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Green Initiatives, Financial Performance, and Institutional Investors

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ABSTRACT

Sustainability in corporate finance has gained prominence under growing societal and regulatory pressures. Green initiatives, encompassing sustainable technologies and practices, enhance environmental responsibility, financial performance, and competitiveness. This study examines a global data set of 2560 firms (2009–2023) to explore links between environmental innovation, financial performance (measured by return on equity), and institutional investors' influence. Findings reveal that pension funds promote green innovation due to long-term goals, while investment firms prioritize short-term returns, discouraging such activities. These results, robust across tests, highlight how investment horizons shape sustainability strategies, offering actionable insights for policymakers, investors, and regulators fostering sustainable growth. Lastly, our study aims to contribute to the advancement of the research stream from a theoretical standpoint by offering insights into overcoming the assumption of shareholder preference homogeneity, as posited by classical agency theory.

JEL Classification: M14, G23, Q56

1 | Introduction and Motivations

In recent years, while policymakers have intensified efforts to enable a rapid transition from carbon-intensive to low-carbon technologies (Aghion et al. 2022; Chen et al. 2018), leveraging various environmental policies (Farooq et al. 2024) heightening interest among firms to implement green strategies (Li et al. 2017) as critical tools to reducing overall pollution (Albitar et al. 2023). Despite this, numerous economies continue to prioritize short-term benefits over long-term environmental quality, resulting in the overexploitation of natural resources for private benefits¹ and underscoring in the end the inadequacies of current environmental policies in fostering sustainability (Farooq et al. 2024). Under this framework, this study aims to investigate the financial performance coupled to green innovation at firms' level, while

accounting for the institutional investor role as shareholders of companies prompting green initiatives.

Two needs in academia and practice motivates the scope of the present study. First motivation resides in the fact that, while from one side previous studies have consistently demonstrated the positive effects of green initiatives: (i) on business efficiency (El-Kassar and Singh 2019); (ii) in enhancing companies' environmental transparency and reducing the burden of regulatory compliance (Costantini et al. 2017) by mainly lowering compliance costs and facilitating increased capital allocation for investment projects (Farooq et al. 2024). From the other the green initiatives and financial performance nexus has left some doubts about the generalizability of the results, since most of the academic literature has focused on only a few industrial

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sectors and countries. Deepening the issue whether the implementation of green initiatives at firm level is accompanied by an economic advantage clearly identifies a fundamental incentive for leveraging the net-zero transition.

Our second motivation stems from the striking gaps in the academic literature regarding the conditions ruling the beneficial role of the institutional investors in financing companies pushing over green innovation. In the ongoing battle against climate change, current corporate investment levels fall short of the European Union's climate and energy targets for 2030, so that substantial financial investment from both public and private sectors² are required where the financial system, addressing also to the investors' needs,³ is tasked with the critical responsibility of redirecting capital from environmentally harmful economic activities to more sustainable alternatives (Rohleder et al. 2022). Institutional investors are particularly well-positioned to influence the inclusion of environmental, social, and governance (ESG) principles into investment strategies and portfolios (Chen et al. 2020). Moreover Dyck et al. (2019) investigating the relationship between institutional investor shareholders and environmental and social performance of firms across 41 countries in the 2004–2013 period, find a positive nexus (on the same issue a relevant academic literature survey is provided by Velte 2023). In this fashion, the question of what are the best conditions for institutional investors to support green innovation remained largely open. While the literature has acknowledged the potential influence of institutional investors in fostering sustainability (Chen et al. 2020; Cui et al. 2021), it remains unclear under which specific firm-level or contextual conditions this influence becomes effective. Several scholars have called for more nuanced analyses that move beyond the binary classification of investor types and instead explore the contingent factors, such as firm size, ESG performance, or sectoral characteristics, that may moderate the relationship between investor ownership and environmental innovation (Miller et al. 2023; Riedl and Smeets 2017; Zhao et al. 2023). For instance, long-term investors like pension funds are assumed to support sustainability-oriented strategies, yet their actual impact may depend on the firms' absorptive capacity or institutional setting. Likewise, the influence of short-term investors might be amplified or mitigated depending on the industry's innovation intensity or regulatory pressures. These open questions underscore the need for a more granular empirical investigation to identify not just whether institutional investors shape green innovation, but how, when, and under what conditions they do so.

