	0.109***
	(0.005)	(0.005)	(0.006)	(0.006)
Observations	10,389	10,389	9,533	9,533
R^2	0.214	0.214	0.196	0.196
Adjusted R^2	0.143	0.143	0.116	0.116
Note:				*p**p***p<0.01

The results support the use of a one-year lag for ESG scores in the baseline model. In Model (3), ESG_0 displayed a negative but only weakly significant coefficient, while in Model (4), the effect turned positive and insignificant once the interaction term was added. This instability in sign and significance suggests that contemporaneous ESG measures may suffer from endogeneity or reflect stakeholder reactions that have not yet fully materialized.

A similar pattern emerged for the two-year lagged models. ESG_2 was negative and marginally significant in Model (5) but became statistically insignificant in Model (6). Compared to the baseline one-year lag, these estimates were smaller in magnitude and less consistent across specifications. Additionally, the interaction terms in Models (4) and (6) were statistically insignificant, indicating that firm size moderated the relationship only at the one-year lag. These results support the notion that ESG effects on risk-taking are neither immediate nor long-lasting but most clearly emerge after one year, consistent with He et al. (2023).

In sum, this analysis confirms that using a one-year lag for ESG scores is the most appropriate timing choice. The one-year lag aligns with theoretical expectations and the observed temporal pattern of ESG's influence, reducing concerns about reverse causality and capturing a delayed, yet meaningful, effect on financial risk-taking.

In addition to testing timing assumptions, a sensitivity analysis was conducted by excluding all firms with any missing ESG values during the 2010-2022 period. This exclusion reduced the sample from 859 to 590 firms, eliminating 1,852 observations. The goal of this test was to reduce potential biases introduced by unbalanced panel data and verify whether the results hold for a strictly balanced sample with complete ESG reporting.

Table 6. Sensitivity Analysis: Exclusion of Firms with Missing ESG Scores

	Dependent variable:			
	Net Leverage			
	(1)	(2)	(7)	(8)
	All Firms		Omitted Firms	
ESG_1	-0.005***	-0.001**	-0.001***	-0.0006**
	(0.0002)	(0.0003)	(0.0004)	(0.0004)
Firm Size	-0.062***	-0.059***	-0.061***	-0.061***
	(0.009)	(0.005)	(0.011)	(0.017)
Inter_1		-0.007**		-0.005**
		(0.001)		(0.002)
AGE	-0.173***	-0.173***	-0.165***	-0.164***
	(0.015)	(0.015)	(0.018)	(0.019)
ROA	-0.473***	-0.472***	-0.468**	-0.468**
	(0.138)	(0.139)	(0.145)	(0.146)
MTB	0.106***	0.106***	0.109***	0.109***
	(0.005)	(0.005)	(0.006)	(0.006)
Observations	10,355	10,355	8,503	8,503
R^2	0.213	0.214	0.219	0.219
Adjusted R^2	0.143	0.143	0.159	0.159
Note:				*p **p ***p<0.01

The estimates from Models (7) and (8), which replicate the main regressions on the balanced sample, remained consistent in both sign and statistical significance. The ESG coefficient remained negative and significant, and the interaction term retained a similar magnitude and significance. Firm size and the control variables also maintain their expected signs and high statistical significance. Although the sample size was reduced, the R^2 and adjusted R^2 remained stable, confirming that the main findings were robust to sample restrictions. The results strengthen confidence that the baseline conclusions were not driven by missing ESG data and are valid even under a stricter balanced-panel specification.

Finally, the robustness analysis employed an alternative risk proxy by replacing net leverage with ROA volatility. As described in the methodology, ROA volatility captures the standard deviation of profitability over time, reflecting instability in operational performance rather than leverage-based risk. This complements the baseline analysis by testing whether ESG performance also affects earnings risk.

