

ESG Decoupling and Debt Maturity: International Evidence from Multilevel Panel Modelling

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Abstract

This study investigates how ESG decoupling, defined as the gap between ESG disclosure and practices, influences the maturity structure of corporate debt. Using multi-level modelling on a panel of 7,369 non-financial listed firms across 40 countries from 2004 to 2023, we find that ESG decoupling is associated with shorter debt maturity, indicating that the debt market reacts negatively to companies whose ESG disclosures are decoupled from their actual practices. Shorter maturities naturally increase rollover risk because firms must refinance more frequently. Firms are therefore paying the price for ESG decoupling, manifested by the increasing difficulties in refinancing maturing obligations. We further examine three mechanisms underlying this negative relationship: information asymmetry, liquidity position, and financial distress. We deploy mediation analysis with bootstrapping and validate all mechanisms. Robustness tests are performed, and the findings are consistent and robust. This study contributes to the ESG-financing decision-making literature, and the findings inform lenders and policymakers that, going beyond ESG ratings, the credibility of ESG commitments is crucial.

Key Words: ESG Decoupling; Corporate Sustainability Disclosure; Information Asymmetry; Debt Maturity Structure; Multilevel Modelling; Liquidity constraints

JEL classification: G32 G21 G30

1. Introduction

The importance of environmental, social, and governance (ESG) practices has been rising steadily in recent years. This trend has increased academic and market interest in whether ESG factors affect corporate financial decisions, with one key area being the structure of corporate debt. As global awareness of sustainable development grows, investors and other stakeholders are placing greater expectations on firms to improve their ESG performance. The rate of institutional ESG adoption has increased sharply. By 2023, more than 4,000 institutions managing over 120 trillion US dollars in assets had committed to the United Nations Principles for Responsible Investment (UNPRI, 2023). Sovereign wealth funds, such as Norway's Government Pension Fund Global, have also integrated ESG indicators into their investment mandates, giving preference to firms with clear climate transition strategies and fair labour practices. These developments indicate that both institutional and market expectations around sustainability have risen substantially. ESG has thus increasingly become a central component of how firms are evaluated and governed

Given the institutional pressure, many firms are reported to overclaim what they actually do. The gap between what they disclose and what they actually do is known as ESG decoupling, indicating a discrepancy between ESG commitments disclosed to the public and genuine business practices (Gull et al., 2023). ESG decoupling behaviour has become increasingly common. Studies show that many firms rely on selective sustainability reporting or promotional ESG claims without implementing substantive changes, making symbolic disclosure a widespread corporate strategy (Delmas and Burbano, 2011; Marquis and Qian, 2014). Media investigations also document frequent cases of overstated climate pledges, incomplete emission reporting, and exaggerated social initiatives, suggesting that symbolic ESG is not an isolated phenomenon but a common corporate strategy.

ESG decoupling may arise when firms use ESG as a symbolic gesture to satisfy regulators and investors, without making substantive changes to their core strategies. For instance, a firm may overstate its environmental efforts in corporate disclosure, while failing to act. This deviation not only risks the firm's reputation but also loses stakeholders' trust due to misleading ESG-related disclosure (Crilly et al., 2012). Notable examples include Volkswagen's emissions scandal and the overstated renewable strategy by BP (Gaim et al., 2021; Hawn and Ioannou, 2016). Their reported low ESG controversies scores of 0.64 and 12.5, respectively, echo the fact, indicating a higher level of controversy and greater reputational or operational risk¹. As a result, Volkswagen's market value decline of nearly 25%, while BP lost approximately USD 100 billion (Ho et al., 2024). Additional evidence shows that ESG decoupling can raise litigation and regulatory risks. For example, DWS Asset Management was fined USD 25 million by the U.S. SEC for overstating

¹ For details on the ESG controversies score methodology, see LSEG ESG Scores Methodology (London Stock Exchange Group, 2023). Available at: https://www.lseg.com/content/dam/data-analytics/en_us/documents/methodology/lseg-esg-scores-methodology.pdf

ESG integration in its funds in 2023². Similar greenwashing claims have been filed against H&M and other multinational firms for misleading sustainability labelling.

Scholars have also increasingly called for greater attention to ESG decoupling, as discrepancies between firms' ESG disclosures and their actual practices generate a wide range of adverse consequences. Kim and Lyon (2014) argue that when firms engage in symbolic ESG reporting, whether through greenwashing or brownwashing, they distort market assessments, weaken legitimacy, and introduce inefficiencies in capital allocation, thereby creating substantial economic risks. Extending this perspective, Lyon and Montgomery's (2015) comprehensive review highlights that the repercussions of misleading ESG communication are not confined to financial outcomes but are inherently multilevel. At the organisational level, greenwashing can erode employees' psychological well-being, trust, commitment, and productivity. At the consumer level, it increases confusion and cynicism, weakening brand evaluations and long-term market value. At the societal level, misleading ESG narratives may delay collective action, undermine public trust in sustainability claims, and impede the progress of environmental legislation. These cases echo the literature showing that ESG decoupling can harm reputation, raise financing costs, and even lead to regulatory sanctions. This underscores that understanding the mechanisms and consequences of ESG decoupling is crucial for safeguarding information integrity in capital markets and for supporting effective sustainability governance (Chen et al., 2024; Garcia-Sanchez et al., 2021). These findings show that ESG decoupling creates significant challenges for firms, investors, and regulators. Building on this literature, this study extends current evidence by examining the dark side of ESG decoupling in corporate debt maturity. Specifically, we investigate whether and how ESG decoupling shapes firms' maturity structures.

Debt maturity reflects firms' preferences in managing liquidity, refinancing risk and agency costs (Barclay and Smith, 1995). Short-term debt increases the exposure to refinancing risk but may strengthen lender discipline. In contrast, long-term debt reduces liquidity pressure, although it may weaken market oversight (Custódio et al., 2013). Firms with longer debt maturities benefit from reduced rollover risk and better alignment with investment horizons, while shorter maturities may signal concerns about information asymmetry and monitoring needs (Wu et al., 2022). Previous research has shown a positive association between ESG performance and longer debt maturities, especially in emerging markets where information asymmetry is more severe and long-term funding is less accessible (Zhou et al., 2024). Firms with weaker reputations or higher levels of uncertainty are more likely to favour shorter maturities, as this helps reduce the cost of adverse selection (Diamond, 1991; Flannery, 1986). In this regard, ESG decoupling, proxied by controversy events, may function as a reputational red flag, signalling deficiencies in governance, ethics, or operational integrity. Consequently, firms associated with such decoupling may be penalised by creditors and forced to rely more heavily on shorter-term debt.

2 U.S. Securities and Exchange Commission. (2023, September 25). Deutsche Bank Subsidiary DWS to Pay \$25 Million for Anti-Money Laundering Violations and Misstatements Regarding ESG Investments. <https://www.sec.gov/newsroom/press-releases/2023-194>

To empirically test these relationships, we construct a panel dataset of publicly listed non-financial firms from 40 countries over the period 2004-2023. ESG decoupling is proxied by the LSEG ESG controversy score, with a score below 100 indicating at least one recorded controversy. Debt maturity is defined as the ratio of long-term debt to total debt. The dataset integrates firm-level financial indicators, industry-level competition measures, and country-level macroeconomic controls. Given the multilevel structure of the data, with firm-year observations nested within industries and countries, we employ a mixed effects modelling approach to account for unobserved heterogeneity. To ensure the robustness of our results, we conduct multiple sensitivity analyses, including lagged specifications, subsample analyses across industry and institutional contexts, and alternative definitions of ESG decoupling.

Furthermore, this study further explores three mechanisms. Despite growing recognition of the risks associated with ESG failures, little is known about the mechanisms through which ESG decoupling affects debt maturity. While prior studies have focused on the impact of controversies on profitability and shareholder value (Mendiratta et al., 2023; Al-Hiyari, 2024), the implications for debt structure remain unclear. To address this gap, our study examines three potential transmission mechanisms linking ESG decoupling to debt maturity: 1) information asymmetry, 2) corporate liquidity position, and 3) financial distress. Specifically, we argue that ESG decoupling may increase information opacity in capital markets, which in turn elevates the bid-ask spread and reduces the availability of long-term financing. In parallel, firms associated with ESG decoupling may respond by increasing their cash reserves as a precautionary measure to maintain financial flexibility, thereby reducing their reliance on long-term debt. Furthermore, ESG decoupling may signal a shift toward more conservative financial management and enhanced solvency, which is reflected in higher Altman Z-scores. These three channels, i.e., heightened information asymmetry, increased liquidity position, and more conservative financial management, may contribute to a shortening of firms' debt maturity structure.

We formally examine the three proposed mechanisms using mediation analysis based on information asymmetry, liquidity position, and financial distress, respectively. Our findings indicate that ESG decoupling increases information asymmetry, strengthens firms' liquidity positions, and reduces financial distress risk, each of which contributes to a shortening of debt maturity. To ensure the robustness of our findings, we perform several complementary analyses. First, we conduct subsample tests based on institutional and industry heterogeneity. Specifically, we divide the sample according to whether the firm is located in a G7 country, whether the financial system is bank-based or market-based, and whether the firm belongs to a socially and environmentally sensitive industry. These classifications reflect varying levels of institutional enforcement, investor expectations and stakeholder scrutiny. Prior literature suggests that firms operating in stronger institutional environments face greater reputational risks when ESG-related misconduct arises (Beckmann & Rogmann, 2024; Bilyay-Erdogan & Ozturkkal, 2023). Likewise, firms in socially sensitive sectors, such as healthcare, retail, and consumer services, are more exposed to public and media criticism (García-Meca et al., 2024; Liu et al., 2023). We also verify

that the results are not driven by the dominance of any single country sample by sequentially excluding firms from the United States, China, and both countries simultaneously. Across all subsamples, we consistently find that ESG decoupling is associated with shorter debt maturity. Second, we apply a one-year lag to the ESG decoupling variable to mitigate concerns about reverse causality and simultaneity. The results remain materially unchanged, suggesting that the observed relationship is not driven by short-term simultaneity bias. Third, we further construct multiple alternative indicators of ESG decoupling. Regardless of the measurement specification, the results consistently show that higher levels of ESG decoupling are associated with shorter debt maturity. Finally, to further validate the robustness of our empirical evidence, we estimate the models using alternative estimation techniques, including OLS, firm fixed effects, and high-dimensional fixed effects regressions. All approaches yield consistent and statistically significant results, confirming the stability of our main findings.

First, this study advances the corporate finance literature by introducing ESG decoupling as a new determinant of the debt maturity structure. Prior research has mainly examined how ESG performance shapes firms' financing structures and outcomes (Asimakopoulos et al., 2023; Bae et al., 2019). These studies rely on ESG ratings and therefore focus on sustainability outcomes. They pay limited attention to the degree of alignment between firms' stated ESG commitments and their actual practices, and the credibility of disclosed ESG information has received little direct scrutiny. In this study, ESG decoupling captures this misalignment. We interpret the divergence between symbolic disclosure and substantive practice as a form of non-financial information risk that may influence lenders' view of firm quality and the maturity of the debt they are willing to provide. This perspective situates ESG decoupling within information-based explanations of debt maturity and clarifies how sustainability credibility can shape creditors' assessments of financing risk. Therefore, our contribution is demonstrating that debt markets react not only to firms' ESG performance, but also to the credibility and consistency of the ESG signals they issue. By integrating ESG decoupling into the study of debt-maturity structure, we broaden information-driven theories of capital structure and highlight the importance of sustainability credibility in corporate financing decisions.

Second, this study deepens the understanding of how ESG credibility affects corporate financing by identifying three key channels through which ESG decoupling shortens debt maturity. Prior research has shown that information asymmetry, liquidity management, and financial distress are central determinants of firms' maturity structures (Allaya et al., 2022; Brick et al., 2017). Within the ESG literature, these mechanisms have typically been studied from a different perspective. For example, much of the prior work has investigated how stronger ESG performance reduces information asymmetry (Bilyay-Erdogan et al., 2024). Building on this foundation, we extend these well-established mechanisms to the context of ESG decoupling. We examine whether ESG decoupling propagates through information opacity, precautionary liquidity behaviour, and distress-related financial adjustments, thereby shortening firms' debt maturities. Our empirical evidence supports this multi-channel transmission structure and highlights how sustainability

credibility risk may affect contractual outcomes through recognised behavioural and financial processes.

Third, this study provides an empirical contribution by documenting the relationship between ESG decoupling and debt maturity using a large international dataset covering 7,369 firms across 40 countries. Much of the existing ESG literature is based on single-country settings or samples drawn from specific institutional environments, which may limit the generalisability of their findings (Ioannou and Serafeim, 2012). Prior research also shows that ESG practices and their financial implications vary considerably across countries, reflecting differences in regulatory regimes, investor protection, and stakeholder expectations (Garcia et al., 2020). These contextual differences suggest that evidence from one institutional setting may not necessarily apply elsewhere. Against this backdrop, the use of a broad international panel enables us to examine whether the financial consequences of ESG decoupling persist across diverse legal, market, and cultural environments. By analysing firms operating under varying institutional and sectoral conditions, we assess whether ESG credibility risk is priced consistently by creditors across markets. The robustness of our results across subsamples, such as G7 versus non-G7 economies, differing levels of credit-market development, and industry sensitivity, indicates that the relationship between ESG decoupling and debt maturity is not confined to specific contexts.

The remainder of this research is organised as follows. Section 2 reviews the relevant literature and presents the testable hypotheses. Section 3 describes the data, variable definitions and empirical methodology. Section 4 presents the baseline regression results and discussion. Section 5 investigates the underlying mechanisms through channel analysis. Section 6 conducts a series of robustness checks. Section 7 shows the economic significance. Section 8 concludes and discusses implications for practice.

2. Literature Review

2.1 ESG decoupling and controversies

This section reviews the concept of ESG decoupling by tracing its theoretical origins, empirical manifestations, and measurement implications within the contemporary sustainability literature. First, it outlines the definitional development of decoupling, beginning with early organisational theory and extending to institutional perspectives that explain why firms may symbolically adopt formal ESG structures without substantive implementation. Second, it summarises subsequent theoretical refinements, particularly the distinction between policy-practice decoupling and ends-means decoupling, which capture different ways in which ESG commitments diverge from organisational behaviour. Third, the section maps the broader decoupling theories onto the ESG context and explains how ESG decoupling emerges within firms. It reviews the organisational and governance-related drivers behind this behaviour and discusses how managerial discretion, weak monitoring, and legitimacy pressures create conditions that make decoupling more likely. Finally,

the section reviews the empirical challenges of measuring ESG decoupling and explains why ESG controversies, although conceptually distinct, can serve as a practical proxy to capture observable manifestations of underlying decoupling behaviour. Therefore, the following provides a more detailed review.

In recent years, growing academic attention has been directed towards the inconsistency between corporate disclosures and actual performance in the domain of ESG practices, commonly referred to as ESG decoupling. The concept was first introduced by Weick (1976) to describe loose coupling between structure and operations in educational organisations. Later, Meyer and Rowan (1977) expanded this notion within the framework of institutional theory. They argued that organisations often adopt formal structures to gain external legitimacy. These structures are designed to align with societal expectations and institutional norms, such as issuing detailed reports. However, organisations do not always implement these norms in practice. This gap between formal adoption and actual execution leads to decoupling. Such behaviour is viewed as a strategic but symbolic response to balance the competing demands of legitimacy and operational efficiency.

Bromley and Powell (2012) further developed the concept by introducing subtypes of decoupling, namely policy-practice decoupling and ends-means decoupling. Policy-practice decoupling refers to situations in which organisations formally adopt rules or policies but do not implement them in practice, or implement them only in a ceremonial manner. Monitoring and evaluation tend to be symbolic rather than substantive. Ends-means decoupling, by contrast, arises when organisations do implement policies and procedures, yet the actions taken have a weak or unclear connection to the intended goals. In this case, implementation appears active, but it does not meaningfully contribute to achieving the stated objectives. They noted that in modern organisations, the complexity of institutional environments, competing stakeholder demands, and the inherent tension between legitimacy and efficiency goals often compel firms to engage in symbolic compliance to resolve such conflicts. For example, on the policy-practice front, although companies may disclose detailed ESG policies or sustainability reports, the absence of institutional safeguards and resource commitment during implementation causes misalignment between the disclosure and the practice. In the case of ends-means decoupling, a firm may announce a long-term commitment to carbon neutrality. However, it may rely on actions such as internal awareness campaigns, which are easy to implement but do not materially reduce emissions. These actions create the appearance of progress while failing to advance the stated environmental goal, resulting in ends-means decoupling.

Within the ESG context, firms often demonstrate their commitment to sustainability goals through formalised policies, reports, and public pledges, thereby signalling a proactive stance to external audiences. However, these responses do not always translate into improved internal practices or actual performance outcomes. As Gull et al. (2023) argue, decoupling becomes evident when there is a gap between a firm's level of ESG disclosure and its real behaviour, reflecting a tendency to adopt superficial compliance strategies rather than substantive reform under legitimacy pressure.

From a corporate governance perspective, Gull et al. (2023) empirically examine the inconsistency between ESG disclosure and actual performance. They contend that differences in governance structures, particularly in the composition and oversight capacity of boards, may lead firms to exaggerate their sustainability commitments. Consistent with Velte (2023), weak monitoring systems and managerial discretion amplify the agency problems underlying ESG decoupling, allowing firms to engage in impression management instead of genuine behavioural change. Firms with weaker governance mechanisms are more inclined to pursue surface-level disclosure to gain external recognition rather than to genuinely fulfil ESG responsibilities. This behaviour not only undermines the credibility of sustainability-related information in the market but also obscures underlying risks, potentially leading to reputational and financial consequences.