Building on these gaps, and in response to recent calls for a deeper understanding of the contextual factors shaping the sustainability–finance nexus (e.g., Riedl and Smeets 2017; Zhao et al. 2023; Miller et al. 2023), this study seeks to investigate whether the implementation of green initiatives fostering innovation at the firm level significantly affects financial performance and under what specific conditions institutional investors play a supportive or inhibitory role in this process.

The objectives of this study are twofold: (i) to assess whether firms' green initiatives are associated with improved financial performance and (ii) to evaluate how and under what conditions institutional investors influence the adoption of environmental innovation. Accordingly, we address the following

research questions: (1) Do green initiatives enhance firm' financial performance across industries and regions? (2) How do different types of institutional investors, such as pension funds and investment companies, affect firms' environmental innovation strategies, and under which firm-specific conditions is this influence more pronounced? The first, inspired by Iqbal et al. (2022), posits a positive relationship between financial performance and green initiatives, while the second, partially informed by Zhao et al. (2023), examines the impact of institutional investors on environmental innovation. These research questions are shaped in the following research hypotheses: Hypothesis 1 (H1) posits that a greater implementation of green initiatives correlates with enhanced financial performance. Hypothesis 2a (H2a) suggests that short-term institutional investors, such as investment companies, are likely to associate green innovation negatively. Conversely, Hypothesis 2b (H2b) proposes that long-term institutional investors, such as those in pension fund groups, are likely to promote firms' green innovation positively. Iqbal et al. (2022) demonstrate that environmental innovation, through green products and processes, has a positive effect on firm value, particularly when supported by strong organizational capital. Their study, focused on U.S. firms, emphasizes the resource-based view (RBV) and suggests that internal capabilities amplify the benefits of environmental innovation. Our study extends this insight by testing whether similar financial gains hold across a broader global sample and by using several measures of financial performance, thus contributing to the debate on the generalizability of these results beyond the U.S. context and across different financial metrics.

The second hypothesis draws from Zhao et al. (2023), who investigate how different types of institutional investors, with varying governance capabilities and investment horizons, affect green innovation in Chinese manufacturing firms. They find that dedicated investors with longer term commitments tend to promote green innovation, while transient investors with short-term perspectives may inhibit it, particularly in firms with weaker financial or social performance. Our study extends this line of enquiry in two main ways: (i) by applying a similar logic to a global, multi-industry data set that includes both developed and emerging markets and (ii) by operationalizing investor heterogeneity using a distinction between pension funds and investment companies, thus offering a more accessible and policy-relevant typology for understanding investor behaviour.

To test our hypotheses, we estimate a set of fixed-effects panel data models over a data set of 2560 firms from diverse sectors and geographic regions from 2009 to 2023. To mitigate endogeneity concerns arising from reverse causality and omitted variable bias, we also employ a two-stage least squares (2SLS) regression analysis. Our findings on institutional investors' ownership and green innovation reveal to be robust to the use of a battery of additional tests.

On the one hand, our findings demonstrate a positive relationship between green initiatives and financial performance. On the other hand, institutional investors' shareholdings exhibit both positive and negative relationships with a firm's financial performance, depending on the investors' policies and their orientation toward short-term profits. The negative association is likely attributable to the short-term focus of investment

companies, which often prioritize immediate financial returns over long-term sustainability objectives. Conversely, the positive relationship between pension fund holdings and green initiative scores supports the notion that pension funds tend to promote higher levels of green initiatives, which typically yield beneficial outcomes over the medium and long term. This divergence underscores the importance of aligning various types of investors with corporate sustainability goals to drive significant advancements in environmental innovation (Alda 2019; Cornett et al. 2007; Gonzalez et al. 2020). Additionally, we found that green initiatives have a more substantial positive impact on financial performance in firms with higher levels of overall social and environmental performance, as measured by their ESG score. The economic rationale lies in evidence suggesting that companies with superior ESG performance are better positioned to leverage environmental innovations, thereby achieving financial advantages. Our results remain robust to endogeneity checks and the application of alternative green initiative measures including segmenting firms based on their emission scores, as pollution control continues to be a critical policy focus on a global scale.