Table 7. Alternative Risk Proxy Using ROA Volatility

	Dependent variable:	
	ROA Volatility	
	(9)	(10)
ESG_1	-0.0006*	-0.0004
	(0.0004)	(0.0003)
Firm Size	-0.011***	-0.016***
	(0.001)	(0.002)
Inter_1		-0.0001
		(0.00003)
AGE	-0.001***	-0.001***
	(0.0002)	(0.0001)
ROA	-0.079***	-0.080***
	(0.02)	(0.006)
MTB	0.0004	0.001
	(0.001)	(0.001)
Observations	7,063	7,063
R^2	0.051	0.045
Adjusted R^2	-0.070	-0.076
Note:		*p**p***p<0.01

In Model (9), ESG displayed a negative but only marginally significant association with ROA volatility, suggesting that higher ESG performance may modestly stabilize profitability. This aligns with a risk-mitigating view. However, Model (10), which included the interaction term, found no significant effects for either ESG or the interaction, and the coefficients were small in magnitude. Additionally, the adjusted R^2 for both models was negative, indicating poor model fit and weak explanatory power.

These results contrast with the baseline findings based on net leverage, where ESG and its interaction with firm size showed significant and economically meaningful effects. One explanation, supported by John et al. (2008) and Teng et al. (2023), is that ROA volatility captures idiosyncratic earnings-based risk, which ESG engagement may not influence as strongly as leverage-based risk. Particularly for large firms, ESG initiatives may primarily affect financing structures rather than short-term profitability.

In conclusion, while the direction of the coefficients in the ROA volatility models generally aligned with the baseline, their lack of significant and small magnitudes suggests that the risk-reducing effect of ESG is not robust across all risk measures. These findings indicate that ESG's influence on corporate risk-taking in this study is best interpreted through a leverage-based lens, and they caution against the assumption that ESG automatically stabilizes all dimensions of financial risk.

4.3 Heterogeneity Analysis

This section investigates whether the relationship varies across ESG sub-pillars and industry sectors. Analyzing the environmental, social, and governance dimensions separately helps clarify which aspects of ESG most strongly drive the observed effects. Additionally, exploring industry-specific patterns can reveal whether sectoral characteristics influence how ESG practices affect corporate risk. These heterogeneity analyses deepen the understanding of the underlying mechanisms and enhance the validity of the main findings.

Table 8 presents results for the environmental, social, and governance pillars analyzed separately. Each pillar was lagged by one year, consistent with the baseline specification, and new interaction terms were constructed by multiplying each pillar score by firm size. Slightly fewer observations were available for the environmental pillar due to missing score data, but the sample remained broadly comparable.

Table 8. Heterogeneity Analysis: ESG Sub-Pillar Effects on Net Leverage

	Dependent variable:					
	Net Leverage					
	(11)	(12)	(13)	(14)	(15)	(16)
	Environment		Social		Governance	
Environment	-0.003***	-0.001**				
	(0.0002)	(0.0002)				
Social			-0.006***	-0.004***		
			(0.0002)	(0.0002)		
Governance					0.0003	0.00003
					(0.001)	(0.001)
Firm Size	-0.060***	-0.059***	-0.061***	-0.053***	-0.059***	-0.059***
	(0.004)	(0.003)	(0.009)	(0.012)	(0.009)	(0.01)
Inter_E		-0.001**				
		(0.001)				
Inter_S				-0.003***		
				(0.001)		
Inter_G						0.00001
						(0.001)
AGE	-0.174***	-0.174***	-0.176***	-0.176***	-0.172***	-0.172***
	(0.016)	(0.017)	(0.015)	(0.015)	(0.015)	(0.015)
ROA	-0.442**	-0.442**	-0.473***	-0.471***	-0.474***	-0.474***
	(0.142)	(0.142)	(0.138)	(0.139)	(0.138)	(0.138)
MTB	0.104***	0.104***	0.106***	0.107***	0.106***	0.106***
	(0.006)	(0.006)	(0.005)	(0.005)	(0.005)	(0.05)
Observations	9,842	9,842	10,355	10,355	10,355	10,355
R^2	0.207	0.207	0.213	0.214	0.202	0.202
Adjusted R^2	0.131	0.131	0.142	0.143	0.128	0.128
Note:						*p**p***p<0.01

The results indicate that both the environmental and social pillars were negatively and significantly associated with net leverage, suggesting that firms engaging in these dimensions tend to adopt more conservative financial strategies. Specifically, the environmental pillar showed coefficients of -0.003 without the interaction and -0.001 with the interaction, indicating a modest risk-reducing effect. The social pillar demonstrated an even stronger negative association, with

coefficients of -0.006 and -0.004, implying that practices related to workforce well-being and community engagement may be especially effective in limiting risk-taking.