Despite the extensive theoretical discussion surrounding ESG decoupling, empirical research continues to face significant measurement challenges. The lack of a standardised framework to assess the gap between ESG performance and disclosure complicates operationalisation. Mainstream ESG data providers vary considerably in terms of data sources, indicator construction, and weighting methods (Berg et al., 2022), often requiring researchers to merge data across databases to capture the divergence between ESG disclosure and performance. For instance, some studies obtain ESG disclosure scores from Bloomberg, while using ESG performance scores from LSEG (Refinitiv) (Aboud et al., 2024; Eliwa et al., 2023). While this cross-database approach offers a practical means of constructing decoupling indicators, it also introduces additional challenges. Specifically, ESG scores assigned to the same firm in the same year may systematically differ across databases, not due to real discrepancies between disclosure and performance, but because of diverging scoring logics. Berg et al. (2022) illustrate how rating agencies employ different indicator names, numbers, and emphases even within the same category. For example, in the water resource category, Sustainalytics may focus on emission reduction and water recycling, whereas Refinitiv places greater emphasis on water management and stress. This lack of consensus undermines the reliability of decoupling indicators.

Although ESG controversies are not conceptually identical to ESG decoupling, as the former represents event-based outcomes while the latter reflects a structural behavioural gap, the two are logically interconnected. On the one hand, many ESG controversies arise from firms' long-term engagement in symbolic disclosure while neglecting substantive execution. On the other hand, frequent controversies also expose the fragility of firms' ESG commitments. Therefore, this study adopts ESG controversies as a practical proxy for ESG decoupling, striking a balance between data availability and theoretical alignment.

2.2 ESG decoupling and Debt Maturity

This study argues that ESG decoupling shortens corporate debt maturity. We conceptualise ESG decoupling as a credibility-reducing event that weakens the informativeness of ESG disclosures and signals potential deficiencies in governance, operational integrity, and stakeholder management. Such events can heighten information asymmetry, weaken organisational legitimacy,

increase risk perceptions, and reshape managerial incentives. To explain these effects, we draw on four major theoretical perspectives. First, information asymmetry theory provides the core mechanism by which ESG decoupling increases opacity and induces creditors to shorten maturity structures. Second, signalling theory explains firms' strategic use of short-term debt to counteract negative impressions and restore investor confidence. Third, legitimacy theory situates financing decisions within broader institutional pressures following ESG failures. Fourth, agency theory highlights how internal governance constraints further shape financing responses. These theories offer a comprehensive explanation of why ESG decoupling leads to shorter debt maturities, as well as guide the hypothesis development in this section.

While the influence of ESG performance on corporate debt financing has received growing attention, few studies have examined this in the ESG decoupling context. Existing literature has largely focused on the positive effects of ESG. For instance, Benlemlih (2017) finds that firms with strong ESG performance in the US are more inclined to adopt long-term debt structures. Similarly, Nguyen et al. (2020), using a sample of Australian mining firms, show that higher ESG scores are associated with greater access to long-term financing, particularly in highly regulated sectors. These studies generally argue that proactive social responsibility enhances investors' confidence in a firm's creditworthiness and governance quality, thereby mitigating moral hazard and uncertainty, and ultimately extending debt maturity.

By contrast, ESG decoupling, as a negative signal of ESG failure, may exert an opposite influence on firms' external financing structures. On the one hand, ESG decoupling undermines market trust and reduces informational transparency, leading to heightened risk perceptions in capital markets (Wan et al., 2024). On the other hand, such events often trigger share price volatility, media scrutiny, and regulatory interventions, increasing financing uncertainty (Capelle-Blancard and Petit, 2019). According to information asymmetry theory, when disclosure is insufficient, signals are ambiguous, or reputational capital is damaged, creditors face greater difficulty in accurately assessing a firm's credit risk. Consequently, they tend to favour short-term debt arrangements that are more controllable and liquid (Flannery, 1986). As noted in the review by Wu et al. (2022), debt maturity choices are jointly influenced by firm characteristics, information quality, governance mechanisms, and institutional contexts.

More specifically, ESG decoupling can be seen as a form of negative external shock that disrupts a firm's ability to manage market expectations and may alter investors' assessment of its long-term solvency. When a firm becomes embroiled in incidents such as environmental violations, labour abuses, or governance failures, creditors may reassess its overall risk profile and grow concerned about higher default risks associated with long-term funding. In such contexts, firms are often forced to rely more on short-term borrowing to satisfy liquidity needs, leading to a shortening of debt maturity structures. De Meyere et al. (2018) find that firms with lower financial reporting quality tend to rely more on short-term debt. Similarly, Pappas et al. (2019) show that earnings management impairs information transparency, thereby limiting access to long-term financing. While these studies do not directly examine ESG decoupling, they support a mechanism involving

trust deficits and informational inconsistencies, which underpin the theoretical foundation of this study.

Within this framework, signalling theory further extends the explanatory logic. As proposed in Spence's (1973) seminal work, firms operating in information-asymmetric markets can send credible signals of quality through observable and costly actions. In the context of debt structure choices, short-term debt may function as a signalling device voluntarily adopted by high-quality firms; its frequent refinancing requirements signal robust cash flow and strong repayment intentions (Flannery, 1986). Kale and Noe (1990) and Custódio et al. (2013) also confirm that short-term debt plays a signalling role, especially in contexts of weak regulation or unreliable credit ratings.

When faced with ESG decoupling, firms find themselves at the intersection of reputational crisis and informational opacity. To avoid being misjudged as high-risk, firms may deliberately shorten debt maturity as a signal of their willingness to accept scrutiny and their repayment capacity. Short-term debt increases the frequency of market scrutiny and imposes refinancing risks, which only firms confident in their liquidity and market access are willing to endure (Flannery, 1986; Diamond, 1991). This "signal-induced maturity shortening" serves as a form of reputational recovery, offering observable cues of financial discipline, compliance willingness, and repayment capacity. It may also be accompanied by adjustments in capital structure or increased voluntary disclosure, further reinforcing the firm's signal of transparency.

However, the signalling effectiveness of shortened maturities depends on the ability of external observers to distinguish between genuine recovery efforts and opportunistic mimicry. If capital markets cannot reliably separate high-quality firms from those attempting to obscure ongoing risks, or if the firm's historical ESG behaviour is inconsistent, then the signal may be discounted or even interpreted negatively. In this context, debt maturity becomes not only a financial instrument but also a contested communication channel between firms and stakeholders (Jucá et al., 2024).

Beyond market mechanisms, legitimacy theory offers an institutional-sociological explanation. Suchman (1995) defines organisational legitimacy as the generalised perception that a firm's actions are desirable within a socially constructed system of norms and beliefs. When firms lose institutional legitimacy due to ESG decoupling, they face the risk of a legitimacy collapse (Deephouse & Carter, 2005). Public opinion, ESG rating agencies, regulators, and responsible investors may simultaneously exert pressure, compelling firms to adopt compliance-oriented behaviour to repair their social standing. According to Bitektine and Haack's (2015) concept of responsive legitimacy strategies, firms in crisis are more likely to adopt formal, quantifiable, and short-term institutional arrangements to restore external trust. In financing terms, this translates into more frequent refinancing, shorter debt contracts, and enhanced disclosure obligations, making short-term debt a preferred tool when legitimacy is damaged.

Ashforth and Gibbs (1990) further argue that organisations facing normative turbulence often pursue symbolic compliance to restore legitimacy. As a contractual variable, debt maturity reflects

the interaction between firms and societal expectations. Thus, under ESG decoupling, debt shortening is not only a financial adjustment but also a strategic institutional response. Recent research increasingly links legitimacy theory with capital structure, emphasising the role of legitimacy concerns in financing behaviour under institutional constraints (Parsons et al., 2021). Building on this, our study constructs a mechanism chain in which ESG decoupling leads to a loss of legitimacy, which in turn results in a contraction of debt maturity.

In addition to external institutional and market forces, internal governance structures also shape firms' financing responses under ESG decoupling. Agency theory posits that managers do not always act in the interests of shareholders, especially under conditions of reputational threat or regulatory scrutiny. Their decisions may instead be driven by tenure concerns, incentive schemes, or personal risk preferences (Jensen & Meckling, 1976). Ioannou and Serafeim (2015) point out that if ESG governance is not integrated into performance assessments or accountability frameworks, managers are more likely to adopt strategic silence, which means treating ESG decoupling as issues to be delayed rather than resolved, thereby avoiding long-term commitments or institutional reform.

In such cases, short-term debt offers high contractual flexibility, faster approval processes, and discretion in fund allocation, making it a preferred choice for managers (Datta et al., 2005). This tendency is particularly pronounced in firms with weak governance, low board independence, or limited external oversight. Huang et al. (2016) further highlight the significant association between managerial characteristics and debt maturity structure. A firm's financing decisions under ESG crises may thus reflect its internal incentive structure. Accordingly, agency theory complements the external perspectives of information asymmetry and legitimacy, offering insight into how internal governance shapes financial responses to ESG decoupling.

Therefore, the effect of ESG decoupling on corporate debt maturity reflects not only market reassessments of information quality but also institutional responses to social expectations, legitimacy threats, and internal incentive structures. Signalling theory explains firms' behavioural responses to distrust, legitimacy theory situates these choices within broader institutional environments, and agency theory reveals the role of managerial motivations. These four theories form the theoretical pillars of this study and guide the development of the empirical models and identification strategies. Accordingly, we propose:

H1: ESG decoupling reduces the maturity structure of corporate debt.

2.3 Mechanism Analysis

In this section, we undertake further analyses to explore the foundations of this relationship. As noted earlier, we posit three underlying mechanisms through which firms' ESG-decoupling behaviour might influence the term structure of their debt: (1) information asymmetry, (2) liquidity position and (3) financial distress. This section examines how each channel clarifies the link

between corporate ESG decoupling and debt maturity, thereby highlighting the ways in which ESG decoupling shapes a firm's overall capital structure.

2.3.1 Information asymmetry

In the preceding theoretical discussion, this study highlights that ESG decoupling may influence corporate debt maturity structures through several theoretical channels. Among these, information asymmetry is regarded as the central mechanism that connects adverse ESG events with adjustments in financing structure. Rather than focusing solely on the overall effect of ESG decoupling on financing outcomes, a mechanism-based approach helps to uncover how controversy-related events indirectly affect capital contracting through changes in the information environment. This offers a deeper explanatory logic for understanding how firms adjust their financing strategies. Building on this motivation, the following subsection elaborates on why information asymmetry may serve as the key channel linking ESG decoupling to debt maturity. Specifically, we first discuss how information asymmetry theoretically leads to shorter debt horizons, and then explain how ESG decoupling increases informational frictions and thus activates this mechanism.

The information asymmetry theory establishes the foundational link between information asymmetry and debt maturity, showing that greater informational frictions shorten debt horizons. According to the theory, when there is a cognitive gap between firms and external capital providers, lenders may find it difficult to accurately assess the firms' creditworthiness. As a result, they tend to adopt more conservative strategies and reduce their willingness to commit to long-term financing. The theoretical models of Flannery (1986) and Diamond (1991) both suggest that higher perceived risk or lower transparency leads to a shift towards short-term debt structures. These propositions have been supported by empirical research. For instance, Barclay and Smith (1995) show that firms with lower valuations, higher research and development expenditure, and greater growth potential are more likely to use short-term debt. These characteristics are typically associated with high levels of information asymmetry.

In the ESG context, decoupling can be seen as a challenge to the reliability of firms' non-financial information. Such events may raise market concerns regarding future repayment capacity and deteriorate the firm's information environment. Bilyay-Erdogan et al. (2024) demonstrate that firms with weaker ESG performance face higher levels of information asymmetry, which intensifies financing constraints and reduces investment efficiency. High-quality ESG disclosure, by contrast, helps alleviate this effect, especially among firms where asymmetry is already pronounced.

Moreover, ESG decoupling may lead to adverse assessments of firm-specific information and trigger a credibility crisis in the capital market. Such credibility shocks effectively exacerbate information asymmetry because lenders face greater difficulty distinguishing between temporary noise and fundamental risk (Healy and Palepu, 2001). In this setting, creditors often prefer to shorten loan maturities in order to maintain flexibility. At the same time, firms may be forced to

accept more frequent refinancing arrangements. This pathway, in which a deteriorating information environment leads to the shortening of debt maturity, is consistent with empirical evidence presented by Berger et al. (2005). Their study finds that when banks do not employ credit scoring mechanisms, an indicator of high information asymmetry, firms are granted significantly shorter average debt maturities. Once information systems improve, low-risk firms experience a notable extension of their debt terms.

The foundational argument of Myers and Majluf (1984) also applies in this context. They argue that information asymmetry may lead investors to undervalue corporate projects, thereby limiting a firm's access to capital. This perspective provides theoretical support for understanding how ESG decoupling can generate friction in non-financial information and disrupt financing outcomes. Furthermore, Lambert et al. (2007) and Dhaliwal et al. (2011) find that firms can reduce financing costs by improving ESG disclosure, which increases capital market transparency. However, if the credibility of these signals is undermined by ESG decoupling, the reverse effect may occur, causing firms to face tighter financing conditions and shorter debt maturity.

Based on the above, this study proposes that ESG decoupling weakens the credibility of firms' non-financial information and increases investors' perception of risk and informational friction. This leads to higher levels of information asymmetry. As creditors reassess the financing risks, firms face greater constraints in accessing long-term debt and are more likely to rely on short-term financing. Therefore, this study proposes:

H2a: Information asymmetry plays a mediating role in ESG decoupling and corporate debt maturities.

2.3.2 Liquidity Position

Existing research shows that the corporate liquidity position serves not only as a buffer against future financing uncertainty but also plays a central role in shaping debt maturity structures (Opler et al., 1999; Bates et al., 2009; Acharya et al., 2007). The theoretical foundation of this behaviour can be traced back to Keynes (1937), who proposed liquidity preference theory. He argued that economic agents tend to hold cash to safeguard against uncertainty and instability in future expectations. Holding liquid assets reflects a rational response to incomplete information and unpredictable shocks, highlighting the role of liquidity as a means of maintaining financial flexibility. When firms face potential funding constraints or market volatility, they tend to adopt more conservative financial policies, increasing internal reserves to enhance resilience. In this context, if a firm is subject to reputational risk or doubts about its information transparency, market participants may revise expectations about its creditworthiness and financing capacity, prompting the firm to raise its cash holdings to reduce the risk of future refinancing failure. This insurance mechanism, whereby firms increase their cash holdings to protect against potential future financing constraints, is known as the precautionary motive (Han and Qiu, 2007). According to Almeida et al. (2004), firms that are financially constrained or lack transparency are more likely to accumulate cash to preserve investment capacity. Harford et al. (2014) further argue that in cases of high short-

term debt exposure or market instability, firms have stronger incentives to build up cash reserves to manage refinancing risk and avoid liquidity shortfalls. Even when cash flows are stable, external reputational shocks or growing uncertainty may lead the market to expect higher financing costs, which in turn encourages firms to secure liquidity in advance.

Therefore, an increase in cash holdings may signal firms' adjustments to their future capital structure in response to rising uncertainty. Drawing on evidence from Southeast Asia, Nnadi et al. (2021) find that in high-growth, high-asymmetry settings, firms are more likely to both shorten debt maturity and increase cash holdings to manage liquidity and refinancing risks. This provides indirect evidence that firms often adopt this dual strategy to strengthen bargaining power under uncertain conditions.

Moreover, firms with high cash reserves tend to reduce their reliance on long-term debt, thereby improving financial flexibility (Han and Qiu, 2007; Sun and Wang, 2015). Cash holdings thus serve not only as a defensive measure but also as a lever in capital structure adjustments. Related studies, such as Harford et al. (2014), suggest that cash can substitute for the stability offered by long-term debt, allowing firms to shift towards shorter maturities and avoid costly long-term commitments.

In summary, firms facing greater information asymmetry or market uncertainty may raise cash holdings as a buffer against future shocks, which in turn influences their choice of debt maturity. Therefore, we propose the following hypothesis:

H2b: Liquidity position plays a mediating role in ESG decoupling and corporate debt maturities.

2.3.3 Financial Distress

Financial distress refers to a situation in which a firm faces difficulty meeting its financial obligations (Whitaker, 1999). Financial distress risk has long been recognised as a central determinant of corporate capital structure and debt maturity. When the likelihood of default or financial instability increases, both creditors and firms face heightened uncertainty in designing financing contracts (Opler & Titman, 1994; Campbell et al., 2008). Prior capital-structure research argues that debt maturity serves as a risk-management mechanism. Firms with higher expected distress risk or volatile earnings typically rely more on short-term debt, which enables lenders to reassess creditworthiness more frequently (Diamond, 1991; Barclay & Smith, 1995). Conversely, financially stable firms are usually granted longer-term loans, reflecting creditors' confidence in their solvency and repayment ability.

However, ESG decoupling may alter this conventional relationship. When firms face legitimacy or reputational pressure due to a widening gap between ESG communication and actual practice, managers often adopt financially conservative policies as a pragmatic response to restore stakeholder confidence (Suchman, 1995; Bromley & Powell, 2012; Wagner et al., 2009). This aligns with the reputation insurance logic that firms employ visible and credible actions, such as

strengthening solvency or reducing leverage to signal financial discipline and regain legitimacy (Godfrey, 2005; Graham, 2000).

Drawing on signalling theory (Spence, 1973; Connelly et al., 2011), adopting a conservative financial stance can be viewed as a compensatory signalling strategy. Firms engaging in ESG decoupling, whose ESG disclosure credibility has been questioned, may attempt to offset negative perceptions by improving observable financial indicators such as leverage ratios and liquidity. By demonstrating strong financial soundness, they send a signal that reassures investors and creditors of their repayment capacity (Godfrey, 2005; Wagner et al., 2009). This aligns with the notion that firms can employ financial prudence to compensate for lost non-financial legitimacy.