The subsequent sections of this study are structured as follows. Section 2 reviews the literature on the concepts of green initiatives and firms' financial performance, as well as the nexus between green initiatives and institutional investors. Based on this discussion, we formulate our research questions and propose a theoretical framework to explain the relationships among green initiatives, green performance, and the role of institutional investors. The conceptual framework of this study is illustrated in Figure 1. Section 3 describes the sample and variable selection, provides a descriptive summary of the data set, and outlines the research design and econometric techniques used to test the hypotheses. Section 4 presents the

empirical results, interprets the findings, and includes additional analyses and robustness checks. Section 5 presents a discussion section over the economic significance of the statistically significant findings identified. The paper closes with a discussion of the results, their policy implications, and suggestions for future research directions.

2 | Theoretical Background and Related Literature

This study contributes to two strands of empirical literature addressing companies' green innovation: one stream examines the impact on firms' financial performance, while the other explores the role of institutional investors in molding a firm's innovation path.

Regarding the first strand, empirical evidence over the last decade has been limited to a few studies, primarily focusing on the manufacturing sector (Xu et al. 2023) and, to a lesser extent, the service and banking sectors (Bătae et al. 2021; Xu et al. 2023). Emerging developments in the European Taxonomy are expected to have a substantial impact across all industries of the economy, highlighting the growing importance of additional research to deepen our understanding of these issues, which are increasingly relevant to organizational stakeholders concerned with sustainable growth (Li et al. 2017). This study gap motivated us to investigate the relationship between green initiatives and firms' financial performance using a broader global data set encompassing all sectors. Moreover, recent studies exploring the relationship among green initiatives and financial performance are often confined to the context of a single country, raising concerns about the generalizability of their findings to other national settings.