In contrast, the governance pillar displayed no significant effect on net leverage in any specification, with coefficients close to zero. This finding is somewhat unexpected, given that governance is typically considered the most relevant pillar for risk control (Albuquerque et al., 2018). A plausible explanation is that governance practices in large, publicly listed firms are already highly standardized, reducing their marginal influence on financial risk (Bouslah et al., 2012).

The interaction terms further confirmed that the moderating role of the firm's size was strongest for the environmental and social pillars. The significant negative interactions indicated that larger firms benefited more from the risk-reducing effects of these subdimensions, consistent with the baseline results. By contrast, the interaction for governance was insignificant, reinforcing the notion that governance-related risk dynamics do not meaningfully vary by firm size within this sample. This suggests that governance structures in developed markets are relatively stable, while environmental and social practices vary more depending on firm scale and stakeholder expectations.

Overall, this sub-pillar analysis demonstrates that the risk-reducing influence of ESG performance is primarily driven by its environmental and social dimensions, with the effects most pronounced among larger firms. These insights add nuance to the baseline results and underscore the value of disaggregating ESG into its components to better understand its role in shaping corporate risk-taking.

To complement the sub-pillar findings, the analysis next explores whether the ESG-risk relationship varies by industry. Specifically, the baseline regression was re-estimated separately for each industry, and the resulting ESG coefficients are plotted with 95% confidence intervals to visualize industry-specific variation. This approach reveals whether ESG engagement has a consistent effect on risk across industries or whether sectoral characteristics shape its impact.