Such stability-oriented behaviour is consistent with insights from classic capital-structure models. Myers (1977) emphasises that excessive debt may induce under-investment problems, leading firms with valuable growth opportunities to restrict leverage to preserve flexibility. Similarly, Stulz (1990) argues that debt exerts a dual effect. While it disciplines managerial discretion, it can also constrain valuable future investment if used excessively. Hence, firms may rationally prefer a low-risk, flexibility-preserving financing profile that prioritises solvency and reduces exposure to distress. In the context of ESG decoupling, this conservative orientation enhances the firm's apparent financial health, reflected in a lower observed distress.

Nevertheless, the improvement in solvency metrics may not necessarily translate into longer debt maturities. From a contracting perspective, creditors may interpret such conservatism as a sign of limited growth potential or managerial caution and therefore prefer shorter-term lending to retain monitoring flexibility (Flannery, 1986; Custódio et al., 2013). At the same time, firms themselves may actively choose shorter maturities as part of their signalling effort. Short-term debt imposes a continuous refinancing discipline, serving as a credible commitment to transparency and repayment confidence (Diamond, 1991). By voluntarily assuming this refinancing pressure, firms reinforce their financial credibility and demonstrate confidence in future cash-flow stability.

In summary, ESG decoupling can influence debt maturity through its effect on financial distress and conservative financial behaviour. Faced with reputational and legitimacy challenges, firms tend to strengthen solvency and adopt stability-oriented financial policies, which improve their Z-scores and lower observed financial distress. Yet this compensatory conservatism, whether interpreted by creditors or strategically signalled by firms, results in shorter debt maturities. Therefore, this study proposes the following hypothesis:

H2c: Financial distress plays a mediating role in ESG decoupling and corporate debt maturities.

3. Methodology

3.1 Sample Size

This study employs panel data from 2004 to 2023, sourced from LSEG (formerly Refinitiv) and the World Bank, covering listed non-financial firms across 40 countries. Our sample begins in 2004 because ESG-related information in the LSEG database becomes noticeably more complete from this year onward. The final sample comprises 7,369 firms, totalling 50,452 firm-year observations. We exclude countries with fewer than five firms to mitigate estimation bias arising from extremely small country samples. In addition, firms lacking key variables, such as ESG controversies scores, total debt, and long-term debt, are removed, as are firms with negative total assets or equity, in order to ensure the robustness and comparability of financial ratios (Jucá et al., 2024).

The dataset is heavily concentrated in several large markets. Notably, companies headquartered in the United States account for 25.51% of the total, followed by China (15.24%), India (6.31%), Japan (5.86%) and the United Kingdom (4.98%). Collectively, firms from these five countries represent over 58% of the sample (Table 1A).

Using the TRBC industry classification, we identify a broad range of sectors represented in the sample. The three largest sectors by firm count are Industrials (17%), Technology (16%), and Consumer Cyclical (15%). These sectors collectively comprise nearly half of the firm-level coverage in our study, providing a diversified yet representative base for analysing the relationship between ESG controversies and debt maturity across industries (Table 1B).

Insert Table 1

3.2 Variables

Our dependent variable, debt maturity, is defined as the ratio of long-term debt, maturing in more than one year, to total debt. This measure reflects the firm's reliance on long-term financing and is widely used in studies examining debt structure decisions (e.g., Antoniou et al., 2006).

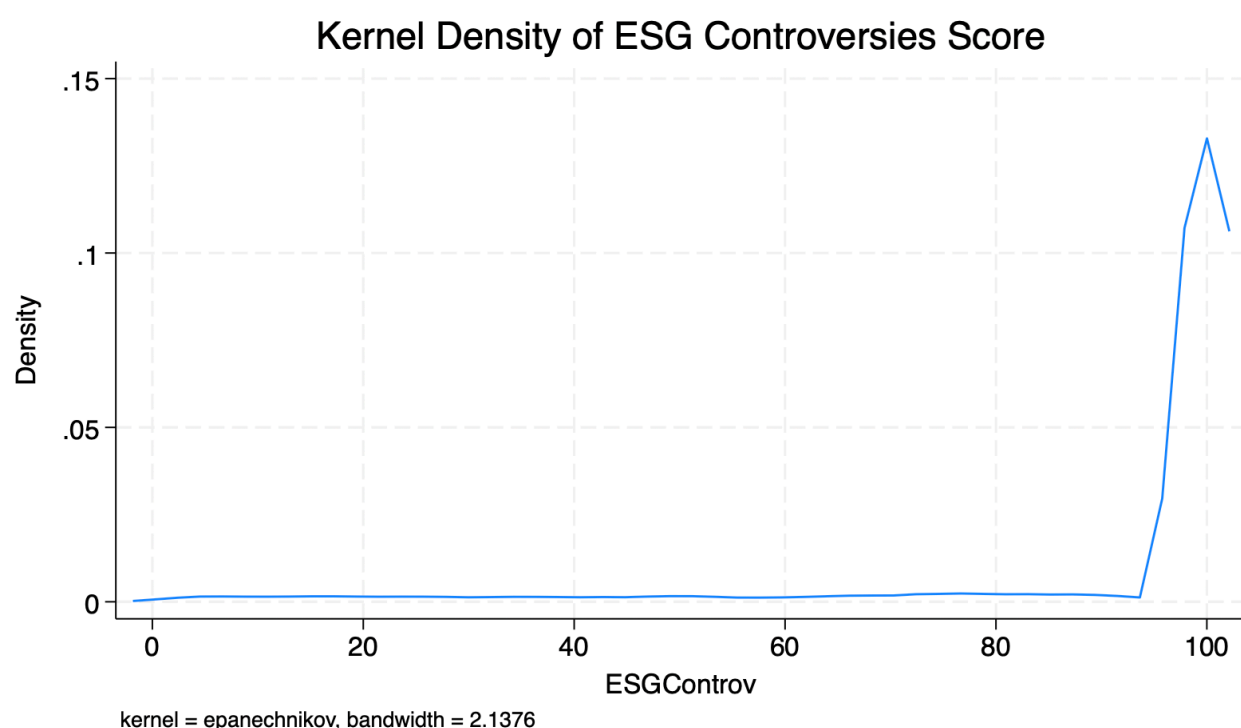
The ESG Controversy Score is sourced from the LSEG database and measures the frequency and severity of negative events related to a firm's ESG practices. The original variable is a percentile score ranging from 0 to 100, with higher values indicating either the absence of ESG controversies or minimal negative impact within the fiscal year. Conversely, lower scores reflect the presence and relative severity of such incidents. A score of 100 denotes that the firm recorded no ESG-related negative events during the year, while any score below 100 indicates the occurrence of one or more controversies (Dorfleitner et al., 2022; LSEG, 2024).

According to the official LSEG scoring methodology (2024), the ESG controversy score is constructed from 23 predefined categories covering various dimensions, including environmental damage, human rights violations, product safety issues, bribery and corruption, and tax fraud. All

events are identified through global media monitoring and weighted by severity factors that adjust for firm size. Specifically, the methodology assigns a severity weight of 0.33 to large-cap firms ($\geq$ USD 10 billion), 0.67 to mid-cap firms, and 1 to small-cap firms, thereby correcting for the systematic bias that larger firms are more likely to receive media coverage. This adjustment helps ensure that a lower score reflects actual controversy severity rather than exposure bias.

As illustrated in Figure 1, the ESG controversies score displays a highly skewed distribution, with a pronounced concentration of firms receiving the maximum score of 100. In contrast, firms with any reported controversy tend to receive significantly lower scores, often in the range of 0 to 75, although these cases are relatively rare. Given this skewness and the limited variation among non-controversial firms, we follow Bryant et al. (2022) and recode the score as a binary indicator: firms with scores below 100 are coded as 1 (indicating the presence of controversy), and those scoring 100 are coded as 0 (indicating no controversy). This transformation enhances interpretability and improves the robustness of comparisons across firms and over time.

Figure 1 Distribution of ESG Controversies Score



To test the robustness of the relationship between ESG decoupling and debt maturity, we also employ four alternative measures, which are illustrated in the Appendix Table A1. The first is an intensity-based continuous measure, labelled decoupling2, defined as one minus the ESG Controversies Score divided by 100. Larger values indicate a higher level of controversy in that year. The second is an ever-occurred firm-level dummy, decoupling3, which equals one if the firm experiences at least one controversy during the sample period, and zero otherwise. This measure captures the persistent shadow of past incidents. The third is a firm-level frequency measure,

decoupling⁴, computed as the proportion of sample years in which the firm's ESG Controversies Score is not equal to 100, which reflects the regularity of controversies. Finally, we include reversed ESG Controversies Score, decoupling⁵, as a monotonic transformation to align the direction with the decoupling concept, so that higher values imply greater decoupling.

In each robustness exercise, we replace the baseline indicator with one alternative proxy, keep all other covariates and the specification unchanged, and confirm that the main results do not depend on a particular measurement choice.

We include a set of control variables to account for firm-specific financial characteristics that may influence long-term debt maturity. *Firm size*, defined as the natural logarithm of total assets, is included because larger firms typically have better access to capital markets and face lower information asymmetry, making them more likely to issue long-term debt (Barclay & Smith, 1995; Barclay et al., 2003; Custódio et al., 2013).

To control for firm characteristics related to liquidity risk and signalling behaviour, this research controls for leverage, liquidity and firm quality to isolate the influence of these factors on debt maturity decisions. *Leverage*, the ratio of total debt to total assets, is included to capture the effect of capital structure on maturity decisions. Prior research shows that firms with higher leverage may prefer longer maturities to reduce refinancing risk (Johnson, 2003; Ataullah et al., 2018). *Liquidity*, measured by the proportion of current assets to total assets, is used to capture short-term financial flexibility. A higher ratio indicates that a firm holds more liquid assets, which may signal a lack of long-term investment. According to Myers and Rajan (1998), excessive liquidity can reduce the credibility of managerial commitment to long-term projects, making lenders less willing to provide long-term debt. *Firm quality*, measured as net income plus depreciation divided by net debt, reflects a firm's operational strength and debt repayment capacity. According to signalling theory (Flannery, 1986), high-quality firms may use short-term debt to signal their strength to an asymmetrically informed market, implying a negative relation.

To account for firms' profitability and growth potential, we control for return on assets (ROA), stock performance, and sales growth. *ROA*, defined as net income over total assets, captures internal earnings capacity and reflects the firm's ability to generate returns from its asset base. A higher ROA signals stronger financial health and is positively associated with long-term debt capacity. *Stock performance*, measured as the annual log change in share price, reflects market confidence in the firm's future prospects. Firms with strong past stock returns may face lower information asymmetry and are more likely to access long-term debt markets (Guedes & Opler, 1996). *Sales growth*, calculated as the year-on-year percentage change in total revenue, serves as an indicator of operating momentum and expected expansion needs. As discussed by Myers (1977) and Titman (1992), growth-oriented firms may prefer short-term debt to mitigate agency and underinvestment problems, while others may rely on long-term debt to reduce liquidity risks or constrain managerial discretion (Diamond, 1991; Hart & Moore, 1995). Furthermore, firms with higher tangible assets are more likely to obtain long-term debt, as these assets can be used as

collateral and better match the maturity of debt to the life of assets (Myers, 1977; Barclay & Smith, 1995). Therefore, we use *asset tangibility* measured by net property, plant and equipment relative to total assets, to reflect the degree of capital intensity and asset pledgeability.

The effective tax rate (ETR) is also included, defined as income tax over pre-tax income, to capture firms' incentives for interest tax shields. According to the tax-based theory of capital structure (Brick & Ravid, 1985; Scholes & Wolfson, 1992), firms facing higher tax rates have a stronger motivation to use long-term debt to maximise the present value of interest deductions. Longer maturity increases the duration over which interest expenses are incurred and deducted, thereby enhancing tax benefits. As a result, a positive association between ETR and debt maturity is expected, as firms optimise their capital structure to exploit tax shields over time.

R&D intensity is included as a control variable to account for firms' innovation strategies and their associated uncertainty in future cash flows. R&D is typically associated with high levels of information asymmetry, suggesting a negative relationship between R&D and debt maturity (Hall, 2002).

Governance structures may shape firms' access to capital and their preferences regarding debt maturity. To account for this, we include several corporate governance indicators that reflect both managerial power and stakeholder engagement. *CEO duality*, where the CEO also serves as board chair, is commonly associated with weaker board oversight and greater agency concerns, which can lead creditors to prefer shorter maturities to reduce risk exposure (Berger et al., 1997). *Board independence* enhances monitoring effectiveness and reduces managerial discretion, which can increase lenders' confidence and lower the risk premium associated with long-term debt (Anderson et al., 2004). *The presence of a CSR committee* signals institutionalised ESG oversight and long-term orientation. Firms with such structures are generally perceived as more transparent and socially responsible, improving their attractiveness to long-term creditors (Ben-Amar et al., 2017). *Gender diversity* on the board has been linked to improved decision-making, enhanced risk governance, and stronger stakeholder responsiveness, all of which contribute to a firm's reputational capital and may facilitate access to long-term financing (Adams & Ferreira, 2009).

Finally, to account for sector-level variation in market structure, we construct an industry-level sales concentration, calculated as the sum of squared market shares based on firm-level sales revenue within each industry-year. A higher sales concentration indicates a more concentrated industry with less competitive pressure. Country-level macroeconomic conditions are controlled for using annual *GDP growth* and *inflation*, sourced from the IMF and World Bank. We follow Brockman et al. (2010) and construct the *term structure* variable as the yield spread between long-term government bonds and short-term treasury bills. The spread is calculated using the month-end yields aligned with the firm's fiscal year-end. A steeper (more upward-sloping) term structure implies higher future interest rates, which may incentivise firms to lock in current rates via longer maturities (Brick & Ravid, 1985).

All continuous variables are winsorised at the 1st and 99th percentiles to mitigate the influence of outliers. Detailed definitions for each variable are provided in Appendix 1.

3.3 Model Selection

This section outlines the regression model used to examine whether ESG decoupling influences corporate debt maturity. Given the international scope of the data and the presence of firm-, industry-, and country-level factors, the analysis requires an approach capable of modelling variation across multiple layers. We therefore describe the structure of the dataset, motivate the use of multilevel modelling, and explain how this framework allows us to capture heterogeneity across countries and industries while accounting for firm-level characteristics. We also discuss key identification considerations, including potential endogeneity, and outline the steps taken to address them.

As mentioned above, this study investigates whether corporate ESG decoupling influences firms' debt maturity structure. The empirical analysis is based on an unbalanced panel dataset spanning the period from 2004 to 2023, covering observations at the firm level across 40 countries and multiple industries. Specifically, the data exhibit a multilayered nesting structure, firm-year observations are nested within firms, which are themselves nested within specific industries and countries. In addition to firm-level financial and ESG indicators, the dataset includes industry-level measures such as the sales concentration and country-level macroeconomic variables such as GDP growth, inflation and term structure. This nested structure implies potential within-group correlation at the firm, industry, or country level, which challenges the independence assumptions underlying conventional regression models.

In light of this structural complexity, we adopt a hierarchical linear model (HLM), also referred to as a linear mixed model (LMM), as our primary estimation approach. Mixed models combine the strengths of fixed and random effects, while the fixed effects estimate the average association between explanatory and outcome variables, the random effects capture unobserved heterogeneity across higher-level groupings such as countries or industries. Compared with traditional OLS or fixed effects models, multilevel models offer the advantage of explicitly modelling variance at multiple levels.

Although the Hausman specification test is commonly employed to choose between fixed and random effects, prior studies have shown that the test may suffer from an over-rejection problem (Kabaila et al., 2015). This limitation suggests that reliance solely on the Hausman test could lead to biased model selection, further justifying the adoption of multilevel modelling in our setting.

By incorporating both random intercepts and random slopes, the model allows us to assess whether the effect of ESG decoupling on debt maturity varies systematically across countries or industries, while simultaneously controlling for firm-specific characteristics. This approach enables us to retain the full richness of the international and cross-sectoral panel structure without sacrificing

estimation efficiency (Rabe-Hesketh & Skrondal, 2021). Furthermore, multilevel models allow for the estimation of the intraclass correlation coefficient (ICC), which quantifies the degree of clustering in debt maturity across countries or industries.

In summary, given the hierarchical nature of the data and the research objective's focus on group-level heterogeneity, the use of multilevel modelling is both theoretically and technically appropriate. To reduce concerns about reverse causality, we adopt a lagged independent variable approach in which the ESG decoupling indicator is lagged by one year to examine any delayed effects of ESG incidents as a robustness check (Favero & Belfiore, 2019).

3.4 Model Design

In our model, we adopt a three-level structure: time (t), firm (j), and a combination of industry (i) and country (c). Following the approach of Juca et al. (2024), we treat industry and country as crossed classification factors rather than nested levels. This reflects the fact that industries are not inherently nested within countries, nor vice versa. For instance, a firm operating in the automotive sector in Germany belongs to the same industry category as a firm in Japan or the US. Accordingly, each firm is nested within a specific industry-country combination. We therefore employ a cross-classified multilevel model, which appropriately accounts for the simultaneous influence of both country- and industry-level contextual heterogeneity (Kayo and Kimura, 2011).

3.4.1 The Null Model

The null model is estimated as a preliminary step to assess the appropriateness of applying a multilevel modelling framework to our panel data, which includes firm-year observations nested within industries and countries. This baseline model does not include any explanatory variables, focusing solely on intercepts and variance components across levels. The aim is to decompose the total variance in debt maturity into time-, firm-, industry-, and country-level components. By identifying how much variation is attributable to each level, we can evaluate the extent to which firms within the same industry and country exhibit similar debt maturity behaviour, potentially due to shared institutional, regulatory, or market environments. Conversely, substantial between-cluster variation across industries and countries would further justify the use of a hierarchical linear model. This null model thus establishes the statistical foundation for the full model by confirming the presence of clustered dependence and multilevel heterogeneity in debt maturity decisions.