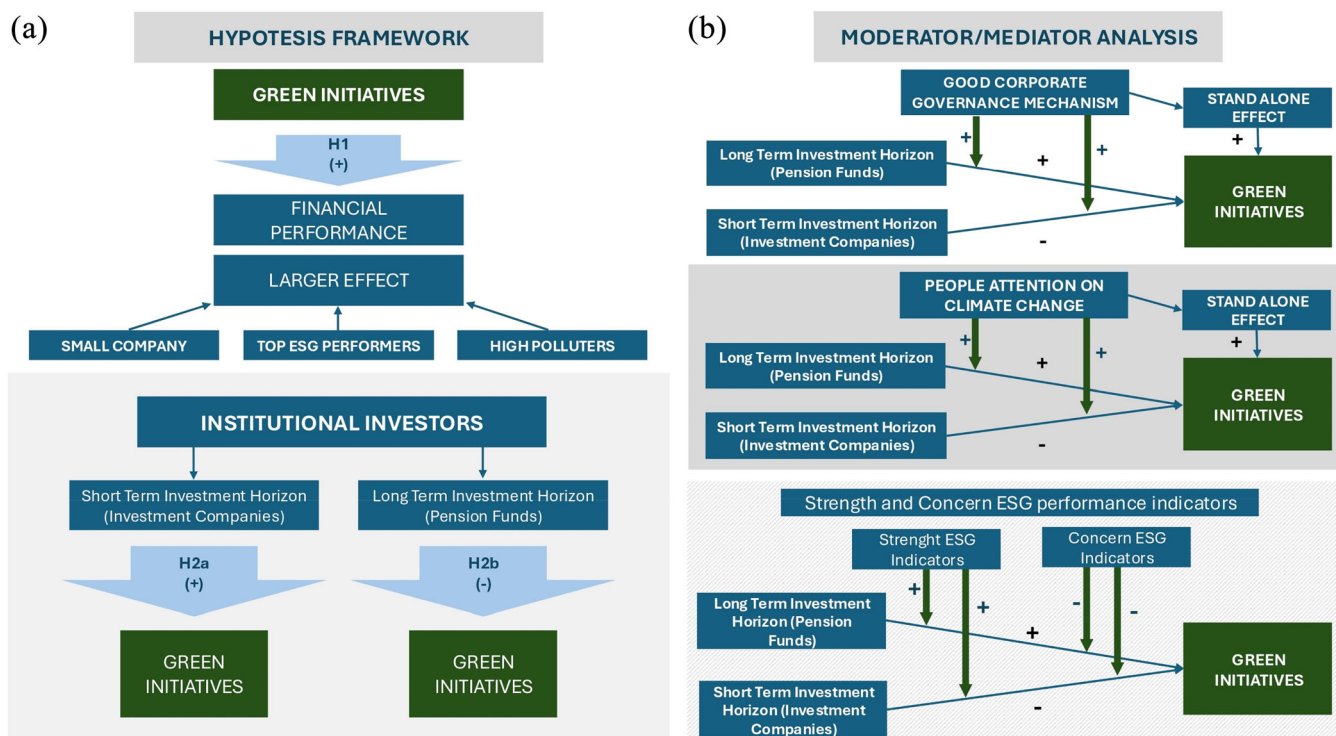


FIGURE 1 | (a) Hypothesis framework. (b) Moderator/mediator analysis. [Color figure can be viewed at [wileyonlinelibrary.com](https://onlinelibrary.wiley.com)]

Variations in environmental regulations and economic inequality across countries may significantly influence the relationship between green initiatives and financial outcomes (Chen et al. 2018; Dixon-Fowler et al. 2013). A notable exception is Dyck et al. (2019), which investigates the relationship between institutional ownership and environmental and social performance in a global context. Our empirical investigation, however, differs from Dyck et al. (2019) in several important respects: (i) our data set is significantly more recent (2023 vs. 2013); (ii) the global sample coverage in Dyck et al. (2019) does not include the United States, which is, of course, the largest financial market in the world; (iii) the sample in Dyck et al. (2019) is self-constructed by the authors, whereas our data set is based on the MSCI Global Equity Index, which is widely recognized as a global investment standard—as evidenced by its common use as a benchmark for global equity investment funds in the public Morningstar database; (iv) the analysis conducted by Dyck et al. is not specifically focused on firm-level green innovation, but rather addresses broader indicators of environmental and social performance. Thus, in line with Zaman et al. (2021), our research also adds to the regulatory discussions on the efficacy of eco-innovation, where further research on a global scale could be crucial to gain a deeper insight into the interplay between environmental and financial performance.

In the second strand, we aim to uncover whether institutional investors influence firms' environmental innovation trajectories based on the mandates of their investment strategies. Institutional investors, as the largest category of shareholders due to their substantial equity stakes, play a key role in encouraging transparency in environmental management and corporate social responsibility (CSR) disclosures (Cheng et al. 2014; Miller et al. 2023; Riedl and Smeets 2017). They assist firms in steering technical developments toward environmentally sustainable practices, particularly when financial constraints pose challenges (Xu et al. 2023). However, as emphasized by Miller et al. (2023), our understanding of the role of institutional investors—especially the distinct contributions of different types of institutional investors—remains limited. Addressing this gap is critical, particularly in light of the significant capital inflows directed toward CSR activities by institutional investors in recent years. To the best of our knowledge, this study is the first to demonstrate the substantial influence of institutional investors in facilitating the global transition to environmentally sustainable technologies across diverse economic activities, extending with new relevant insights the findings of a group of recent papers in the same field (Velte 2023; Xu et al. 2023; Zhao et al. 2023; Shi et al. 2024; Slama et al. 2025). First, Velte (2023) academic literature survey over the institutional investors role in driving the corporate sustainability, considers just two, out of a total of 66 papers analysed, academic contributions dealing with the green innovation issue, confirm that the pitch of our paper aims to cover a scant investigated area (so that the 97% of the paper discussed are out of the scope with respect to our empirical investigation). Second, by examining the specific targets of institutional investors' strategy mandates, this study aims to shed new lights into their roles. In doing so, we partially build on the work of Zhao et al. (2023), who explored the relationship between green initiatives and investor holdings, though their analysis was confined to Chinese financial markets. Same applies to Xu et al. (2023) and Shi et al. (2024). Both

papers deal with China A-shares. A-shares are valued in renminbi (RMB) and differ from B-shares, which are quoted in foreign currencies and more accessible to international investors. In this regard, the inclusion of A-shares could limit the generalizability of the results due to regulatory discrepancies. By contrast, our analysis is conducted within a global context, not focusing just on a single local market (e.g., Slama et al. 2025) or on a single industrial sector (e.g., Shi et al. 2024). Our research also diverges from Miller et al. (2023) by disentangling investor types not by holding periods or embedded asset management strategies, but by distinguishing between local and distant institutional investors. Lastly our green innovation measure aims to cover a wide spectrum of green initiatives at firm level not being limited by analysing just a single theme (e.g., Xu et al. 2023; Shi et al. 2024).