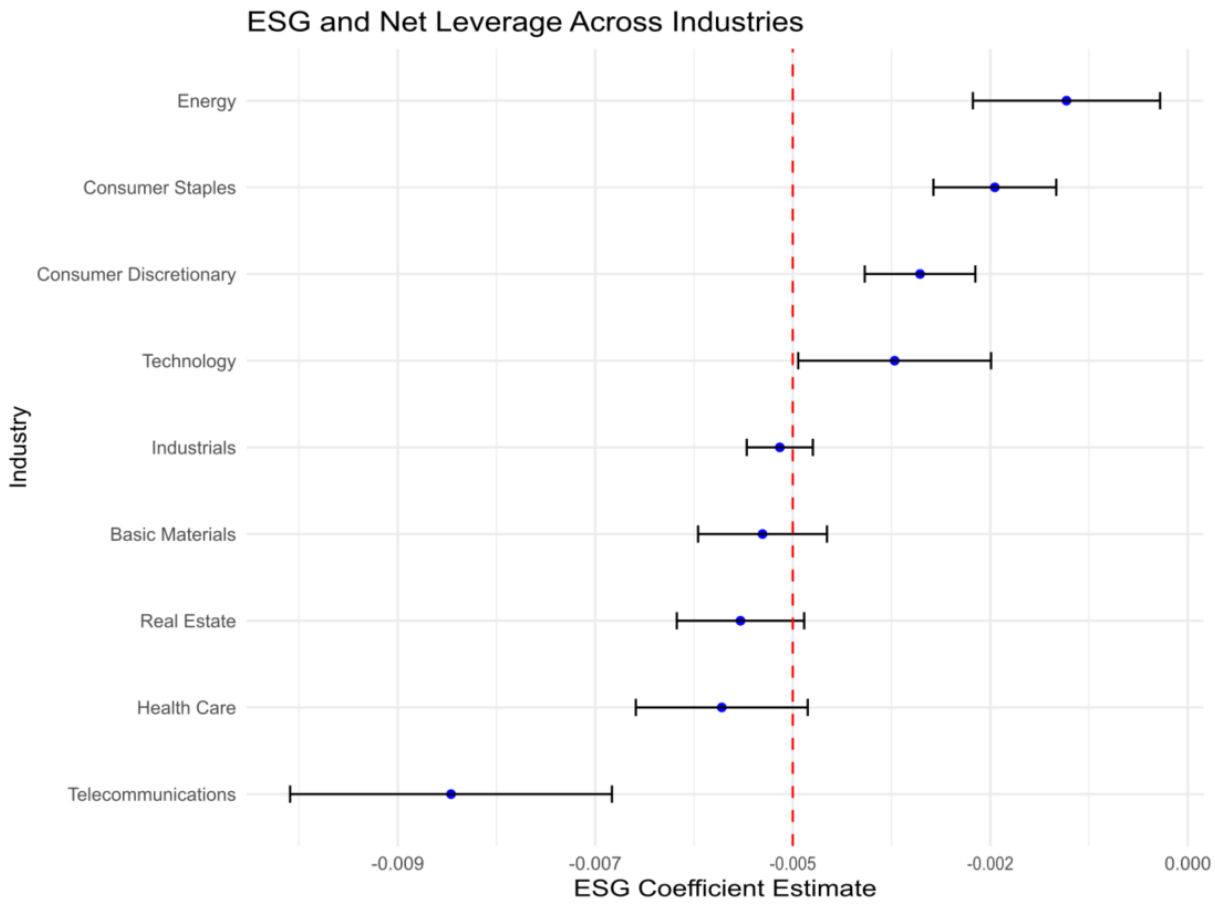

Figure 2. Industry-Specific ESG Effects on Net Leverage

Figure 2 illustrates considerable variation in the magnitude of ESG's effect on net leverage across industries. The red-dotted line represents the ESG coefficient estimated in the baseline Model (1). Telecommunications and Health Care exhibited relatively strong negative coefficients, suggesting that ESG engagement in these sectors was associated with pronounced reductions in financial risk-taking. These industries tend to be highly visible, subject to elevated stakeholder expectations, or face significant reputational pressures (Jo & Na, 2012; Bouslah et al., 2012). However, it is important to note that the Telecommunications sector displayed wider confidence intervals due to fewer observations and greater data volatility, indicating lower precision in those subsample estimates.

By contrast, sectors such as Energy and Consumer Staples showed ESG coefficients close to zero, implying that ESG initiatives there had little or no effect on leverage decisions in these contexts. This may reflect industry-specific factors, such as high capital intensity or stable cash flow patterns, which reduce the marginal influence of ESG (Teng et al., 2023).

Technology and Consumer Discretionary industries showed moderately negative ESG coefficients but with wider confidence intervals, suggesting a potential risk-reducing effect accompanied by greater uncertainty. This could be explained by the growth-oriented and

innovation-driven characters of these industries, where ESG engagement coexists with a higher appetite for risk (Teng et al., 2023).

Taken together, this industry analysis indicates that while ESG performance is generally associated with reduced net leverage, the magnitude of this effect differs across sectors. Most industries clustered around the baseline coefficient, supporting a broadly consistent average relationship, but with clear sector-specific deviations. Sectoral regulatory environments, stakeholder scrutiny, and strategic ESG positioning all appear to shape how effectively ESG translates into more conservative financial strategies. This is consistent with Bouslah et al. (2012), who argued that industry norms and reputational visibility influence the financial materiality of ESG engagement. Sectors with high reputational risk may experience stronger ESG-driven risk reductions, in line with Godfrey's (2005) moral capital argument. Conversely, structurally conservative industries might exhibit minimal ESG effects on leverage, echoing Teng et al.'s (2023) findings on ESG's diminished marginal impact in resource-intensive settings. These findings emphasize the importance of accounting for industry heterogeneity when evaluating ESG outcomes. Applying a uniform ESG framework without sector-specific considerations risks overlooking important differences in how ESG practices influence corporate financial strategies.

Collectively, the heterogeneity analyses show that ESG's influence on corporate risk-taking is highly contextual, aligning with, but also extending, the mixed and conditional patterns reported in the literature. These results confirm the need for nuanced ESG frameworks and policies that explicitly account for differences in firm size, sectoral characteristics, and institutional contexts, as highlighted in the literature review.

5 Conclusion and Discussion

This thesis explored how ESG performance influences corporate financial risk-taking, with particular attention to the moderating role of firm size. The central research question examined whether high ESG performance reduces financial risk-taking and whether this relationship differs depending on firm size. The theoretical framework drew on stakeholder theory, resource-based theory, and the concept of ESG as a form of reputational or moral insurance (Godfrey, 2005; Jo & Na, 2012). Prior studies provided important empirical foundations. He et al. (2023) documented a negative ESG-risk relationship in Chinese listed firms, while Dunbar et al. (2020) highlighted conditions under which ESG may increase risk-taking incentives.