In the first stage of the model, we decompose the observed variation in debt maturity at the time level as follows:

$$\text{Eq.1: Maturity}_{tjic} = \beta_{0jic} + e_{tjic}$$

Where Maturity_{tjic} represents the debt maturity of firm (j) in industry (i) and country (c) at time (t). The term β_{0jic} captures the average debt maturity level of that firm across time, industry, and country. The residual term e_{tjic} at this level represents variation across years and is assumed to

follow a normal distribution with a constant variance σ^2 . This specification allows us to isolate within-firm temporal variation before incorporating higher-level random components.

Next, we account for firm-level variation in average debt maturity by linking each firm's intercept term β_{0jic} to the overall mean maturity within its industry-country context, denoted as γ_{00ic} . This structure captures systematic similarities among firms that operate under comparable institutional and sectoral conditions. A firm-specific deviation term r_{0jic} is included to reflect unobservable differences between firms, such as variations in financial policy or managerial discretion.

$$\text{Eq1a: } \beta_{0jic} = \gamma_{00ic} + r_{0jic}$$

After that, we capture variation across industry and country contexts by modelling the industry-country-specific intercept γ_{00ic} as a random variable. This term is decomposed into four components: the grand mean of debt maturity across all observations δ_{0000} , an industry-level deviation s_{00i0} , a country-level deviation τ_{000c} , and an interaction term u_{00ic} that reflects residual variation jointly attributable to the industry-country combination. This specification enables the model to account for contextual heterogeneity stemming from structural factors specific to both national and sectoral environments.

$$\text{Eq1b: } \gamma_{00ic} = \delta_{0000} + s_{00i0} + \tau_{000c} + u_{00ic}$$

Finally, the fourth equation integrates all components of the multilevel structure into a single unconditional mixed model, where each term captures variation at a specific level of the data hierarchy. The overall debt maturity for firm (j) in industry (i) and country (c) at time (t) is modelled as the sum of five sources of random variation, where the global average δ_{0000} , deviations are attributable to industry s_{00i0} , country τ_{000c} and their interaction u_{00ic} , as well as firm-specific r_{0jic} and time-specific errors e_{tjic} . This specification, referred to as Model 1, serves as a baseline for evaluating the proportion of variance in debt maturity attributable to each level of the cross-classified structure.

$$\text{Eq1c: Maturity}_{tjic} = \delta_{0000} + s_{00i0} + \tau_{000c} + u_{00ic} + r_{0jic} + e_{tjic}$$

3.4.2 Random intercept models

In the second stage of the model (Eq2), we extend the unconditional null specification by incorporating firm-level explanatory variables into a random intercept framework. Specifically, we estimate a linear mixed-effects model with random intercepts at the country, industry, and firm levels, as well as at the cross-classified interaction between country and industry. This approach accounts for unobserved heterogeneity across hierarchical and cross-classified clusters, while allowing for fixed effects of ESG decoupling and a range of control variables ($\mathbf{X}_{tjic}$), such as firm size, leverage, liquidity, and macroeconomic indicators. Time fixed effects (year dummies) are also included. The random intercept model thus allows us to estimate firm-level relationships

within shared industry and country environments, while accounting for systematic differences across contextual groupings. In Equation (2a), firm-level variables are included at the first level of analysis, as they vary both between firms and within firms over time.

Equation (2a):

$$\text{Maturity}_{tjic} = \beta_{0jic} + \beta_1 \cdot \text{Decoupling}_{tjic} + \beta_\gamma \sum \mathbf{X}_{tjic} + \beta_\delta \cdot \text{Year}_t + e_{tjic}$$

Equation (2b) adds fixed effects related to the industry level. Specifically, we include the sales concentration to capture market concentration across sectors. This addition allows us to test whether the degree of competition within an industry influences the relationship between ESG decoupling and debt maturity. The firm-level average debt maturity term β_{0jic} is now partially explained by industry-specific structural factors, while the residual firm-level variance is captured by a random error component.

Equation (2b):

$$\text{Maturity}_{tjic} = \beta_{0jic} + \beta_1 \cdot \text{Decoupling}_{tjic} + \beta_\gamma \sum X_{tjic} + \beta_\varepsilon \cdot \text{SC}_i + \beta_\delta \cdot \text{Year}_t + e_{tjic}$$

Equation (2b') further expands the structure of the random intercept. It allows the average debt maturity at the firm level to be partially explained by industry-level market concentration, as captured by the Sales Concentration (SC). The term γ_{00ic} reflects the baseline industry-country mean, while γ_{01ic} measures the marginal effect of SC, and r_{0jic} captures firm-specific residual variance.

Equation (2b'):

$$\beta_{0jic} = \gamma_{00ic} + \gamma_{01ic} \cdot \text{SC}_{00ic} + r_{0jic}$$

Equation (2c) includes country-level explanatory variables. It extends the previous model by examining whether country-specific macroeconomic conditions systematically influence firm-level debt maturity. The country-level predictors, Z , include the inflation rate, GDP growth, and the term structure of the interest. These variables capture macroeconomic stability, credit market development, and interest rate expectations. The firm-level intercept γ_{00ic} , representing the average maturity level for firms in industry (i) and country (c), is thus modelled as a function of these country-level characteristics. Residual variation is partitioned into industry-specific random effects s_{00i0} , country-level random effects τ_{000c} and their interaction term u_{00ic} .

Equation (2c)

$$\gamma_{00ic} = \delta_{0000} + \delta_{0001} \cdot Z_{000c} + s_{00i0} + \tau_{000c} + u_{00ic}$$

Finally, Equation (2d) integrates the firm-, industry-, and country-level components into a unified mixed-effects framework. It combines the fixed effects introduced in previous specifications, including ESG decoupling, firm-level financial and governance controls, industry structure (SC), and macroeconomic conditions such as inflation, GDP growth, and the term structure. This comprehensive model enables us to assess whether ESG decoupling influences debt maturity decisions after accounting for variation across firms, industries, and institutional contexts.

The intercept terms at the country, industry, and firm levels are modelled as random, capturing unobserved heterogeneity nested or crossed within the data structure. As such, debt maturity is treated as a function of multi-level factors, each with its own associated source of residual variation.

Equation (2d):

$$\text{Maturity}_{tjic} = \delta_{0000} + \beta_{1jic} \cdot \text{Decoupling}_{tjic} + \beta_{2jic} \cdot X_{tjic} + \gamma_{01ic} \cdot W_{00ic} + \delta_{0001} \cdot Z_{000c} \\ + \beta_{3jic} \cdot \text{Year}_t + s_{00i0} + \tau_{000c} + u_{00ic} + r_{0jic} + e_{tjic}$$

Where,

t=time (level 1)

j=firm (level 2)

i=industry (level 3)

c =country (level 3)

Maturity =debt maturity as the dependent variable (level 1)

YEAR =year dummy independent variable (level 1)

Decoupling=ESG controversy score based dummy variable (level 2)

X=firm control variables (level 2)

W=industry control variables (level 3)

Z=country control variables (level 3)

e_{tjic} , r_{0jic} , u_{00ic} , s_{00i0} and τ_{000c} are random errors at levels 1, 2, and 3, respectively.

β_{0jic} , γ_{00ic} and δ_{0000} are intercepts at levels 1, 2, and 3, respectively.

4. Analysis and Results

In this section, we present the empirical results assessing whether ESG decoupling is associated with firms' debt maturity structures. Section 4.1 provides descriptive statistics, and Section 4.2

offers pairwise correlations for the key variables used in our analysis. In Section 4.3, we estimate a series of linear mixed-effects models to account for the multilevel structure of our panel data. We begin with a null model to assess the proportion of variance attributable to each level, and then incrementally introduce fixed effects and random components at the firm, industry, and country levels.

4.1 Descriptive Statistics

Table 2 Panel A reports summary statistics for the full sample of 50,452 firm-year observations. The dependent variable, (*Maturity*), ranges between zero and one, with a mean of about 0.732 and a standard deviation close to 0.276. On average, firms finance roughly 70% of interest-bearing debt with long maturities, yet there is wide dispersion. Observations at zero indicate exclusive reliance on short-term debt in a given year, while observations at one indicate entirely long-term structures. This variation is economically meaningful because it reflects heterogeneous rollover risk, monitoring intensity from creditors, and differences in contracting environments.

The ESG controversy score, *ESGControv*, has a mean of 92.5 on a 0 to 100 scale and spans almost the full range. Higher values indicate fewer recorded controversies, so the distribution suggests that most firms face limited controversy in a typical year, although a non-trivial tail experiences significant incidents. Consistent with this, the decoupling indicators show measurable incidence. The annual dummy decoup1 averages about 0.154, which implies that around 15% of firm-years are flagged as decoupling events. The continuous index decoup2 is small on average, which reflects the high level of ESG decoupling, but it reaches values close to one for the most controversy-prone observations. At the firm level, decoup3 indicates that roughly 49% of firms experience at least one decoupling over the sample window. The intensity measure decoup4 averages about 0.154, which means that, for the typical firm, flagged years account for around one-sixth of its observed history. These patterns show that ESG-related shocks are infrequent for many firms, yet common enough to provide meaningful cross-sectional and intertemporal variation.

In terms of the three channels, the information environment displays substantial heterogeneity. The three-week bid-ask spread (*spread*) averages about 0.004, with a long right tail up to 0.133. Most firms therefore trade in relatively liquid markets, while a minority face periods of poor liquidity and wider spreads that raise information costs for outside investors. Cash holdings (*cashholding*) average about 0.150 of total assets and reach values close to one in extreme cases. Altman's Z-Score shows that the mean is 0.576, with a standard deviation of 0.287, and values range from -0.748 to 1.582 . The positive mean indicates that firms, on average, maintain a comfortable solvency cushion in this accounting-based composite. The dispersion is moderate relative to the mean, which suggests meaningful but not extreme variation in solvency conditions across the panel. The lower tail captures episodes of weaker coverage and higher leverage for a minority of observations, consistent with tighter financing constraints and greater rollover risk. The upper tail points to firms with resilient balance sheets and easier access to long-term funding.

Firm-level controls are in expected ranges. Firm size, measured as the logarithm of total assets, has a mean of 15.2 and a standard deviation of 1.68, which indicates a broad coverage from relatively small-listed firms to very large corporations. For profitability and performance measures, *ROA* is positive on average and exhibits a wide range from large losses to strong profitability. *Sales Growth* captures the rate at which a firm's revenue expands over time. The mean growth rate is 0.112, with a standard deviation of 0.344, and the values range from -0.611 to 2.071. The widespread and positive skewness suggests that while many firms experience moderate or negative sales growth, a subset demonstrates exceptionally strong revenue increases, potentially due to rapid market expansion or product innovation. *Stock Performance* is measured as the logarithmic return on the firm's stock close price. This transformation captures the continuously compounded rate of return and is commonly used in financial studies due to its time-additive property. The mean log return is -0.014 with a standard deviation of 0.396, and the values range from -1.316 to 1.020. The distribution centres near zero, indicating that most firms exhibit relatively modest price fluctuations over the period.

This research also controls the firm's internal ability to service debt by *Firm Quality*, which is proxied by the ratio of Net Income plus Depreciation to Net Debt. The mean is 0.105, but the standard deviation is large (5.171), with extreme values from -601.35 to 315.75. This dispersion implies that while many firms maintain moderate financial quality, a few exhibit extreme leverage or strong solvency. *Leverage* centres around 0.286 with ample variation from near zero to three-quarters of assets, which captures differences in target capital structures and debt capacity. *Liquidity* averages about 0.39, again with wide dispersion. The effective tax rate, *ETR*, averages about 0.193 with a standard deviation of 0.342, and the values range from -1.529 to 1.776. Negative values arise when firms report losses or tax credits that make the total tax expense negative. Values above one occur when pre-tax income is small or when one-off items and deferred tax adjustments raise the reported tax charge. The distribution points to heterogeneous tax positions across firms and over time, which matters for financing choices because the marginal benefit of the interest tax shield and the internal cash flow available for debt service vary with the effective tax burden. Research and development Intensity (*R&D*) shows how much a firm spends on research and development relative to the profits it reports. The mean is 0.020, with a standard deviation of 0.051, and the values lie between 0 and 0.804. The distribution is concentrated near zero, which indicates that many firms report little or no research and development expenditure, while a smaller group invests heavily.

Governance characteristics show meaningful cross-sectional variation. CEO duality is present in about 35% of observations. A CSR committee exists in roughly 57% of firm-years. Board independence averages about 57% of seats, with a wide range from one-eighth to over nine-tenths. Female representation on the board averages about 18% and reaches over three-quarters in the most gender-diverse boards. These features imply diversity in monitoring intensity and stakeholder engagement across firms, which may influence financing choices.

Lastly, industry and macro controls behave as expected. Sales Concentration (*SC*) has a mean of around 0.197, coupled with a standard deviation of 0.2075, revealing wide heterogeneity in industry concentration. This implies that the sample spans markets ranging from highly competitive industries with numerous small firms to concentrated sectors dominated by a few large companies. Average *inflation* and *GDP growth* are 2.7% and 2.5% respectively, and the *term structure* has a mean of 0.7531% and a standard deviation of 1.0761. This suggests that, on average, the yield curve is upward-sloping, but with substantial variation across countries and years. The large range (from -14.11% to 5.67%) indicates that the sample spans both inverted and steep yield curve periods, capturing diverse macro-financial conditions.

Table 2 Panel B compares the mean and median values of key variables between decoupling and non-decoupling firms. Both measures indicate that non-decoupling firms have significantly shorter debt maturities than their decoupling counterparts (mean = 0.721 vs. 0.792; median = 0.816 vs. 0.857; $p < 0.01$). This suggests that, on average, firms exhibiting ESG decoupling are associated with longer debt structures. One possible explanation is that decoupling firms tend to be larger (mean = 14.93 vs. 16.62) and more visible, often operating in industries with higher sales concentration (mean = 0.194 vs. 0.215), which may provide them with better access to long-term financing.

In contrast, non-decoupling firms are generally smaller, less leveraged, and hold higher liquidity ratios, reflecting more conservative financial policies. Median differences confirm these tendencies, indicating that the results are not driven by outliers. Moreover, decoupling firms show weaker governance characteristics, such as higher CEO duality (0.44 vs. 0.34) and lower board independence (0.66 vs. 0.56), but are more likely to establish dedicated CSR committees, consistent with the notion that larger firms face stronger institutional and stakeholder pressures. These descriptive patterns highlight meaningful structural and governance differences between decoupling and non-decoupling firms, suggesting potential heterogeneity in their financing behaviour.

Insert Table 2

4.2 Correlation

Table 3 presents the pairwise correlation coefficients for all variables included in the empirical analysis. The correlation between the key independent variable, ESG Controversies Score, and the dependent variable, maturity, is negative and statistically significant (-0.085, $p < 0.01$). This preliminary result is consistent with our main hypothesis (H1) that firms involved in ESG controversies tend to adopt shorter debt maturity structures, potentially due to elevated uncertainty and weakened investor confidence.

Several control variables also show significant correlations with maturity, in directions that are largely in line with prior literature. For instance, the proportion of independent directors is

positively associated with debt maturity (0.335, $p < 0.01$), suggesting that stronger governance may improve lenders' confidence in long-term repayment. Similarly, tangibility is positively correlated with maturity (0.192, $p < 0.01$), supporting the notion that firms with greater fixed assets seek to match long-term liabilities with long-term investments.

In terms of macroeconomic factors, GDP growth is negatively associated with debt maturity (-0.133, $p < 0.01$), suggesting that firms may tend to select shorter maturities in high-growth environments to maintain financial flexibility. By contrast, the term structure of interest shows a positive correlation (0.042, $p < 0.01$), consistent with the theoretical prediction that a steeper yield curve encourages long-term borrowing.

The correlation matrix also provides initial support for our proposed mechanisms. ESG Controversies score is negatively correlated with board independence (-0.144, $p < 0.01$), implying that ESG controversies may be associated with weaker governance, which may be an important factor that can elevate information asymmetry or financial distress and thus shorten debt maturity.

To assess the presence of multicollinearity, we calculate the Variance Inflation Factor (VIF). The average VIF in our model is 1.27, well below the commonly accepted threshold of 2.0 (Zuur et al., 2010), suggesting that multicollinearity is not a concern in our analysis.

Insert Table 3

4.3 Baseline model

4.3.1 Null Model

Table 4 presents the results of the variance decomposition based on multilevel modelling, evaluating how the total variance in debt maturity is distributed across firm, industry, country, and time levels. In the first column, the total variance is 0.0762. Country accounts for 0.0124, which is 16.26% of the total. Industry accounts for 0.0021, which is 2.80%. The country by industry cell also contributes 0.0021, which is 2.80%. Firm explains 0.0311, which is 40.80%. The residual is 0.0284, which is 37.33% and captures variation over time because year is not modelled as a random effect.

Columns 2 to 4 progressively include explanatory variables at the firm, industry, and country levels, respectively. The shape of the variance decomposition remains essentially unchanged. The firm component is consistently the largest at about 40%, the country component is the next largest, from 13.66% to 16.26%, industry and the country-industry cell each account for only around 1 to 2%, and the residual remains sizeable and is close to 40% as it absorbs within firm variation over time.

This pattern indicates that the primacy of firm-specific conditions in shaping debt maturity, with institutional context at the country level playing a stable secondary role. Second, the large residual share indicates meaningful within-firm movement over time that is not captured by random

intercepts alone. These features justify a mixed effects framework with crossed random intercepts at the firm and country levels, complemented by year effects and macro controls in the main regressions.

Across all model specifications, the likelihood-ratio tests are highly significant ($p < 0.001$), rejecting the null hypothesis that variance between groups is zero. This provides strong support for adopting a multilevel modelling approach rather than a conventional linear regression, as it more accurately accounts for the nested data structure and the unignorable clustering effects at multiple levels.