In line with the above, we believe that our empirical analysis may offer a better understanding of the institutional investors role in prompting the firm green innovation on a global scale while also aiming to hopefully provide significant contributions to the literature and actionable insights for stakeholders.

2.1 | Green Initiatives and Financial Performance

Green initiatives have emerged as a vital strategy for companies aiming to minimize their environmental impact and promote sustainability. These initiatives encompass activities such as developing eco-friendly products, improving resource efficiency, and implementing sustainable organizational practices (Roy and Khastagir 2016). Organizations adopting green initiatives are recognized for complying with environmental regulations, enhancing operational efficiency, and fostering positive relationships with stakeholders, including customers, investors, and policymakers (Loeser et al. 2017). Green initiatives often align with evolving consumer preferences for environmentally friendly products, enabling firms to expand their market share and secure sustainable economic advantages (Reddy et al. 2023).

In addition to market benefits, green initiatives can generate financial returns by reducing production costs and optimizing resource utilization (Ambec and Lanoie 2008). Companies that adopt green practices often improve their reputation, which can lead to increased public trust and enhanced market positioning. Moreover, government policies frequently provide financial incentives to encourage environmentally sustainable practices, further supporting corporate growth and stability (Hanim Mohamad Zailani et al. 2012; Zhang et al. 2021).

However, despite these advantages, the literature underscores several challenges associated with green initiatives. Implementing these practices typically requires significant initial investments, with financial returns materializing only in the long term. This poses risks for firms prioritizing short-term profitability (Chen and Ma 2021). Additionally, transitioning to sustainable practices can be challenging due to the distinct nature of green innovation compared to traditional methods (Aguilera-Caracuel and Ortiz-de-Mandojana 2013). Shareholders focused on short-term financial gains may hesitate to support green initiatives due to their uncertain returns and the

potential emphasis on social rather than financial outcomes (Fernando et al. 2017).

The relationship between green initiatives and financial performance has garnered significant attention in recent years as companies increasingly recognize the dual environmental and economic benefits of sustainability practices (Li et al. 2017). Green initiatives—such as the development of eco-friendly products, improvements in resource efficiency, and the adoption of sustainable organizational processes—are often seen as strategic responses to the growing demand for corporate environmental responsibility. These practices enable firms to comply with environmental regulations, while creating opportunities for cost savings and enhanced market competitiveness (Chen and Ma 2021).

Several studies demonstrate a positive correlation between green initiatives and financial performance, particularly when companies successfully integrate sustainability into their core business strategies. Firms investing in green products and processes can lower operational costs by minimizing resource waste, optimizing energy consumption, and recovering valuable materials (Iqbal et al. 2020; Vasileiou et al. 2022). These efficiencies often lead to sustained economic advantages, such as increased profitability and stronger competitive positioning, especially as consumer preferences increasingly favour environmentally sustainable products (Ortiz-de-Mandojana and Bansal 2016). Additionally, companies with strong environmental performance can benefit from an enhanced reputation and increased brand loyalty, which may translate into higher financial returns through improved sales and expanded market share (Gangi et al. 2020).

To summarize, the majority of previous research suggests a positive relationship between financial performance and green initiatives according mainly to three transmission channels dealing with: (i) the enhancing of market competitiveness (Chen and Ma 2021; Gangi et al. 2020), also through the environmentally sustainable products marketing (Ortiz-de-Mandojana and Bansal 2016; Reddy et al. 2023) and the improvement of the brand's reputation through the cultivation of constructive relationships with stakeholders, such as customers, investors, and policymakers (Gangi et al. 2020; Zhang et al. 2021); (ii) the enhancement of the overall corporate profitability through cost reduction and a better use of company resources (Chen and Ma 2021; Iqbal et al. 2020); (iii) the lower business riskiness, coupled to improved environmental risk management, involving a cost of equity capital reduction and a consequent higher company valuation (Sharfman and Fernando 2008). From a theoretical standpoint, classical agency theory assumes that shareholders have homogeneous preferences, primarily oriented toward financial returns (Jensen and Meckling 1976). As a result, it tends to overlook ESG performance, since ESG-related investments may reduce short-term financial outcomes. Nevertheless, a screening of the research articles and the studies included in the most recent literature supports the stakeholder theory perspective, particularly in the form of the “business case argument for ESG” (Schaltegger et al. 2022). In line with this, environmental risks and opportunities should be properly assessed and integrated into investment decisions, particularly in relation to disruptive