Drempetic et al. (2020) further emphasized the relevance of firm size in moderating ESG outcomes. Building on these perspectives, this thesis formulated two hypotheses: (1) higher ESG performance is negatively associated with corporate financial risk-taking, and (2) this risk-reducing effect of ESG is stronger for larger firms.

The results provide partial support for Hypothesis 1, demonstrating that higher ESG performance is generally associated with more conservative financial behavior and reduced risk-taking. However, this risk-mitigating effect was predominantly present among firms above average size, lending strong support to Hypothesis 2. The analysis also revealed that smaller firms exhibited a positive relationship between ESG performance and financial risk-taking. This suggests that while larger firms use ESG initiatives to strengthen stakeholder trust and pursue risk-averse strategies, smaller firms may adopt ESG practices more symbolically, using them as a form of reputational insurance to justify riskier behavior. The robustness check indicated that these relationships held consistently only when using net leverage as the risk proxy, whereas alternative risk measures produced fewer stable results. Additional heterogeneity analyses across industries and ESG sub-pillars further emphasized the complexity and context-dependence of the ESG-risk relationship.

Beyond these empirical findings, this research contributes to the academic debate in several important ways. First, by analyzing firms from both the U.S. and Europe, it extends the literature beyond single-country studies and highlights regional variation in ESG impacts. Second, the study explicitly examines firm size as a moderating factor, moving beyond previous research that typically treats size as a control variable. Third, the findings reveal that ESG's influence on financial risk-taking is heterogeneous rather than uniform. Specifically, ESG appears to stabilize corporate behavior primarily under certain organizational conditions. This nuanced perspective helps reconcile mixed results in earlier studies and supports framing ESG as a strategic risk-management tool, rather than solely a reputational mechanism.

In addition to academic contributions, the results carry several implications for practice. For policymakers and regulators, the key implication of these findings is that ESG policies can enhance financial stability but should be adapted to firm-specific contexts. Mandating or incentivizing ESG reporting for large firms appears justified, given their greater capacity to integrate ESG effectively. At the same time, offering training, guidelines, or other forms of support could help smaller firms develop meaningful ESG practices rather than purely symbolic initiatives. It is important to recognize that ESG should not be dismissed as mere "greenwashing," but rather acknowledged as a potentially systematic tool for managing financial risk.

For asset managers and investors, the results reinforce that ESG metrics can serve as valuable signals of risk-taking behavior. Portfolio managers and risk officers should incorporate ESG scores into their risk assessments, particularly for large firms where ESG efforts more reliably translate into lower risk-taking. Investors may consider tilting portfolios to large firms with strong ESG profiles to reduce volatility exposure. However, when evaluating smaller firms, ESG scores should be interpreted with caution and supplemented by deeper due diligence, as these firms may use ESG initiatives as a reputational buffer while maintaining higher risk-taking.

Corporate managers should view ESG engagement as a strategic component of financial risk management. Managers of large firms can build existing governance structures to further embed ESG practices, strengthening stakeholder trust and reducing incentives for excessive risk-taking. Smaller firms, meanwhile, should prioritize developing substantive ESG initiatives while guarding against treating ESG reputations as a license to pursue more aggressive financial strategies. Taken together, these insights advance our empirical understanding of when and how ESG performance creates value by reducing corporate financial risk. Ultimately, this thesis offers a more nuanced perspective, showing that ESG's risk-mitigating benefits depend on firm size, stakeholder context, and implementation depth.

Despite its contributions, this study has several important limitations. Because the analysis focuses on publicly listed firms in the U.S. and Europe, the results may not generalize to emerging markets, developing economies, or privately held firms. Like much ESG research, the findings rely on one ESG score provider, and rating methodologies can differ substantially across agencies, potentially affecting comparability. Moreover, the study primarily uses net leverage as a proxy for financial risk-taking, which captures only a specific dimension of risk. Alternative risk measures did not yield consistent or robust results, indicating that the conclusions are most relevant to leverage-based risk behavior only. Additionally, not all robustness checks confirmed the findings with equal strength, and nonlinear dynamics or unobserved interaction effects might still be present. The true ESG-risk relationship may be stronger or weaker under different conditions, and generalization beyond the studied sample should be approached carefully. Readers should interpret these results as evidence within a specific empirical and institutional context rather than a universal conclusion.