Insert Table 4

4.3.2 Random intercept models

Table 5 presents the results from four hierarchical linear models with random intercepts at the country, industry, and firm levels. These models examine H1, i.e., whether ESG decoupling influences corporate debt maturity decisions, while accounting for the nested structure of the data and unobserved heterogeneity across firms, industries, and countries.

In the Null Model, which includes no explanatory variables, the estimated intercept is 0.7081 ($p < 0.01$), indicating that the average value of debt maturity across the full sample, after accounting for random variation across firms, industries, and countries, is approximately 70.81%. This serves as a useful baseline for evaluating the effect of ESG decoupling and other covariates in subsequent models.

In the second column, firm-level controls are added. The coefficient for ESG decoupling is negative and statistically significant at the 1% level (-0.0097), suggesting that, on average, firms with ESG-related controversies have debt maturities that are 0.97% shorter than those without such controversies. Among the firm-level covariates, firm size shows a positive and significant effect (0.0235 , $p < 0.01$), consistent with the idea that larger firms enjoy stronger market access. Leverage is positively associated with maturity (0.2259 , $p < 0.01$), which may reflect a substitution toward longer debt instruments to stabilise cash flows. Liquidity is negatively related to maturity, possibly indicating that more liquid firms rely less on long-term borrowing. Governance variables such as independence (0.0266) and gender (0.04) are both positive and significant at the 1% level, reinforcing the view that stronger governance is associated with improved access to long-term debt.

Column 3 extends the specification by adding industry-level controls. The coefficient on ESG decoupling remains (-0.0097 , $p < 0.01$), reinforcing the robustness of its effect across sectors. The consistency of coefficients across Models 2 and 3 indicates that the ESG decoupling-maturity relationship is not confounded by sectoral differences.

Column 4 further incorporates macroeconomic variables at the country level, including inflation, GDP growth, and term structure, to capture institutional and financial market differences across countries. The ESG decoupling coefficient remains negative and statistically significant (-0.0095 ,

$p < 0.01$), suggesting a 0.95 percentage point reduction in debt maturity for decoupled firms, even after controlling for country-specific factors. Among macro-level controls, inflation has a significantly negative impact on debt maturity (-0.2367 , $p < 0.01$), indicating that in inflationary environments, firms may prefer or be forced to shorten their debt horizon due to increased refinancing risk or lender caution.

This result supports Hypothesis 1 (H1) and indicates that ESG decoupling, reflecting inconsistencies between firms' stated ESG commitments and actual practices, is associated with shorter debt maturities. This empirical pattern aligns with the perspective of signalling theory. The observed shortening of debt maturities may represent a market response to ambiguous ESG signals, as creditors seek to reduce monitoring costs by favouring shorter contractual horizons. Also, from the perspective of legitimacy theory, the result could also suggest that firms experiencing legitimacy concerns find it more difficult to secure long-term debt, as lenders and stakeholders reassess their credibility following ESG controversies. Agency theory offers an internal interpretation as well. Under heightened scrutiny, managers might prefer short-term financing to maintain strategic flexibility and discretion, even if such choices increase refinancing exposure. Jiang et al. (2025) also find that disagreement in ESG ratings increases market uncertainty and exacerbates firms' default risk, thereby negatively influencing debt maturity structures using a panel of Chinese non-financial listed firms from 2007 to 2020.

Insert Table 5

5. Channel Analysis

After establishing a significant association between ESG decoupling and firms' debt maturity structure, we further investigate the potential mechanisms that underlie this relationship. Drawing on institutional theory and the financial contracting literature, we propose three plausible, non-mutually exclusive channels through which ESG decoupling may influence corporate debt maturity decisions: (1) elevated levels of information asymmetry, (2) increases in the corporate liquidity position, and (3) deteriorated financial health as indicated by distress risk.

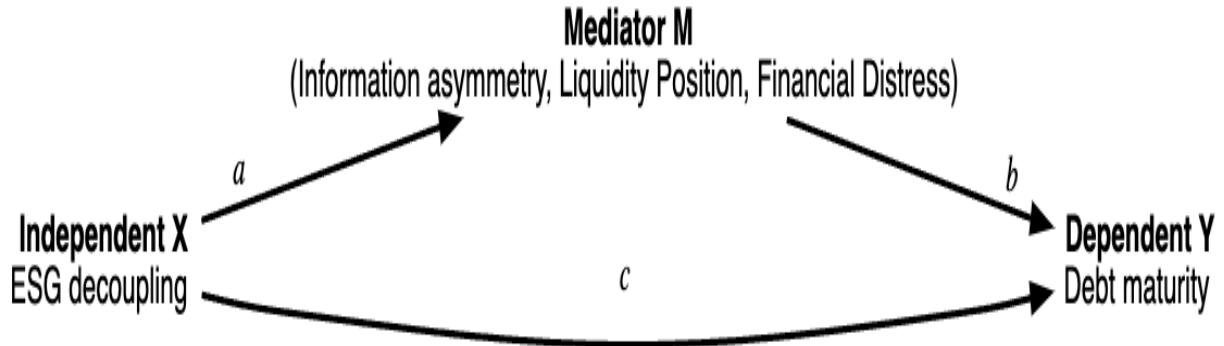
As discussed in Section 2, ESG decoupling reflects a discrepancy between symbolic sustainability commitments and substantive practices, which can erode market trust and reduce the transparency of corporate operations. This opacity potentially increases information asymmetry between firms and creditors, thereby prompting creditors to demand shorter maturity structures. Second, in response to heightened external scrutiny or anticipated financing constraints, firms engaging in symbolic ESG behaviour may accumulate excess cash reserves as a form of self-insurance, which in turn affects their capital structure preferences. Third, ESG decoupling may signal underlying

deficiencies in governance and operational resilience, contributing to greater financial distress and reducing firms' ability to secure long-term debt.

These mechanisms are grounded in established research streams within corporate finance, corporate governance, and sustainability disclosure. By examining these pathways, this section aims to clarify how the symbolic-practical gap in ESG practices translates into observable changes in debt maturity structure, thus contributing to a more nuanced understanding of capital structure decisions under legitimacy pressures.

To investigate the mechanisms through which ESG decoupling affects debt maturity structure, we initially estimate a series of regression models to identify whether an indirect effect exists. Specifically, we follow the conceptual logic often attributed to Baron and Kenny (1986), which involves assessing whether ESG decoupling influences a hypothesised mediator (e.g., information asymmetry, liquidity position, or financial distress), and whether this mediator, in turn, affects debt maturity. However, rather than requiring that the total effect of ESG decoupling on debt maturity be significant, or that the direct effect becomes insignificant upon inclusion of the mediator, we follow Zhao et al. (2010) in focusing solely on the significance of the indirect effect ($a \times b$) to establish mediation (Figure 2).

Figure 2 A Three-variable Non-recursive Causal Model



We avoid reliance on the traditional "three-step" causal steps approach, which has been criticised for imposing strict and potentially misleading conditions. In particular, the absence of a significant direct effect does not imply the absence of mediation, and a significant direct effect may still coexist with meaningful indirect paths, potentially indicating omitted mechanisms.

Moreover, including both ESG decoupling and the mediator in a single regression may introduce post-treatment bias, given that the mediator is itself causally affected by ESG decoupling (Zhao et al., 2010; Imai, Keele, & Tingley, 2010). To mitigate such concerns and derive more robust inferences, we employ a nonparametric bootstrap test to directly assess the statistical significance of the indirect effect. This method, as recommended by Preacher and Hayes (2004, 2008),

constructs percentile-based confidence intervals using 1,000 replications and does not rely on the normality assumptions or on potentially endogenous regression specifications.

By integrating this bootstrap procedure with regression-based estimation of a and b paths, we preserve the accessibility and interpretability of the traditional linear modelling framework while enhancing the credibility of our mediation analysis. This hybrid strategy has been increasingly adopted in empirical finance research where mediators are observed rather than experimentally manipulated and where residuals often violate classical distributional assumptions.

5.1 Information Asymmetry

To explore the underlying mechanisms through which ESG decoupling influences the corporate debt maturity structure, this study considers information asymmetry as a key mediating variable. Following prior research, we employ the bid-ask spread as a proxy for firm-level information asymmetry (Copeland and Galai, 1983, Glosten and Milgrom, 1985, Easley and O'hara, 1987, Glosten and Harris, 1988). A wider spread reflects greater disagreement among market participants about firm value, typically arising from insufficient or untrustworthy disclosures. In the context of ESG decoupling, investors may perceive such inconsistency as a signal of hidden risks or masked management practices, thereby elevating information asymmetry.

As discussed in the theoretical section, higher information asymmetry increases the costs of external financing, particularly for long-term borrowing, as creditors require stronger signals to price long-horizon risks. Consequently, firms facing greater perceived opacity tend to shorten their debt maturity structure, in line with adverse selection theory.

To test this mediating pathway, we apply the three-step procedure proposed by Baron and Kenny (1986) using Model 1-3.

$$\text{Model 1: Maturity}_{it} = \alpha_1 + c \cdot \text{Decoupling}_{it} + X'_{it}\gamma + u_i + v_j + \varepsilon_{it}$$

$$\text{Model 2: Mediator}_{it} = \alpha_2 + a \cdot \text{Decoupling}_{it} + X'_{it}\delta + u_i + v_j + \varepsilon_{it}$$

$$\text{Model 3: Maturity}_{it} = \alpha_3 + c' \cdot \text{Decoupling}_{it} + b \cdot \text{Mediator}_{it} + X'_{it}\theta + u_i + v_j + \varepsilon_{it}$$

Where:

X'_{it} = Control variables

u_i = Firm-level random intercept

v_j = Cluster-level random intercept (e.g., country, industry)

ε_{it} =Residuals

a = Effect of the independent variable on the mediator

b= Effect of the mediator on the dependent variable

c= Total effect of the independent variable on the dependent variable

c'= Direct effect of the independent variable on the dependent variable, controlling for the mediator

Table 6 shows the mechanism analysis results. In panel A, column (1) estimates the total effect of ESG decoupling on debt maturity and reveals a significant negative, suggesting that firms with ESG decoupling tend to adopt shorter debt maturity profiles. This result is consistent with the broad theoretical prediction that the weaker credibility of non-financial information leads to greater financing frictions, as creditors are less willing to commit resources for longer horizons when uncertainty about firm quality rises (Flannery, 1986; Diamond, 1991). Thus, column (1) establishes the baseline effect that needs to be unpacked through potential mechanisms.

Model (2) regresses the bid-ask spread on ESG decoupling and finds a positive and significant effect (coefficient=0.0002, $p < 0.05$), indicating that ESG decoupling increases information asymmetry. This finding is in line with the information asymmetry perspective, which suggests that when adverse ESG events occur, they undermine the credibility of firms' signals to the market, increasing the cognitive gap between firms and creditors (Myers and Majluf, 1984). Empirical research has shown that controversies intensify informational frictions by weakening market trust in reported ESG performance (Bilyay-Erdogan et al., 2024). The positive association between ESG decoupling and the bid-ask spread confirms this logic, indicating that symbolic compliance leads to heightened trading frictions and limited transparency. This provides direct evidence for the first step of Hypothesis H2a, namely that ESG decoupling increases information asymmetry.

Model (3) includes both ESG decoupling and the bid-ask spread as explanatory variables for debt maturity. In this specification, both coefficients are negative and significant, which means that ESG decoupling retains a direct effect of -0.0123 ($p < 0.01$), and the bid-ask spread also negatively affects debt maturity (-0.2688, $p < 0.01$). These results suggest that the presence of a partial mediation, where information asymmetry partially transmits the effect of ESG decoupling on the maturity structure. The latter result validates the second stage of the hypothesised mechanism, indicating that higher information asymmetry leads to shorter debt maturity. This pattern accords with the theoretical models of Flannery (1986) and Diamond (1991), who argue that lenders respond to greater informational opacity by favouring short-term debt contracts in order to mitigate risk exposure. It is also consistent with empirical findings, such as Berger et al. (2005), who show that firms facing high information asymmetry are granted shorter maturities until more reliable information becomes available. Taken together, the results of Model (3) corroborate the argument that ESG controversies, by worsening the information environment, constrain firms' ability to obtain long-term financing.

To further validate the mediation pathway, we implement a nonparametric bootstrap analysis of the indirect effect. The estimated product term ($a \times b$) equals -0.00012, with a standard error of

0.0007. While marginally significant at the 10% level ($p=0.083$), the result provides statistical evidence that ESG decoupling shortens debt maturity in part through the channel of heightened information asymmetry. According to the typology of Zhao et al. (2010), this pattern constitutes a case of complementary mediation, where both the direct and indirect effects operate in the same negative direction, thereby reinforcing the overall influence of ESG decoupling on capital structure decisions.

5.2 Liquidity Position

To further explore the mechanisms through which ESG decoupling affects corporate debt maturity, we examine liquidity position as a potential mediating variable. Existing literature suggests that firms may increase cash reserves in response to either precautionary concerns or strategic capital structure adjustments.

First, under the precautionary motive, ESG decoupling may raise investor suspicion, increase perceived risk, or trigger reputational concerns. In response, firms may accumulate excess cash as a buffer against future financing constraints (Opler et al., 1999; Bates et al., 2009). This conservative approach enhances financial flexibility and mitigates refinancing pressure, particularly when access to long-term credit markets becomes uncertain (Acharya et al., 2007; Han & Qiu, 2007). In the context of ESG decoupling, such precautionary behaviour can be interpreted as a self-protective response to heightened information asymmetry. When stakeholders perceive inconsistency between a firm's ESG disclosure and its actual practices, they may downgrade expectations regarding transparency and creditworthiness. To mitigate such negative market perceptions, firms may strengthen internal liquidity buffers as a potential signalling mechanism of financial prudence and to lessen their dependence on external funding.

Second, under the strategic adjustment motive, firms may intentionally increase cash holdings as a substitute for long-term borrowing, thus rebalancing their capital structure. As argued by Harford et al. (2014), holding more cash can reduce reliance on long-maturity debt, especially in volatile or information-asymmetric environments. This strategic substitution enhances short-term financial agility and allows firms to defer long-term commitments while maintaining liquidity buffers.

Empirically, we find that ESG decoupling is positively associated with firms' subsequent liquidity positions (Table 6, Panel B). The coefficient on lagged liquidity position is 0.0037 ($p < 0.01$), indicating that firms tend to strengthen internal liquidity buffers after experiencing ESG decoupling events. This pattern suggests a delayed liquidity adjustment rather than an immediate response, as firms often require time to reassess their financing strategies and liquidity targets following reputational or informational shocks. Such a gradual increase in liquidity reserves remains consistent with the precautionary motive proposed by Han and Qiu (2007) and Acharya et al. (2007), since precautionary behaviour may be implemented with a lag due to governance procedures and financial planning cycles.

In the third-stage regression, the lagged liquidity position is positively associated with debt maturity (0.0303, $p < 0.05$), while the direct effect of ESG decoupling remains negative and significant (-0.0076, $p < 0.05$), suggesting a potential partial mediation.

A bootstrap-based mediation test further confirms that the indirect effect through the lagged liquidity pathway is statistically significant (estimate = 0.0001, $p = 0.078$).

Overall, these findings provide empirical support for Hypothesis H2b, demonstrating that the liquidity position constitutes an important pathway through which ESG decoupling influences debt maturity. Firms adjust their liquidity positions over time in response to ESG decoupling. The delayed strengthening of liquidity buffers reflects a dynamic precautionary strategy, aimed at mitigating future refinancing risks and enhancing financial flexibility. Firms facing credibility or transparency concerns tend to strengthen liquidity buffers, either as a precaution against future financing constraints or as a strategic substitute for long-term debt, thereby modifying their maturity structure.

5.3 Financial Distress

To examine the role of financial distress in mediating the relationship between ESG decoupling and corporate debt maturity, we adopt the Altman Z-score³ as a proxy for firms' financial condition. The Z-score is a weighted composite index widely used to assess a firm's likelihood of financial distress or bankruptcy.

As discussed before, ESG decoupling may undermine the credibility of firms' non-financial signals and expose them to greater scrutiny from external stakeholders. In response, managers may adopt financially conservative adjustments, such as reducing leverage or strengthening liquidity, to restore confidence and convey prudence. Such adjustments enhance observable solvency ratios, reflected in a higher Z-score, yet they may not necessarily indicate improved fundamentals. Instead, they represent a defensive restructuring aimed at preserving legitimacy and mitigating perceived financial fragility.

The empirical results reported in Table 6, Panel C, are consistent with this reasoning. ESG decoupling shows a positive and significant effect on the Z-score (coefficient = 0.0082, $p < 0.01$), suggesting an improvement in accounting-based financial health. However, when the Z-score is incorporated into the debt maturity regression, it displays a negative and significant relationship with debt maturity (coefficient = -0.0447, $p < 0.01$), indicating that firms with higher Z-scores tend to issue shorter-term debt. This pattern implies that improved solvency metrics coexist with more cautious debt structures, consistent with the notion of precautionary conservatism introduced in the theoretical framework.

³ We calculate the Altman Z-score, defined as: $Z = 0.012X_1 + 0.014X_2 + 0.033X_3 + 0.006X_4 + 0.999X_5$; where X_1 is working capital to total assets, X_2 is retained earnings to total assets, X_3 is earnings before interest and taxes (EBIT) to total assets, X_4 is market value of equity to book value of total liabilities, and X_5 is sales to total assets. A higher Z-score reflects stronger financial health, while a lower score signals greater financial vulnerability.

To verify this mechanism formally, we conduct a bootstrap-based mediation analysis. The indirect effect of ESG decoupling on debt maturity via financial distress is -0.0004 (standard error = 0.0001, $p = 0.000$), which is statistically significant at the 1% level. These findings confirm that financial distress acts as a significant mediating channel, supporting Hypothesis 2c.