business models, as well as the growing impact of climate change regulations and evolving societal expectations. From this perspective, effective ESG strategies are expected to result in improved financial performance, as supported by several prior meta-analyses that report a positive relationship between ESG performance and financial outcomes (e.g., Velte 2023). In line with the above, we propose the following hypothesis:

Hypothesis 1 (H1). *A greater implementation of green initiatives correlates with enhanced financial performance.*

However, the impact of green initiatives on financial performance is not always straightforward. While the long-term benefits of sustainability initiatives are widely recognized, the substantial upfront costs associated with adopting green practices can pose significant short-term financial risks (Mao and Wang 2019; Hornuf and Yüksel 2024; Bernard et al. 2024). Companies often face challenges in recouping their investments in green innovation, particularly when financial returns are delayed or when adverse market conditions arise (Zhan 2023).

2.2 | Green Initiatives and Institutional Investors

Institutional investors are key stakeholders whose characteristics can significantly influence firms' decision-making through proactive oversight and management (Ghaly et al. 2020) as well as the attitude to engage in CSR disclosure initiatives (Lu and Abeysekera 2021). Their influence varies based on their ownership stake, and they exhibit distinct attitudes and value-driven objectives when exercising their rights within firms (Bose et al. 2024; Cremers et al. 2020; Harford et al. 2018).

Prior research suggests that certain institutional investors oversee corporate managers due to their substantial ownership stakes, long-term investment horizons, and active engagement in corporate governance (Hayashi 2003; Shleifer and Vishny 1997; Pan et al. 2019). These investors often hold large blocks of shares, granting them significant voting power and influence over key corporate decisions, including executive appointments, dividend policies, and strategic direction. While some investors engage actively in decision-making to achieve long-term benefits, others adopt uncertain or free-riding strategies aimed at short-term gains (Bena et al. 2017; Callen and Fang 2013).

Chen et al. (2020) and Safiullah et al. (2022) argue that institutional investors' differing impacts can be attributed to variations in their governance abilities and motivations for oversight. This complexity is further influenced by the holding periods of institutional investors, with some prioritizing short-term returns and others focusing on long-term value creation. Investors with shorter holding periods, such as investment companies, tend to engage less in governance, aligning their interests with immediate financial gains. In contrast, long-term investors, such as pension funds, are more likely to closely monitor corporate management to ensure sustainable growth.

Although prior studies have explored green initiatives from multiple perspectives, this study seeks to deepen the understanding of the financial and strategic implications of sustainability practices within the corporate landscape. To achieve this, we categorize

institutional investors into two groups: investment companies and pension funds, following the classification provided by the Refinitiv LSEG database. This classification reflects the asset management company's investment strategy and holding period, focusing on either short- or long-term horizons.

The cornerstone of any holding period strategy is the investment horizon (Fernando et al. 2017). Investment companies typically exhibit lower portfolio concentration and shorter investment horizons, which often result in a more passive supervisory role within the companies they invest in (Sampson and Shi 2023). Previous research (Harford and Kolasinski 2014; Martin et al. 2007) suggests that such investors are less likely to engage deeply in firm governance or strategic decision-making, as their focus is oriented more toward short-term financial returns than long-term value creation.

By contrast, pension fund investors typically exhibit higher portfolio concentration and a greater degree of shareholding independence, traits essential for stronger governance involvement and active monitoring (Cornett et al. 2007; Gonzalez et al. 2020). Due to their long-term investment horizons and commitment to sustainable returns, pension funds are more likely to influence major corporate decisions and assume a supervisory role within the firms in which they invest (Alda 2019). These investors prioritize long-term profitability and sustainability, aligning with their primary objective of ensuring stable returns for future beneficiaries (Della Croce et al. 2011).