Future research should extend this analysis in several promising directions. First, examining the ESG-risk relationship in broader geographic and institutional settings, such as emerging or frontier markets, could reveal how local regulatory environments and stakeholder expectations influence this dynamic. Studying privately held or family-owned firms through surveys or case

studies might uncover different patterns of ESG commitment and risk profiles. Including industry-specific controls or conducting sector-by-sector analyses would further help clarify nuances. Third, disaggregating ESG into environmental, social, and governance sub-pillars could enrich understanding of which dimensions most strongly drive risk-taking behavior. Similarly, future research might investigate how ESG-linked innovation and strategic initiatives mediate risk outcomes. Additionally, employing more rigorous causal identification strategies, such as natural experiments or difference-in-difference designs around policy changes, would strengthen the validity of findings in this field. Finally, while this study focused on relatively short-term risk measures, future work could examine long-term outcomes such as bankruptcy rates, credit spreads, or multi-year stock performance, and investigate how the ESG-risk relationship evolves over time. This is especially relevant considering climate-related risks becoming more pronounced. In sum, this thesis has laid the groundwork for a more nuanced and contextual understanding of ESG's role in shaping corporate financial risk-taking, offering a solid platform for future scholarship to build upon.

References

Albuquerque, R., Koskinen, Y., & Zhang, C. (2018). Corporate Social Responsibility and Firm Risk: Theory and Empirical Evidence. *Management Science*, *65*(10), 4451–4469. https://doi.org/10.1287/mnsc.2018.3043

Ali, F. M., Wu, Y., & Zhang, X. (2023). ESG disclosure, CEO power and incentives and corporate risk-taking. *European Financial Management*, *30*(2), 961–1011. https://doi.org/10.1111/eufm.12447

Bagh, T., Khan, M. A., Naseer, M. M., & Iftikhar, K. (2024). Does financial flexibility drive firm's risk-taking in emerging markets? The moderating role of investment efficiency. *Managerial And Decision Economics*, *45*(8), 5541–5561. https://doi.org/10.1002/mde.4337

Bao, X., Sadiq, M., Tye, W., & Zhang, J. (2024). The impact of environmental, social, and governance (ESG) rating disparities on corporate risk: The mediating role of financing constraints. *Journal Of Environmental Management*, *371*, 123113. https://doi.org/10.1016/j.jenvman.2024.123113

Bernile, G., Bhagwat, V., & Yonker, S. (2017). Board diversity, firm risk, and corporate policies. *Journal Of Financial Economics*, *127*(3), 588–612. https://doi.org/10.1016/j.jfineco.2017.12.009

Bissoondoyal-Bheenick, E., Brooks, R., & Xuan, H., DO. (2023). ESG and firm performance: The role of Size and media channels. *Economic Modelling*, *121*, 106203. https://doi.org/10.1016/j.econmod.2023.106203

Borghesi, R., Houston, J. F., & Naranjo, A. (2014). Corporate socially responsible investments: CEO altruism, reputation, and shareholder interests. *Journal Of Corporate Finance*, *26*, 164–181. https://doi.org/10.1016/j.jcorpfin.2014.03.008

Bourne, E., Schlich, B., & Dodsworth, C. (2024). Made to Measure: Indicator Construction and Measurement Scales in ESG Score Design. *The Journal Of Impact And ESG Investing*, *5*(1), 148–175. https://doi.org/10.3905/jesg.2024.1.108

Bouslah, K., Kryzanowski, L., & M'Zali, B. (2012). The impact of the dimensions of social performance on firm risk. *Journal Of Banking & Finance*, *37*(4), 1258–1273. https://doi.org/10.1016/j.jbankfin.2012.12.004

Drempetic, S., Klein, C., & Zwergel, B. (2020). The Influence of Firm Size on the ESG Score: Corporate Sustainability Ratings Under Review. *Journal of Business Ethics*, *167*(2), 333–360. https://doi.org/10.1007/s10551-019-04164-1