Insert Table 6

6. Robustness Check

6.1 Subsample Analysis

To ensure the reliability and generalisability of our baseline findings, this section conducts a series of robustness checks. Given the international and cross-sectoral nature of our panel dataset, it is crucial to examine whether the observed negative relationship between ESG decoupling and corporate debt maturity persists under alternative sample compositions. Specifically, we perform subsample analyses based on three theoretically and empirically relevant dimensions: (1) whether a firm is headquartered in a G7 country, reflecting institutional and regulatory maturity; (2) whether the firm operates in environmentally or socially sensitive industries, which are likely to attract greater stakeholder scrutiny and ESG pressure; and (3) the financial system type of the host country, distinguishing between bank-based and market-based economies, as classified by existing literature. These stratifications allow us to test for heterogeneity in the decoupling–maturity nexus across institutional contexts, stakeholder exposure, and financing environments. The results consistently indicate that the negative association between ESG decoupling and debt maturity remains statistically significant and directionally stable across all subsamples, reinforcing the robustness of our main conclusion.

6.1.1 G7 vs non-G7

First, in order to examine whether the relationship between ESG decoupling and debt maturity varies across different institutional environments, we conduct a subsample analysis based on whether firms are located in G7 countries. The G7 group, comprising Canada, France, Germany, Italy, Japan, the United Kingdom, and the United States, is often characterised by more advanced regulatory frameworks, higher levels of investor protection, and more stringent ESG disclosure requirements. In contrast, non-G7 countries exhibit greater heterogeneity in institutional quality and market development. Prior literature suggests that the effect of ESG-related practices on financial outcomes can be amplified in settings where governance standards are more mature and enforcement mechanisms more credible (Ioannou & Serafeim, 2012; Liang & Renneboog, 2017). This motivates the need to test whether the impact of ESG decoupling on debt maturity is contingent on the broader institutional context.

We split the sample accordingly and estimate the baseline mixed-effects model separately for G7 and non-G7 subsamples, maintaining the same model specification and control variables as in the main analysis. The G7 subsample comprises approximately 49.73% of the total observations, with the remainder belonging to non-G7 countries. This partition allows us to examine whether the negative association between ESG decoupling and debt maturity holds consistently across institutional contexts.

The results, presented in Table 7, Panel A, indicate that ESG decoupling is negatively and significantly associated with debt maturity in both subsamples. For firms based in G7 countries, the coefficient of ESG decoupling is -0.0086, significant at the 5% level, while in non-G7 countries, the corresponding coefficient is -0.0102, which is also statistically significant. These findings confirm that the negative association between ESG decoupling and debt maturity holds across different institutional environments, suggesting that the effect is not driven by country-specific institutional features or regulatory settings.

6.1.2 Sensitive Industry

Secondly, we examine whether the impact of ESG decoupling on debt maturity is contingent on industry characteristics. We categorise firms based on their environmental and social sensitivity using established sectoral classification schemes using TRBC (Thomson Reuters Business Classification) sector codes. Following the framework of Garcia et al. (2017), we classify Energy, Basic Materials, Industrials, and Utilities as environmentally sensitive industries due to their high levels of pollution, intensive use of natural resources, and heavy exposure to environmental regulation. Firms in these sectors are frequently subject to heightened scrutiny and enforcement from environmental authorities and stakeholders.

Also, we identify Consumer Cyclical, Consumer Non-Cyclical, and Financials as socially sensitive industries. These industries are more exposed to social externalities such as labour standards, consumer protection, and trust-based relationships with communities. In contrast, sectors such as Technology, Real Estate, and Academic & Educational Services are treated as non-sensitive industries, given their relatively limited direct environmental or social externalities. While Healthcare and Technology are often discussed in social impact contexts, they are not classified as sensitive in our setting, consistent with prior empirical taxonomies (SASB, 2020).

We begin by analysing the subsample split by environmental sensitivity (EnvSensi). The results in Table 7, Panel B, show that ESG decoupling significantly shortens debt maturity in both the environmentally sensitive (-0.0081, $p < 0.05$) and non-sensitive (-0.0108, $p < 0.05$) subsamples. This indicates that the adverse impact of ESG decoupling behaviour on debt maturity is not confined to sectors with high environmental exposure. Instead, the evidence suggests that creditors generally perceive ESG inconsistency as a negative signal, regardless of industry-level environmental sensitivity.

Next, we examine socially sensitive industries (SocSensi) in Table 7, Panel C. The results indicate some variation in the estimated effects across sectors. In socially sensitive industries, ESG decoupling shows a negative and marginally significant association with debt maturity (-0.0119 , $p < 0.1$), suggesting that firms in these sectors may respond to ESG signal divergence by shortening their debt maturity. In non-sensitive industries, the coefficient remains negative (-0.0089) and is statistically significant at the 1% level, indicating a more robust relationship. These findings collectively demonstrate that the negative association between ESG decoupling and debt maturity holds across different types of industry sensitivity. Overall, the results reinforce that the observed relationship is robust and not driven by a specific subset of industries, implying that creditors tend to respond similarly to ESG decoupling regardless of sectoral context.

6.1.3 Bank-based vs Market-based

Lastly, we examine whether the relationship between ESG decoupling and debt maturity is influenced by the structure of national financial systems. Specifically, we investigate whether the effect differs between bank-based and market-based economies.

In bank-based systems, firms often rely on long-term lending relationships with financial intermediaries. Banks typically engage in relationship lending, possess greater private information about borrowers, and exercise ongoing monitoring over corporate activities (Boot, 2000). Under such systems, ESG decoupling may be interpreted through a more relational lens: banks might tolerate some degree of symbolic ESG behaviour if it does not threaten the firm's creditworthiness or violate contractual obligations. Nevertheless, visible ESG inconsistencies could still erode trust and trigger renegotiation or shorter debt terms, especially when information asymmetry increases.

In contrast, market-based systems rely more heavily on public capital markets, where investor decisions are driven by disclosed information and market signals. In these settings, firms face more dispersed creditor bases. Consequently, ESG decoupling is likely to be penalised more quickly and severely by market participants, who interpret such inconsistencies as signals of governance weakness or greenwashing. Moreover, capital markets tend to incorporate ESG-related controversies into pricing and contract terms, potentially leading to shorter maturity structures as a risk management response (La Porta et al., 1997; Krüger, 2015).

Therefore, the role of the financial system is not merely institutional, but also functional. It shapes how ESG decoupling is perceived and acted upon by creditors. This motivates our empirical test of whether the maturity-shortening effect of ESG decoupling varies between bank-based and market-based financial environments. Following Guney et al. (2017), we classify countries based on the ratio of credit market development to stock market development. Countries with a ratio above the median are categorised as bank-based, while those below the median are defined as market-based.

Table 7 Panel D presents the regression results across the two financial system subgroups. We find that ESG decoupling is negatively associated with debt maturity in both bank-based and market-based economies. Specifically, in bank-based systems, the coefficient on ESG decoupling is -0.0110 ($p < 0.05$), indicating a statistically significant reduction in debt maturity. In market-based systems, the coefficient is -0.0084 ($p < 0.05$), likewise indicating a statistically significant negative association. Taken together, these results show that firms exhibiting greater ESG decoupling tend to have shorter debt maturity across alternative financial architectures, reinforcing the robustness and generalisability of the main finding.

Insert Table 7

6.2 Alternative Measurement

We also estimate the baseline model using an alternative measurement strategy for the key explanatory variable ESG decoupling as a robustness check. Instead of relying on a binary indicator that assigns a value of one to firms with any ESG controversies (i.e., those with an ESG controversies score less than 100), we construct a categorical variable that captures the severity of ESG controversies. Specifically, we classify firms into three groups based on their ESG controversy scores: (i) firms with no controversies (score = 100), (ii) firms with mild to moderate controversies (score between 60 and 99), and (iii) firms with severe controversies (score below 60). These three categories account for approximately 84.6%, 6.9%, and 8.5% of the total sample, respectively. This approach retains the substantive logic of the original dummy variable, linking decoupling to the presence of negative ESG events, while introducing variation in controversy intensity, thereby allowing us to assess whether the effect of decoupling on debt maturity increases with severity.

This approach is grounded in the premise that ESG controversies differ not only in occurrence but also in their potential implications for market participants. Prior studies suggest that widely reported ESG controversies, such as high-profile regulatory violations, major environmental incidents, or publicised labour disputes, tend to attract greater media attention and investor scrutiny, potentially affecting external perceptions of the firm's credibility and non-financial risk profile (Luo et al., 2015; Krüger, 2015). From the perspective of information asymmetry, more intense controversies can amplify uncertainty regarding the firm's internal practices or disclosure credibility, thereby aggravating adverse selection problems in credit markets (Healy & Palepu, 2001). In such contexts, creditors may respond by shortening the maturity structure of debt as a precaution against potential under-pricing of risk.

Furthermore, the binary cut-off at a score of 100 may oversimplify the spectrum of ESG-related risks by treating all non-perfect scores as equivalent. A categorical specification offers more granular measurement, enabling the detection of intensity effects and better aligning the empirical model with the underlying theoretical mechanism. This approach also mitigates the influence of

extreme skewness in the original score distribution, enhancing the robustness and interpretability of the results (Angrist & Pischke, 2009).

The results reported in Table 8, Column 1, confirm the robustness of the main findings. Compared to firms with no ESG controversies, those with mild to moderate controversies show a statistically significant reduction in debt maturity by 0.84 percentage points, while those with severe controversies face a larger reduction of 1.11 percentage points. The direction and significance of these effects provide support for the main findings and indicate that the economic consequences of ESG decoupling may increase with the perceived severity of controversies.

In addition to the categorical specification, we re-estimate the model using four complementary measures that capture different margins of ESG decoupling. First, we construct $\text{Decoupling}_2 = 1 - (\text{ESG Controversies Score} / 100)$. This rescaled index ranges from 0 to 1, where higher values indicate greater ESG decoupling (more controversies) and 0 indicates no decoupling. Second, we define Decoupling_3 as an extensive-margin indicator that equals 1 if the firm records an ESG controversies score below 100 in any year within the sample window, and 0 otherwise. This captures whether the firm ever experiences decoupling. Then, we measure persistence with Decoupling_4 , defined as the firm-level frequency of decoupling, namely the proportion of years in which the controversies score is below 100. Higher values imply more recurrent decoupling. Finally, we include $\text{Decoupling}_5 = -1 \times (\text{ESG Controversies Score})$ as a monotonic transformation to align the direction with the decoupling concept, so that higher values imply greater decoupling.

These measures allow us to assess intensity (continuous scores), incidence (ever vs. never), persistence (frequency over time), and directional consistency, providing a comprehensive triangulation of the decoupling construct and reducing concerns about functional-form dependence. As a result, the relationship between ESG decoupling and debt maturity is replicated with both continuous and discrete formulations, and with measures that emphasise either the extensive or the persistent nature of decoupling.

Consistently, across the alternative measures, the estimated coefficients remain negative in sign and economically meaningful, with statistical significance patterns that mirror the baseline where precision allows. Results for alternative measurement of ESG decoupling (decoupling_2 -5) are reported in Table 8, Columns 2 to 5, and they corroborate the conclusion that higher decoupling, whether captured as lower scores, weaker alignment, the incidence of any event, or greater frequency of events, is associated with shorter debt maturity.

6.3 Lagging One Year

To assess the robustness of our baseline findings and address potential concerns about reverse causality, we estimate the main models using a lagged specification of the ESG decoupling variable. Specifically, we replace the contemporaneous ESG controversy indicator with its one-year lagged value, capturing the possibility that debt maturity structures adjust in response to ESG-related

controversies with a delay. This approach is consistent with prior literature highlighting the timing mismatch between non-financial event occurrence and financial restructuring (Lins et al., 2017; Amiraslani et al., 2022).

The regression results, presented in Table 8, Column 6, confirm the robustness of the main effect. The coefficient on the lagged decoupling variable is negative (-0.0070) and statistically significant at the 5% level, indicating that the presence of ESG controversies in the previous year continues to be associated with a reduction in debt maturity. These findings reinforce the interpretation that ESG decoupling contributes to heightened information asymmetry, which in turn leads creditors to shorten the maturity structure of corporate debt. The temporal consistency of the effect also suggests that the relationship is not driven by contemporaneous shocks, further strengthening the validity of the proposed mechanism.

6.4 Without Large Samples

To further verify that our main findings are not driven by country-specific effects, we re-estimate the model on several subsamples. First, we exclude all observations from the United States, the single largest country in our dataset, accounting for approximately 29% of firm-year records. Second, we exclude firms from China, which represents the second-largest country sample (about 15.2 %). Finally, we remove both the United States and China simultaneously. As reported in Panel B of Column 7-9, the estimated coefficients of ESG decoupling remain negative and statistically significant across all three subsamples (-0.0091 **, -0.0087 ***, and -0.0084 **, respectively). These consistent results confirm that our conclusions are not driven by the influence of any single country, reinforcing the robustness of the baseline relationship between ESG decoupling and debt maturity.

6.5 Alternative Estimation Methods: OLS, Fixed Effects, High-Dimensional Fixed Effects and IV-2SLS

To further confirm the robustness of the baseline results, this study additionally estimates the relationship between ESG decoupling and debt maturity using three conventional panel data estimators, ordinary least squares (OLS), firm fixed effects (FE), and high-dimensional fixed effects (HDFF). The purpose of these additional estimations is to benchmark the mixed-effects model results against alternative specifications that vary in their treatment of unobserved heterogeneity and data clustering. In addition, to address potential endogeneity concerns associated with ESG decoupling, we further apply an instrumental variable two-stage least squares (IV-2SLS) estimation, the results of which consistently confirm the negative effect of ESG decoupling on debt maturity.

The OLS estimator provides a straightforward benchmark model that assumes homogeneity across observations and does not control for unobserved firm characteristics. Although this approach offers an intuitive reference point, it may suffer from omitted variable bias if firms differ systematically in ways correlated with both ESG decoupling and debt maturity.

The firm fixed-effects model mitigates this concern by removing all time-invariant firm-specific factors through within-firm demeaning, thereby focusing on the variation over time within each firm. However, it still assumes that all firms share a common slope and does not account for potential heterogeneity across industries or countries, which could be important in a cross-national setting.

To address these limitations, the high-dimensional fixed-effects model is employed. This estimator efficiently absorbs multiple layers of fixed effects (firm, industry, country, and year) using an iterative within-transformation algorithm (Correia, 2016). By doing so, it controls for unobserved heterogeneity simultaneously at several hierarchical levels, providing a more stringent robustness check. Comparing the results from OLS, FE, and HDFE allows us to assess whether the estimated relationship between ESG decoupling and debt maturity is sensitive to modelling assumptions regarding unobserved heterogeneity.

However, despite extensive fixed-effects controls, ESG decoupling may still be endogenous. Firms that anticipate higher refinancing uncertainty, shifts in stakeholder pressure, or changes in future regulatory scrutiny may strategically adjust their disclosure stance relative to actual practices, leading to reverse causality or omitted variable bias (Christensen et al., 2021). Consistent with this concern, the Durbin-Wu-Hausman (DWH) test indicates that ESG decoupling is endogenous in the debt maturity equation.

Therefore, we further implement an instrumental variable two-stage least squares (IV-2SLS) approach to obtain unbiased causal estimates. Following prior studies (Benlemlih and Bitar, 2018; Li et al., 2023), we construct two instruments: (1) the industry-year average level of ESG decoupling, and (2) the firm's own ESG decoupling lagged two years. The former captures exogenous peer-level reputational pressure and industry-wide controversy salience, while the latter reflects historical ESG behaviour unlikely to be affected by current debt maturity decisions. The first-stage results show that both instruments are strongly correlated with the endogenous ESG decoupling variable, and over-identification tests indicate no violation of the exclusion restriction. The second-stage IV estimates remain negative and statistically significant, confirming that ESG decoupling causally leads firms to shorten their debt maturity structures. This finding reinforces the interpretation that decoupling increases information asymmetry and hence motivates creditors to prefer shorter rollover cycles, even after accounting for endogeneity concerns.

Table 9 reports the results obtained under the four estimation methods. Across all specifications, the coefficient of decoupling remains negative and statistically significant, confirming that

companies that have ESG decoupling activities are associated with shorter debt maturities. The consistency of sign and statistical significance across OLS, FE, and HDFE estimations provides compelling evidence that the negative impact of ESG decoupling on debt maturity is robust to different estimation frameworks. Importantly, the IV-2SLS estimates further confirm that this relationship persists after accounting for endogeneity, reinforcing a causal interpretation whereby ESG decoupling motivates creditors to impose shorter refinancing cycles. In summary, across all models demonstrates that the observed effect is not model-specific but instead represents a stable empirical relationship between ESG decoupling and corporate debt maturity.

Insert Table 9

7. Economic significance

We also assess the economic significance of the estimated effect of ESG decoupling on debt maturity. For the binary indicator, we calculate economic significance as the percentage change in the dependent variable's mean when the explanatory variable changes from 0 to 1. Using the formula $E_{\frac{z}{y}} = \left| \frac{b}{\bar{y}} \right|$, we find that the presence of ESG decoupling reduces debt maturity by approximately 1.30% (decoupling1) and declines by about 2.9% (decoupling3) relative to the sample average⁴.

For continuous measures, we compute economic significance as the product of the estimated coefficient and the standard deviation of each decoupling variable. The results show that a one-standard-deviation increase in decoup2 reduces debt maturity by 0.4%, decoup4 by 2.9%, and the inverted ESG Controversy Score (decoupling5) by 0.6%, all relative to the sample mean. These results demonstrate that ESG decoupling exerts a small-to-moderate yet economically meaningful effect on firms' debt-maturity structure.

This indicates a meaningful economic impact in the context of corporate debt structuring.