Classifying investors into investment company and pension fund categories enhances our understanding of their distinct impacts on corporate decision-making and long-term strategies. This framework allows for a comprehensive examination of the unique roles that different institutional investors play in shaping sustainability efforts within companies, particularly regarding environmental innovation. Based on a cross-national European sample Kordsachia et al. (2021), explores the relationship between sustainable institutional investors and environmental performance finding that sustainable institutional ownership is positively associated with a firm's environmental performance and the willingness to adhere to carbon emission reduction initiatives.

Institutional investors play a pivotal role in shaping firms' green initiatives by influencing decision-making processes through their governance capabilities and investment strategies. While classical agency theory assumes that shareholders are homogeneous in their preferences—focusing exclusively on financial returns and disregarding environmental and social sustainability concerns (Basse Mama and Mandaroux 2022; Velte 2023)—more recent interpretations, such as stakeholder-oriented management theories, reject the assumption of homogeneity among institutional investors (Schaltegger et al. 2022). Thus, it depends on the nature and special types of institutional investors (Velte 2023). From this perspective, specific categories of investors may regard environmental expenditures—such as those associated with green innovation strategies—as worthwhile investments, particularly when they contribute to reducing investment risk (Dyck et al. 2019). Our research embraces this assumption and posits that specific characteristics of institutional investors may positively influence a firm's orientation toward green innovation. To

this end, in contrast to classical agency theory, institutional investors should not be regarded as a homogeneous group of shareholders. Rather, considering their diverse preferences and characteristics, it may be necessary to distinguish between short-term and long-term oriented investors (Velte 2023). In this vein, the study may also offer some noteworthy theoretical contributions. Research indicates that institutional investors with long-term investment horizons, such as pension funds, are particularly likely to encourage companies to adopt sustainable practices, including green initiatives (Zhao et al. 2023). These investors are motivated by objectives such as ensuring long-term profitability and aligning corporate strategies with broader sustainability goals including reducing environmental risks and enhancing operational efficiency. Through their supervisory role, institutional investors promote the integration of eco-friendly products and sustainable resource management practices, thereby contributing to both improved financial performance and environmental stewardship (Aguilera-Caracuel and Ortiz-de-Mandojana 2013).

Conversely, investors with short-term goals, such as those from investment companies, may be less inclined to actively engage in green initiatives. These investors often prioritize short-term financial returns and tend to adopt a more passive role in corporate governance, thereby exerting limited influence on a firm's environmental strategies (Wahba 2010). The divergence in motivations between long- and short-term institutional investors leads to varying levels of support for sustainability efforts, with long-term investors frequently serving as catalysts for driving environmentally responsible practices.

By examining the interactions between institutional investors and green initiatives, this study seeks to understand how different types of investors influence firms' adoption and effectiveness of sustainability strategies. Additionally, our research extends the existing literature by incorporating a global data set and covering a wide range of industries. This approach facilitates cross-regional and cross-industry comparisons, providing a more comprehensive understanding of how institutional investors shape environmental and financial outcomes on a global scale. Based on the above, we propose the following:

Hypothesis 2a (H2a). *Short-term institutional investors, such as investment companies, are likely to have a negative association with green innovation.*

Hypothesis 2b (H2b). *Long-term institutional investors, such as those in pension fund groups, are likely to positively promote firms' green innovation.*

To summarize the beneficial role of institutional investors in financing companies promoting green innovation lies in the evidence that green innovation investments prove to be the more effective as the holding time horizon of an institutional investor is consistent with the medium-long term trajectory of realization and full exploitation of the innovation related to green investments. In this fashion, it is crucial to choose the right type of investor for its financing. This consideration is particularly relevant in light of a recent contribution by Li and Lu (2023) highlighting how the growth of global warming directly affects the ability of companies to carry out green

innovation plan. Authors shows that “for 1°C increases in summer, industrial green innovation reduce by 2.1%.