Dunbar, C., Li, Z., & Shi, Y. (2020). CEO risk-taking incentives and corporate social responsibility. *Journal Of Corporate Finance*, *64*, 101714. https://doi.org/10.1016/j.jcorpfin.2020.101714

Eccles, R. G., Ioannou, I., & Serafeim, G. (2014). The Impact of Corporate Sustainability on Organizational Processes and Performance. *Management Science*, *60*(11), 2835–2857. https://doi.org/10.1287/mnsc.2014.1984

Faccio, M., Marchica, M., & Mura, R. (2011). Large Shareholder Diversification and Corporate Risk-Taking. *Review Of Financial Studies*, *24*(11), 3601–3641. https://doi.org/10.1093/rfs/hhr065

Faccio, M., Marchica, M., & Mura, R. (2016). CEO gender, corporate risk-taking, and the efficiency of capital allocation. *Journal Of Corporate Finance*, *39*, 193–209. https://doi.org/10.1016/j.jcorpfin.2016.02.008

Frecautan, I., & Nita (Danila), A. (2022). Who is going to win: The EU ESG regulation or the rest of the world? – A critical review. *The Annals of the University of Oradea, Economic Sciences*

Gallo, P. J., & Christensen, L. J. (2011). Firm Size Matters: An Empirical Investigation of Organizational Size and Ownership on Sustainability-Related Behaviors. *Business & Society*, *50*(2), 315–349. https://doi.org/10.1177/0007650311398784

Godfrey, P. C. (2005). The relationship between corporate philanthropy and shareholder wealth: A Risk Management perspective. *Academy Of Management Review*, *30*(4), 777–798. https://doi.org/10.5465/amr.2005.18378878

Godfrey, P. C., Merrill, C. B., & Hansen, J. M. (2008). The relationship between corporate social responsibility and shareholder value: an empirical test of the risk management hypothesis. *Strategic Management Journal*, *30*(4), 425–445. https://doi.org/10.1002/smj.750

Guest, P. M. (2021). Risk Management in Financial Institutions: a replication. *The Journal Of Finance*, *76*(5), 2689–2707. https://doi.org/10.1111/jofi.13063

He, F., Ding, C., Yue, W., & Liu, G. (2023). ESG performance and corporate risk-taking: Evidence from China. International Review Of Financial Analysis, 87, 102550. https://doi.org/10.1016/j.irfa.2023.102550

Hirshleifer, D., & Thakor, A. V. (1992). Managerial Conservatism, Project Choice, and Debt. *Review Of Financial Studies*, *5*(3), 437–470. https://doi.org/10.1093/rfs/5.3.437

Ioannou, I., & Serafeim, G. (2015). The impact of corporate social responsibility on investment recommendations: Analysts' perceptions and shifting institutional logics. Strategic Management Journal, 36(7), 1053–1081.

Jo, H., & Na, H. (2012). Does CSR Reduce Firm Risk? Evidence from Controversial Industry Sectors. *Journal Of Business Ethics*, *110*(4), 441–456. https://doi.org/10.1007/s10551-012-1492-2

Kim, K., Patro, S., & Pereira, R. (2016). Option incentives, leverage, and risk-taking. *Journal Of Corporate Finance*, *43*, 1–18. https://doi.org/10.1016/j.jcorpfin.2016.12.003

Krüger, P. (2014). Corporate goodness and shareholder wealth. *Journal Of Financial Economics*, *115*(2), 304–329. https://doi.org/10.1016/j.jfineco.2014.09.008

Lewin, L. D., & Warren, D. E. (2024). Hypocrites! Social Media Reactions and Stakeholder Backlash to Conflicting CSR Information. *Journal Of Business Ethics*. https://doi.org/10.1007/s10551-024-05700-4

Martínez, R. G., Medrano-Garcia, M. L., & Navas, D. A. (2024). Evaluating ESG performance: The influence of firm size and gender diversity. *Small Business International Review*, *8*(2), e693. https://doi.org/10.26784/sbir.v8i2.693

Matuszewska-Pierzynka, A. (2024). Relationship between corporate sustainability performance and corporate financial performance: the case of companies from the WIG-ESG Index. *Economics And Business Review/The Poznań University Of Economics Review*, *10*(4), 165–188. https://doi.org/10.18559/ebr.2024.4.1886