Although the estimated effect, up to 2.90% relative reduction in debt maturity, may seem modest in absolute terms, it carries important economic implications in the context of corporate financial management. The structure of debt maturity is a critical element of a firm's capital structure policy. It is closely associated with refinancing risk, liquidity management, and the discipline imposed by financial markets (Stohs & Mauer, 1996). A shorter maturity horizon requires firms to refinance

⁴ We calculate economic significance using the formula $E_{\frac{z}{y}} = \left| \frac{b}{\bar{y}} \right| = \frac{-0.0095}{0.7319}$, which means the percentage of the dependent variable's change relative to its mean when the explanatory variable changes by one standard deviation (Mitton, 2024).

their obligations more frequently. This increases the exposure to refinancing costs and makes firms more vulnerable to changes in interest rates or tightening credit conditions, especially in volatile or emerging markets.

From a governance perspective, the findings suggest that ESG decoupling may serve as a negative signal to creditors. As a result, lenders may respond by imposing stricter debt terms such as shorter maturities. This reflects concerns about reputational damage, future compliance costs, or managerial opacity. These results are consistent with previous studies linking ESG weaknesses to greater information asymmetry and reduced trust among financial stakeholders (Jiang et al., 2025; Goss & Roberts, 2011). Therefore, even a relatively small decrease in debt maturity can represent a meaningful change in the terms of external financing. This shift may ultimately influence a firm's investment capacity and long-term financial flexibility.

8. Conclusion

This study investigates the relationship between ESG decoupling and the maturity structure of corporate debt. Drawing upon a multi-country panel dataset spanning from 2004 to 2023, the paper provides empirical evidence on how ESG decoupling behaviour shapes firms' financing decisions, particularly in terms of the maturity profile of their debt obligations. Our findings show that ESG decoupling is consistently associated with shorter debt maturities, indicating that lenders respond to sustainability credibility gaps by reducing long-term credit provision. While the existing literature has extensively examined the effects of ESG performance on capital structure, our research moves beyond the traditional rating-based view to capture the strategic inconsistencies that arise when firms fail to align their ESG communication with genuine ESG practices. In doing so, we contribute to a deeper understanding of the real financial implications of ESG credibility gaps in global capital markets.

From a practical perspective, our findings carry important implications for firms, investors, and regulators. For firms, the results underscore the financial risks of overstating ESG achievements, especially when such claims are not matched by substantive performance. Shortened debt maturities may reduce firms' long-term financial flexibility and increase refinancing risk, particularly in periods of tightening credit conditions. Therefore, firms should aim to align their ESG communications with measurable and verifiable progress to build lasting trust with capital providers. For investors, the study provides a signal that ESG decoupling could indicate not only reputational risk but also deteriorating financial fundamentals. Incorporating ESG credibility metrics, such as decoupling indicators or controversy-adjusted scores, into credit risk models may improve due diligence and asset pricing accuracy. For policymakers and regulators, our evidence suggests the need to enhance ESG disclosure frameworks and auditing standards, especially in markets where voluntary disclosure dominates. Regulatory harmonisation and third-party assurance could reduce the space for symbolic compliance and improve the reliability of ESG information.

Despite its contributions, the study is not without limitations. First, while we adopt rigorous econometric strategies to address potential endogeneity, causal interpretations should still be made with caution. Future research could explore natural experiments or exploit regulatory changes as exogenous shocks to strengthen identification. Second, our measurement of ESG decoupling relies on secondary data derived from LSEG's ESG controversies scores, which, despite being widely used, may not fully capture the nuance of corporate ESG behaviour. Future work could complement score-based approaches with textual analysis of ESG reports, media coverage, or stakeholder surveys. Third, although our dataset spans 40 countries, it remains constrained by data availability, particularly for emerging markets and unlisted firms. Expanding the sample or focusing on country-specific institutional changes could provide further insights.

In conclusion, this paper demonstrates that ESG decoupling is far from being a symbolic or superficial concern and has tangible consequences for corporate financial decisions. By shortening debt maturities, decoupling undermines firms' ability to secure long-term financing, particularly in the eyes of sceptical creditors and investors. The mechanisms driving this effect, specifically, increased information asymmetry, financial precaution, and distress, highlight the deeper structural implications of symbolic ESG behaviour. In a global context where sustainability claims are increasingly scrutinised, bridging the gap between ESG disclosure and performance is not only a matter of legitimacy but also a prerequisite for maintaining access to patient capital. Future research on ESG should continue to move beyond scorecard assessments and probe the credibility and consistency of corporate sustainability efforts in shaping financial outcomes.

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Appendix

Table A1: Variables Definition

Variable Name	Formula	Description
Debt Maturity	LTD / TD	The ratio of long-term debt to total debt
ESG Controversies Score	ESG Controv	ESG controversy score from LSEG (0-100, 100 = no controversy)
Decoupling1	1 if ESG Controversies score < 100, else 0	Indicates whether the firm had any ESG controversies in the year
Decoupling2	one minus ESG Controversies score divided by one hundred.	Reversed and rescaled ESG decoupling index. Values range from 0 (fully decoupled) to 1 (fully aligned). Higher values indicate stronger alignment between ESG disclosure and ESG performance.
Decoupling3	1 if the firm's ESG controversies score falls below 100 in any firm-year within the window, and 0 otherwise.	Firm-level indicator for whether the firm ever experienced ESG decoupling during the sample period
Decoupling4	$Decoupling_Freq_i = \frac{1}{T_i} \sum_{t=1}^{T_i} I(ESGControv_{it} < 100)$	Firm-level frequency of ESG decoupling. Indicates the proportion of years in which a firm's ESG controversy score is below 100. Higher values imply more frequent ESG decoupling events.
Decoupling5	-1*ESG Controversies Score	The negative of ESG Controversies Score, to align the variable's direction with that of ESG decoupling (higher values indicate greater possibility of involving ESG decoupling).
Firm Size	ln(Total Assets)	Natural logarithm of total assets
Leverage	Total Debt / Total Assets	Leverage ratio measuring financial risk
ROA	Net Income / Total Assets	Return on Assets
Liquidity	Current Assets / Total Assets	Liquidity measure indicating short-term solvency
Sales Growth		Annual growth rate of a firm's total sales, indicating the firm's growth potential
Effective tax rate	Income Tax / Pre-tax Income	The effective tax rate (ETR) is calculated as the ratio of income tax expense to pre-tax income
Asset Tangibility	Net PPE / Total Assets	Capital intensity measure using fixed assets
Stock Performance	Log(Yr End Price_t) - Log(Yr End Price_t-1)	Stock price performance based on log returns
Information Asymmetry	(Ask price - bid price) / closing price	Relative bid-ask spread, used as a proxy for information asymmetry
Liquidity Position	Cash and Equivalents / Total Assets	the ratio of cash and cash equivalents to total assets
Financial Distress	$Z = 0.012X_1 + 0.014X_2 + 0.033X_3 + 0.006X_4 + 0.999X_5$	Altman Z score. A higher Z-score reflects stronger financial health, while a lower score signals greater financial vulnerability.
Firm Quality	(Net Income + Depreciation) / Net Debt	Firm's internal funding quality
R&D Intensity	R&D Expenses / Net Income	Innovation intensity
CEO Duality	1 if CEO = Chairman, else 0	A dummy variable equal to 1 if the chief executive officer (CEO) also serves as the board chairman, and 0 otherwise.
CSR Committee	1 if CSR Committee Exists, else 0	Existence of CSR oversight mechanism
Board Independence	Proportion or presence of independent directors	The ratio of independent directors to the total number of board members, capturing the degree of board independence and monitoring strength.

Female	Proportion of female directors	The ratio of female board members to the total number of directors, reflecting gender diversity and inclusiveness in corporate governance.
Sales Concentration	$SC_{it} = \sum_{j=1}^n \left(\frac{Sales_{jit}}{Sales_{it}} \right)^2$	Industry concentration measure, where $Sales_{jit}$ denotes the revenue of firm j , and $Sales_{it}$ is the total industry sales.
Term Structure	measured as the difference between long-term government bond yield and short-term T-bill yield	This proxy captures the slope of the yield curve
Inflation	The annual percentage change in the consumer price index (CPI)	Reflecting the rate at which the general level of prices for goods and services consumed by households changes over time
GDP Growth	Annual percentage growth of GDP	GDP Growth Rate Available in World Bank Database

Table 1A Samples by Countries

Country	Observation	Firm	Country	Observation	Firm
AUSTRALIA	2,354	297	MALAYSIA	1,068	299
AUSTRIA	235	25	MEXICO	420	66
BELGIUM	316	40	NETHERLANDS	501	49
BRAZIL	874	107	NEW ZEALAND	319	48
CANADA	2,661	314	NORWAY	393	58
CHILE	341	35	PHILIPPINES	265	28
CHINA	5,343	1123	POLAND	194	22
DENMARK	250	43	PORTUGAL	93	12
EGYPT	86	20	ROMANIA	20	7
FRANCE	1,476	145	RUSSIAN FEDERATION	337	32
GERMANY	1,306	191	SINGAPORE	721	82
GREECE	46	20	SOUTH KOREA	1,160	142
HONG KONG	1,534	146	SPAIN	433	57
HUNGARY	47	6	SWEDEN	1,289	229
INDIA	1,674	465	SWITZERLAND	740	125
INDONESIA	433	60	THAILAND	652	140
IRELAND	279	32	TURKEY	310	75
ISRAEL	175	33	UNITED KINGDOM	2,988	367
ITALY	612	98	UNITED STATES	13,489	1880
JAPAN	4,959	432	VIETNAM	59	19
Table 1B Samples					
Energy	3,458	434	Healthcare	5,221	943
Basic Materials	6,453	913	Technology	7,180	1154
Industrials	9,066	1288	Utilities	3,297	346
Consumer					
Cyclicals	6,645	1080	Real Estate	5,435	689
Consumer Non-			Academic & Educational		
Cyclicals	3,534	488	Services	163	34
Total				50,452	7369

Table 2 Panel A-Descriptive Statistics

Variable	Obs	Mean	Std. dev.	Min	Max
Debt Maturity	50,452	0.7319	0.2758	0	1
ESGControv	50,452	92.5230	20.7134	0.2900	100
Decoupling1	50,452	0.1540	0.3609	0	1
Decoupling2	50,452	0.0748	0.2071	0	0.9971
Decoupling3	50,452	0.4909	0.4999	0	1
Decoupling4	50,452	0.1540	0.2374	0	1
Liquidity Position	50,447	0.1496	0.1611	0.0000	0.9974
Financial Distress	45,795	0.5758	0.2874	-0.7483	1.5822
Information Asymmetry	39,307	0.0044	0.0077	0.0000	0.1325
Firm Size	50,452	15.1875	1.6813	8.5903	20.0541
Leverage	50,452	0.2855	0.1786	0.0009	0.7632
ROA	50,452	0.0301	0.0998	-0.4811	0.2640
Sales Growth	49,953	0.1119	0.3442	-0.6112	2.0713
Liquidity	46,632	0.3903	0.2215	0.0044	0.9992
Effective tax rate	50,366	0.1935	0.3416	-1.5291	1.7764
Stock Performance	41,870	-0.0138	0.3962	-1.3157	1.0195
Firm Quality	44,358	0.1051	5.1706	-601.3495	315.7459
Asset Tangibility	50,452	0.3533	0.2774	0.0000	0.9962
R&D	50,452	0.0198	0.0513	0.0000	0.8038
CEO Duality	50,452	0.3529	0.4779	0.0000	1.0000
CSR Committee	50,431	0.5720	0.4948	0.0000	1.0000
Independence	48,359	0.5762	0.2404	0.1250	0.9167
Female	50,042	0.1779	0.1410	0.0000	0.7778
Sales Concentration	50,452	0.1973	0.2075	0.0191	1.0000
Inflation	50,438	0.0274	0.0299	-0.0135	0.7231
GDP Growth	50,452	0.0253	0.0330	-0.1094	0.2462
Term Structure%	50,452	0.7531	1.0761	-14.1100	5.6705

Notes: This table displays the summary statistics for the key variables used in the analysis. The definitions of all variables are provided in Appendix1.

Table 2 Panel B Mean and Median Differences between Decoupling and Non-Decoupling Firms

Variables	Non-decoupling Firms			Decoupling Firms			Diff	
	N	Mean	Median	N	Mean	Median	Mean	Median
Debt Maturity	42683	0.721	0.816	7769	0.792	0.857	-0.070***	-0.041***
Liquidity	42679	0.153	0.099	7768	0.131	0.095	0.022***	0.004***
Position								
Financial	38344	0.572	0.571	7451	0.595	0.58	-0.023***	-0.009***
Distress								
Information	33119	0.006	0.002	6188	0.003	0.001	0.003***	0.001***
Asymmetry								
Firm size	42683	14.927	15.018	7769	16.617	16.72	-1.689***	-1.702***
Leverage	42683	0.283	0.275	7769	0.303	0.289	-0.020***	-0.014***
Liquidity	38964	0.4	0.375	7668	0.340	0.313	0.060***	0.062***
Sales Growth	42211	0.205	0.063	7742	0.093	0.047	0.111**	0.016***
Effective Tax	42601	0.194	0.213	7765	0.213	0.241	-0.019***	-0.028***
Rate								
Asset	42683	0.358	0.287	7769	0.331	0.267	0.027***	0.020***
Tangibility								
Stock	34731	-0.017	0.008	7139	-0.002	0.036	-0.015***	-0.028***
Performance								
Firm Quality	37430	0.089	0.162	6928	0.194	0.22	-0.106	-0.058***
R&D	42339	0.036	0	7748	0.036	0.003	0.000	-0.003***
CEO Duality	42683	0.337	0	7769	0.440	0	-0.103***	0.000***
CSR	42664	0.537	1	7767	0.764	1	-0.227***	0.000***
Committee								
Independence	40978	0.558	0.556	7381	0.661	0.714	-0.103***	-0.158***
Female	42311	0.174	0.154	7731	0.201	0.2	-0.027***	-0.046***
Sales	42683	0.194	0.118	7769	0.215	0.124	-0.022***	-0.006***
Concentration								
Inflation	42677	0.027	0.021	7761	0.029	0.021	-0.002***	0.000***
GDP Growth	42683	0.026	0.025	7769	0.023	0.025	0.003***	0.000***
Term Structure	42683	0.733	0.674	7769	0.866	0.734	-0.133***	-0.060***

This table displays the summary statistics for the key variables used in the analysis. The definitions of all variables are provided in Appendix I.

Table 3 Pairwise correlations

Variables	(Debt Maturity)	(ESGControv)	(Decoupling2)	(Decoupling4)	(Liquidity Position)	(Financial Distress)	(Information Asymmetry)	(Firm size)	(Leverage)	(ROA)	(Liquidity)
Debt Maturity	1										
ESGControv	-0.085***	1									
Decoupling2	0.085***	-1	1								
Decoupling4	0.133***	-0.615***	0.615***	1							
Liquidity Position	-0.210***	0.034***	-0.034***	-0.059***	1						
Financial Distress	-0.108***	-0.021***	0.021***	0.051***	-0.048***	1					
Information Asymmetry	-0.061***	0.101***	-0.101***	-0.170***	-0.013**	-0.093***	1				
Firm size	0.156***	-0.331***	0.331***	0.525***	-0.291***	-0.007	-0.380***	1			
Leverage	0.325***	-0.044***	0.044***	0.050***	-0.342***	-0.139***	-0.073***	0.245***	1		
ROA	-0.055***	-0.018***	0.018***	0.067***	-0.153***	0.399***	-0.162***	0.209***	-0.136***	1	
Liquidity	-0.365***	0.087***	-0.087***	-0.146***	0.630***	0.251***	-0.030***	-0.263***	-0.369***	-0.044***	1
Asset Tangibility	0.192***	0.028***	-0.028***	-0.052***	-0.382***	-0.140***	0.063***	0.113***	0.286***	0.006	-0.569***
Stock Performance	0.044***	0	0	0.053***	0.023***	0.099***	-0.150***	0.074***	-0.040***	0.254***	-0.008
Firm Quality	0.031***	-0.007	0.007	0.014***	-0.023***	-0.007	-0.004	0.013***	0.023***	-0.011**	-0.025***
R&D	-0.040***	-0.009**	0.009**	0.018***	0.490***	-0.072***	-0.043***	-0.211***	-0.161***	-0.362***	0.357***
Independence	0.335***	-0.144***	0.144***	0.210***	-0.068***	-0.056***	-0.092***	-0.005	0.099***	-0.079***	-0.165***
Female	0.156***	-0.071***	0.071***	0.067***	-0.014***	-0.026***	-0.031***	-0.036***	0.043***	-0.011**	-0.053***
Sales Concentration	0.001	-0.033***	0.033***	0.071***	-0.058***	0.005	0.143***	0.018***	-0.017***	0.056***	-0.094***
Inflation	0.020***	-0.024***	0.024***	-0.011***	-0.010**	-0.024***	0.042***	-0.119***	0.009**	0.012***	-0.008*
GDP Growth	-0.133***	0.037***	-0.037***	-0.049***	0.035***	-0.030***	-0.040***	-0.045***	-0.054***	0.099***	0.082***
Term Structure	0.042***	-0.035***	0.035***	0.101***	-0.052***	0.022***	-0.052***	0.085***	0.016***	0.052***	-0.039***
Variables	(Asset Tangibility)	(Stock Performance)	(Firm Quality)	(R&D)	(Independence)	(Female)	(Sales Concentration)	(Inflation)	(GDP Growth)	(Term Structure)	
Asset Tangibility	1										
Stock Performance	-0.001	1									
Firm Quality	0.010**	0.003	1								
R&D	-0.272***	-0.040***	0.010**	1							
Independence	0.034***	0.035***	0.015***	0.115***	1						
Female	-0.055***	-0.016***	0.008*	0.039***	0.317***	1					
Sales Concentration	0.030***	-0.013***	-0.017***	-0.081***	-0.150***	0.006	1				
Inflation	-0.007	-0.142***	-0.009*	-0.011**	0.061***	0.146***	0.070***	1			
GDP Growth	-0.034***	-0.013***	-0.012**	-0.017***	-0.051***	-0.018***	-0.001	0.228***	1		
Term Structure	0.008*	0.095***	0.007	-0.052***	0.008*	-0.150***	0.054***	-0.456***	-0.002	1	

Notes: This table reports the Pearson correlation matrix for all the continuous variables. All variables are defined in Table A1. *, **, and *** denote the significance at the 10%, 5%, and 1% levels, respectively. For reference, a multicollinearity diagnostic performed on the baseline regression model reports a mean VIF of 1.27, indicating no multicollinearity concerns.

Table 4 Variance decomposition of the full sample.

Level	Level 1	Level 2	Level 3	Level 4
	Null	Fim	Industry	Country
Country	0.0124	0.0085	0.0085	0.0079
Industry	0.0021	0.0009	0.0009	0.0009
Country_Industry	0.0021	0.0009	0.0009	0.0009
Firm (isin)	0.0311	0.0232	0.0232	0.0232
Residual (Time)	0.0284	0.0251	0.0251	0.0251
Total	0.0762	0.0585	0.0585	0.0579
Prob $\geq$ chibar2	0.0000	0.0000	0.0000	0.0000
Percentage of total variance or residual intraclass correlation				
Between countries	16.26%	14.56%	14.54%	13.66%
Between industries	2.80%	1.48%	1.48%	1.51%
Between countries and industries	2.80%	1.48%	1.48%	1.51%
Between firms	40.80%	39.64%	39.65%	40.06%
Over time*	37.33%	42.83%	42.84%	43.26%
Total	100%	100%	100%	100%
*Note: As time is not specified as a random effect in the model, its variance is implicitly captured by the residual error term, making it functionally analogous to the error.				

Table 5 ESG Decoupling and Debt Maturity: Multilevel Results with Random Intercepts

VARIABLES	Null	Firm	Firm & Industry	Firm, Industry & Country
Decoupling1		-0.0097*** (0.0030)	-0.0097*** (0.0030)	-0.0095*** (0.0030)
Firm Size		0.0235*** (0.0015)	0.0235*** (0.0015)	0.0234*** (0.0015)
Leverage		0.2259*** (0.0099)	0.2259*** (0.0099)	0.2262*** (0.0099)
Sales Growth		0.0041 (0.0032)	0.0041 (0.0032)	0.0053* (0.0032)
ROA		0.0416*** (0.0146)	0.0415*** (0.0146)	0.0428*** (0.0146)
Liquidity		-0.2182*** (0.0108)	-0.2182*** (0.0108)	-0.2183*** (0.0108)
Effective tax rate		0.0050* (0.0028)	0.0050* (0.0028)	0.0049* (0.0028)
Asset Tangibility		-0.0056 (0.0106)	-0.0057 (0.0106)	-0.0049 (0.0106)
Stock Performance		0.0044 (0.0027)	0.0043 (0.0027)	0.0043 (0.0027)
Firm Quality		0.0002 (0.0002)	0.0002 (0.0002)	0.0003 (0.0002)
R&D		0.1571*** (0.0414)	0.1570*** (0.0414)	0.1563*** (0.0414)
CEO Duality		-0.0061* (0.0032)	-0.0061* (0.0032)	-0.0062* (0.0032)
CSR Committee		-0.0001 (0.0030)	-0.0000 (0.0030)	-0.0005 (0.0030)
Board Independence		0.0266*** (0.0094)	0.0266*** (0.0094)	0.0264*** (0.0094)
Female		0.0400*** (0.0121)	0.0399*** (0.0121)	0.0435*** (0.0122)
Sales Concertation			0.0033 (0.0119)	0.0078 (0.0120)
Inflation				-0.2367*** (0.0595)
GDP Growth				-0.0277 (0.0529)
Term Structure				-0.0000 (0.0014)
Constant	0.7081*** (0.0186)	0.3222*** (0.0305)	0.3206*** (0.0311)	0.3295*** (0.0311)
Observations	50,452	33,085	33,085	33,071
Year fixed effects	NO	YES	YES	YES

Table presents coefficients and standard errors from linear mixed-effects regressions examining the relationship between ESG decoupling and firms' debt maturity structure. The dependent variable is the debt maturity. Column 1 is the null model including only random intercepts. Column 2 to 4 progressively introduce firm-level, industry-level, and country-level covariates. Column (2-4) include year fixed effects (i.year) to account for time-specific unobserved heterogeneity. The multilevel structure includes random intercepts at the country, industry, country-industry interaction, and firm (ISIN) levels. Standard errors are shown in parentheses. Standard errors are computed based on the variance-covariance structure implied by the mixed-effects specification, with random intercepts at the firm, industry, and country levels, effectively accounting for within-firm correlation. All continuous variables are winsorized at the 1% and 99% levels. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

Table 6. Mediation Analysis: Channels Linking ESG Decoupling to Debt Maturity

Panel A-Information Asymmetry			
VARIABLES	Debt Maturity	Information Asymmetry	Debt Maturity
Decoupling1	-0.0098*** (0.0030)	0.0002** (0.0001)	-0.0116*** (0.0034)
Infor. Asymmetry			-0.6050*** (0.2086)
Indirect effect	Coefficient	Bootstrap Standard Errors	P Value
a*b	-0.0001	0.0001	0.083
Control Variables	YES	YES	YES
Year FE	YES	YES	YES
Panel B-Liquidity Position			
VARIABLES	Debt Maturity	Liquidity Position	Debt Maturity
Decoupling1	-0.0072** (0.0033)	0.0037*** (0.0012)	-0.0074** (0.0033)
Liquidity Position			0.0303** (0.0134)
Indirect effect	Coefficient	Bootstrap Standard Errors	P Value
a*b	0.0001	0.0001	0.078
Year FE	YES	YES	YES
Control Variables	YES	YES	YES
Panel C-Financial Distress			
VARIABLES	Debt Maturity	Financial Distress	Debt Maturity
Decoupling1	-0.0098*** (0.0030)	0.0082*** (0.0019)	-0.0081*** (0.0031)
Financial Distress			-0.0447*** (0.0065)
Indirect effect	Coefficient	Bootstrap Standard Errors	P Value
a*b	-0.0003	0.0001	0.0000
Control Variables	YES	YES	YES
Year FE	YES	YES	YES

Notes: This table presents the results of the channel analysis examining whether information asymmetry, liquidity position, and financial distress mediate the relationship between ESG decoupling and debt maturity. In each panel, the first regression tests the direct effect of ESG decoupling on debt maturity. The second regression examines the association between ESG decoupling and the proposed mediator, and the third regression includes both decoupling and the mediator to assess potential mediation effects. All regressions control for firm-level variables, industry characteristics, and macroeconomic factors, along with year fixed effects. The indirect effect ($a \times b$) represents the product of the coefficient of decoup1 on the mediator (Path a) and the coefficient of the mediator on Debt Maturity (Path b). Liquidity Position is measured in the subsequent year ($t + 1$) to mitigate potential simultaneity bias and better capture the forward effect of ESG decoupling on firms' liquidity management. Bootstrap standard errors are based on 1000 replications. For brevity, coefficients of control variables are not reported. Standard errors are shown in parentheses. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

Table 7 Robustness Check: Subsample Analyses

	Panel A		Panel B		Panel C		Panel D	
VARIABLES	G7	Non-G7	EnvSensi	Non-EnvSensi	SocSensi	Non-SocSensi	Bankbased	Marketbased
Decoupling1	-0.0086** (0.0037)	-0.0102** (0.0051)	-0.0081** (0.0040)	-0.0108** (0.0045)	-0.0119* (0.0065)	-0.0089*** (0.0034)	-0.0110** (0.0052)	-0.0084** (0.0037)
Control Variables	YES	YES	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES	YES	YES
Observations	16,445	16,626	15,479	17,592	7,117	25,954	13,379	19,692

Notes: This table presents the subsample regression results examining the robustness of the relationship between ESG decoupling and debt maturity. Panel A divides firms by institutional environment (G7 vs. non-G7 countries); Panel B by industry environmental sensitivity; Panel C by industry social sensitivity; and Panel D by the dominant financial system (bank-based vs. market-based). All regressions include firm, industry and country-level control variables and year fixed effects. The dependent variable is Debt Maturity, and the key independent variable is Decoupling1. EnvSensi industries include sectors with high environmental exposure and pollution intensity, such as energy, materials, and utilities. SocSensi industries comprise Consumer Cyclical, Consumer Non-Cyclical, and Financials, which are more exposed to social externalities such as labour standards, consumer protection, and community trust. In contrast, Technology, Real Estate, and Academic & Educational Services are classified as non-sensitive industries, consistent with prior empirical taxonomies (SASB, 2020). ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

Table 8 Robustness Check: Various considerations

	Panel A					Panel B			
	Alternative Decoupling Measurement					Lagged Decoupling	Excluding US Firms	Excluding Chinese Firms	Excluding US & Chinese Firms
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
lagdecoup						-0.0069** (0.0032)			
Decoupling1							-0.0091** (0.0039)	-0.0087*** (0.0031)	-0.0084** (0.0040)
Controversies 60_99	-0.0084** (0.0038)								
Controversies < 60	-0.0107*** (0.0038)								
Decoupling2		-0.0151*** (0.0053)							
Decoupling3			-0.0215*** (0.0058)						
Decoupling4				-0.0881*** (0.0135)					
Decoupling5					-0.0002*** (0.0001)				
Control Variables	YES	YES	YES	YES	YES	YES	YES	YES	YES
Observations	33,071	33,071	33,071	33,071	33,071	32,795	24,170	29,070	20,169
Year fixed effects	YES	YES	YES	YES	YES	YES	YES	YES	YES

Note: This table reports the robustness tests for the baseline regression examining the effect of ESG decoupling on debt maturity. Column (1) replaces the binary indicator with a categorical variable based on ESG controversy severity: firms with no controversies (score = 100), mild to moderate controversies ($60 \leq \text{score} < 100$), and severe controversies (score < 60). These three categories account for approximately 84.6%, 6.9%, and 8.5% of the total sample, respectively. Columns (2)–(5) employ alternative decoupling proxies (Decoupling2–5), while while Column (6) uses a one-year lag of the decoupling variable to address potential reverse causality. Columns (7)–(9) test sample robustness by excluding firms from the United States, China, and both countries simultaneously. All models include firm-level control variables and year fixed effects. Standard errors are computed based on the variance-covariance structure implied by the mixed-effects specification, with random intercepts at the firm, industry, and country levels, effectively accounting for within-firm correlation..

Table 9 Robustness: Different Method

	OLS	FE	HDFE	2SLS	
VARIABLES	Debt Maturity	Debt Maturity	Debt Maturity	Decoupling1	Debt Maturity
Decoup_ind_mean				0.7550*** (0.0792)	
L2.decoupling1				0.2865*** (0.0080)	
Decoupling1	-0.0277*** (0.0043)	-0.0057* (0.0030)	-0.0057* (0.0031)		-0.0448*** (0.0123)
Constant	0.4561*** (0.0386)	0.0928 (0.0838)	0.1275* (0.0682)	-1.4386*** (0.0484)	0.5320*** (0.0360)
Control Variables	YES	YES	YES	YES	YES
Underidentification test					1269.798***
Weak identification test					1125.868***
Hansen					2.541
Hansen J statistic p-value					0.1109
Observations	33,071	33,071	32,035	27,136	27,136
Adj R-squared	0.3853	0.1444	0.6617		0.2942
Year Fixed effects	YES	YES	YES	YES	YES
Firm Fixed effects	NO	YES	YES	NO	NO
Industry Fixed Effects	YES	NO	YES	YES	YES
Country Fixed effects	YES	NO	YES	NO	NO

This table reports the results of alternative estimation methods used to examine the relationship between ESG decoupling and debt maturity. Column (1) presents results from the ordinary least squares (OLS) estimator, which does not account for firm-level unobserved heterogeneity. Column (2) reports estimates from the firm fixed effects (FE) model, which controls for time-invariant firm-specific factors through within-firm demeaning. Column (3) presents results from the high-dimensional fixed effects (HDFE) estimator implemented via the reghdfe command, which simultaneously absorbs firm, industry, country, and year fixed effects to address unobserved heterogeneity across multiple hierarchical dimensions. The number of observations is smaller in the HDFE specification because it drops singleton groups by default, i.e., observations that belong to unique combinations of fixed effects with no within-group variation. Columns (4) and (5) list the first and second stage regression coefficients for the observed samples. In the first stage, the dependent variable is decoupling1, and we use the industry mean of decoupling1 and the lagged two-period decoupling1 as instruments. In the second stage, we use the decoupling1 estimated from the first stage regression as the independent variable and re-run the baseline regression for debt maturity using the instrumented decoupling1. Weak identification test is higher than critical values. Robust standard errors in parentheses. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

Figure 3: Cross-Entity Variation in Average ESG Decoupling

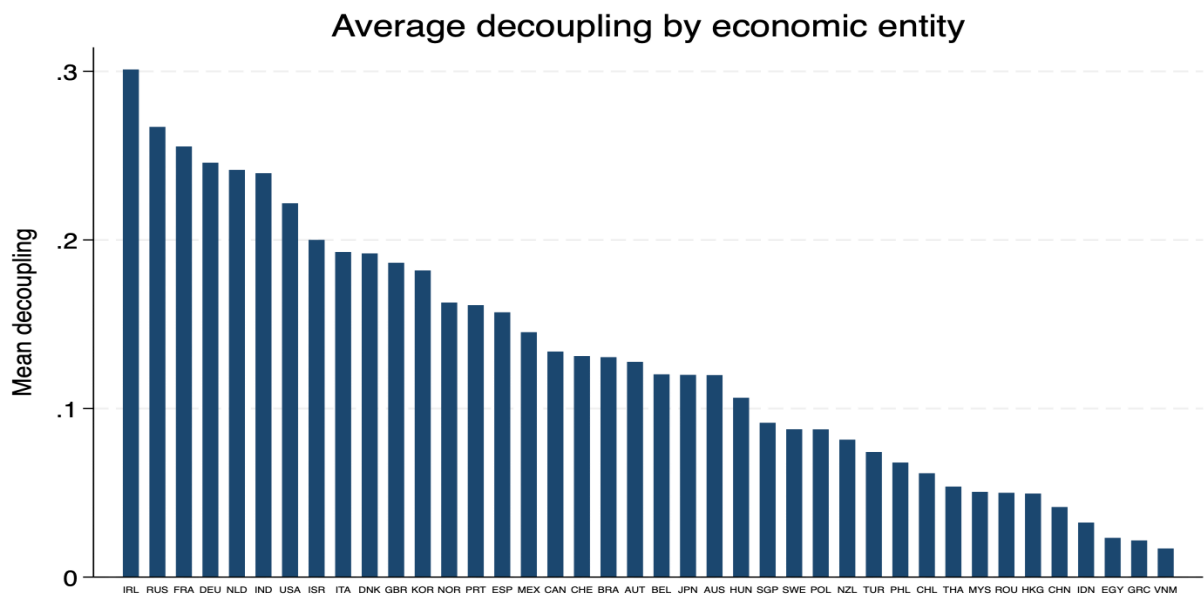


Figure 4: Cross-Industry Variation in Average ESG Decoupling

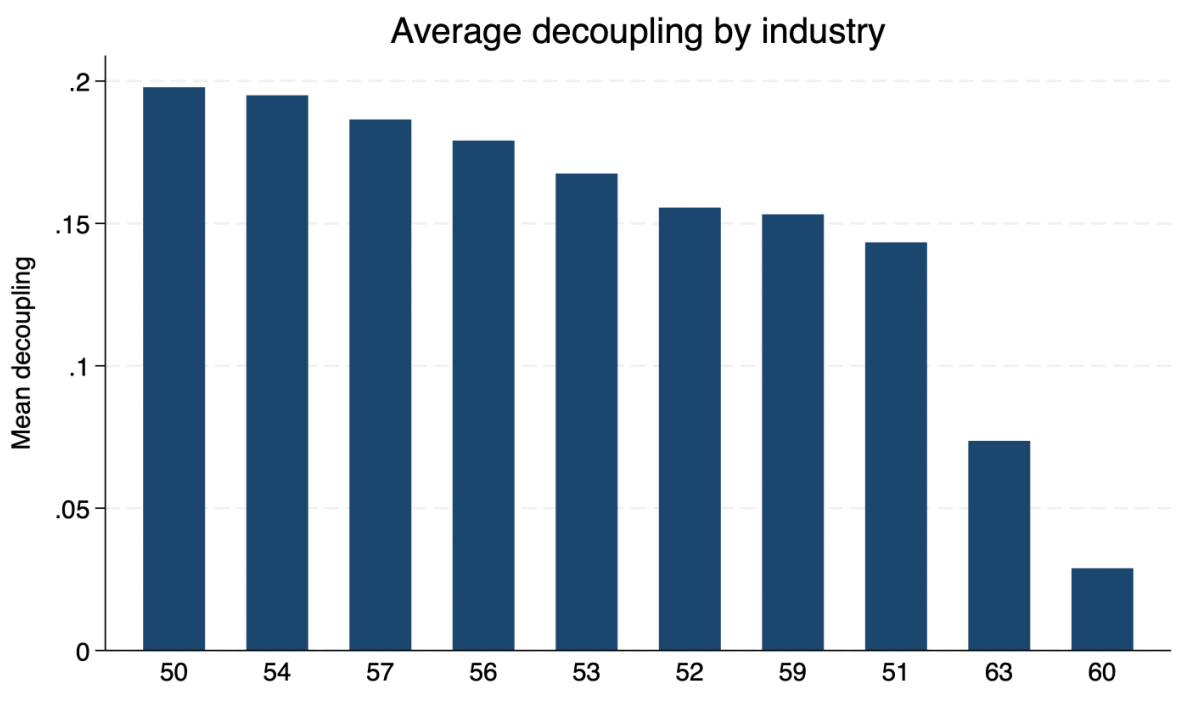


Figure 5: Time trend in the share of ESG Decoupling firms