Monteduro, F., Cecchetti, I., Lai, Y., & Allegrini, V. (2020). Does stakeholder engagement affect corruption risk management? *Journal Of Management & Governance*, *25*(3), 759–785. https://doi.org/10.1007/s10997-020-09527-9

Ng, T., Lye, C., Chan, K., Lim, Y., & Lim, Y. (2020). Sustainability in Asia: The Roles of Financial Development in Environmental, Social and Governance (ESG) Performance. *Social Indicators Research*, *150*(1), 17–44. https://doi.org/10.1007/s11205-020-02288-w

Postiglione, M., Carini, C., & Falini, A. (2025). Assessing firm esg performance through corporate survival: The moderating role of firm size. *International Review Of Financial Analysis*, *100*, 103973. https://doi.org/10.1016/j.irfa.2025.103973

Pozo, J. (2024). Excessive bank risk-taking in an infinite horizon economy. *Journal Of Financial Stability*, *73*, 101263. https://doi.org/10.1016/j.jfs.2024.101263

Rahman, R. A., & Alsayegh, M. F. (2021). Determinants of Corporate Environment, Social and Governance (ESG) Reporting among Asian Firms. *Journal Of Risk And Financial Management*, *14*(4), 167. https://doi.org/10.3390/jrfm14040167

Teng, X., Wu, K., Kuo, L., & Chang, B. (2023). Investigating the double-edged sword effect of\ environmental, social and governance practices on corporate risk-taking in the high-tech industry. *Oeconomia Copernicana*, *14*(2), 511–549. https://doi.org/10.24136/oc.2023.014

Thomas, J., Yao, W., Zhang, F., & Zhu, W. (2022). Meet, beat, and pollute. *Review Of Accounting Studies*, *27*(3), 1038–1078. https://doi.org/10.1007/s11142-022-09694-0

Tian, T., & Chen, N. (2024). How does entrepreneurship promote corporate ESG performance? *International Review Of Financial Analysis*, 103557. https://doi.org/10.1016/j.irfa.2024.103557

Torres-Reyna, O. (2007). Panel Data analysis. https://www.princeton.edu/~otorres/Panel101.pdf

Whelan, T., Atz, U., Van Holt, T., & Clark, C. (2021). *Uncovering the relationship by aggregating evidence from 1,000 plus studies published between 2015–2020*. NYU Stern Center for Sustainable Business. https://www.stern.nyu.edu/sites/default/files/assets/documents/NYU-RAM_ESG-Paper_2021%20Rev_0.pdf

Wong, M. C. S., & Li, W. (2024). Investigating ESG Funds in China: Management Fees and Investment Performance. *International Journal Of Financial Studies*, *12*(2), 38. https://doi.org/10.3390/ijfs12020038

Wu, F., Zhu, B., & Tao, S. (2024). Can good ESG performance of listed companies reduce abnormal stock price volatility? Mediation effects based on investor attention. *PLoS ONE*, *19*(9), e0307535. https://doi.org/10.1371/journal.pone.0307535

Appendix

Generative AI tools were used solely to refine language, review consistency, and assist with coding and data visualization. Specifically, I used Grammarly to improve grammar, sentence structure, and overall readability, ensuring that all revisions accurately reflect my intended meaning. Additionally, I used ChatGPT (GPT-4) to help check and debug my R code for the main regression models, as well as to assist with Figures 1 and 2. ChatGPT provided suggestions to correct errors in my existing code and supported the preparation of visualization code. All outputs from these tools were critically reviewed and, where necessary, modified to align with the objectives of this thesis. No other AI tools were used to generate original content, arguments, or ideas. All academic insights and written sections are my own. By submitting this thesis, I declare full responsibility for its accuracy and completeness and confirm that it complies with the rules set out in the course manual.

Table 3. Correlation Matrix

	ESG	Firm Size	Interaction	Age	ROA	MTB
ESG	1					
Firm Size	0.490	1				
Interaction	0.480	0.950	1			
Age	0.250	0.180	0.180	1		
ROA	-0.060	-0.230	-0.180	-0.030	1	
MTB	-0.110	-0.260	-0.230	-0.050	0.390	1