3 | Data and Empirical Strategy

3.1 | Data and Sample

This study uses data from 2560 publicly listed companies included in the Morgan Stanley Capital International (MSCI), spanning all sectors and geographic regions, and covering the period from 2009 to 2023 (we start our analysis in 2009, as this is the first year in which the data coverage becomes comparable to that of subsequent years). MSCI World Index captures large and mid-cap representation across Developed Markets countries covering approximately 85% of the free float-adjusted market capitalization in each country (<https://www.msci.com/indexes/index/990100>). This data set provides a comprehensive perspective on global sustainability practices and stock market performance along different market conditions. The geographical locations of listed companies cover the following countries: Australia, Canada, China, Europe, India, Japan, New Zealand, Russia, South Korea, the United States, while are also included the most relevant stock financial markets in Europe. To guarantee robustness, key variables are winsorized at the 1st and 99th percentiles to mitigate the possible impact of outliers. Firm-specific characteristics, including financial performance, institutional investor ownership, and attitudes toward green initiatives, were obtained from Refinitiv (now LSEG), widely known as Refinitiv Eikon and hosted by Thomson Reuters. Control variables were also sourced from Refinitiv. This database was selected for its reputation as a reliable international resource, offering one of the most extensive ESG data sets in the industry (Bätae et al. 2021).

3.2 | Measuring Corporate Financial Performance

This study evaluates corporate financial performance using key indicators, including return on equity (ROE), return on assets (ROA), and return on invested capital (ROIC), and Tobin's *Q*. These metrics are widely regarded for their ability to capture various aspects of a company's financial health and operational efficiency (Iwata and Okada 2011).

Return on assets (ROA) assesses a company's efficiency in employing its assets to produce profits, reflecting management effectiveness (Xie et al. 2019). ROE evaluates profitability relative to shareholder equity, highlighting returns to investors. ROIC assesses how effectively a firm employs its capital to generate profits, serving as a key indicator of long-term profitability (Iwata and Okada 2011). Tobin's *Q* captures market valuation relative to asset replacement cost, providing insight into growth expectations and intangible asset value.

3.3 | Green Initiatives Measures

Researchers from diverse fields have shown substantial interest in addressing environmental challenges, with a particular focus

on corporate practices involving environmental management, disclosure, and performance—collectively referred to as Corporate Environmental Management (CEM) (Albertini 2013). Empirical research on green metrics has gained prominence, offering valuable guidelines for managers to enhance environmental efforts and facilitate decision-making in green projects (Golcic et al. 2010).

This study uses the Environmental Innovation Score,⁴ a key performance indicator obtained from the Refinitiv database, to assess green initiatives. According to Rajesh (2020), this score is a critical indicator of firms' ESG performance. In our empirical analysis, the Environmental Innovation Score serves as a dependent variable, reflecting a firm's ability to innovate in environmentally friendly ways. Unlike standard measures such as Research and Development (R&D) expenditures, which often lack detailed disclosure of environmental costs, the Environmental Innovation Score provides a comprehensive evaluation of a firm's eco-innovation activities.

This score assesses a firm's ability to reduce environmental costs and operational burdens while simultaneously creating new market opportunities through advanced environmental technologies and processes (Arena et al. 2018; Nadeem et al. 2020; Zaman et al. 2022). The Environmental Innovation is a composite, weighted, industry-adjusted value ranging from 0 to 100, where higher scores indicate greater dedication to eco-innovation. A score of 100 represents the highest level of commitment to environmentally sustainable practices.

3.4 | Institutional Investors' Ownership

Prior studies have demonstrated that institutional investors can influence corporate behaviour to promote environmentally friendly practices (Aghion et al. 2013; Contreras et al. 2021). In this context, our second research hypothesis examines the impact of different types of institutional investors on a company's commitment to green initiatives, specifically in terms of environmental innovation.

Green initiatives often require significant time and sustained effort to yield measurable outcomes, with financial or environmental returns realized only in the long term. This characteristic underscores the importance of the nature of investors, as their investment horizons and strategies play a critical role in determining their level of support for green strategies.

To capture the influence of institutional investors, building over the Refinitiv LSEG database, we categorize institutional investors into two groups: pension funds and Investment companies, following the classification provided by the Refinitiv LSEG database.⁵ Refinitiv collects ownership data from the UK Share Register and filings relating to Portfolio Ownership (e.g., Form 13F in the United States). Previous scholars largely consider Pension fund as long-term institutional investors (Cornett et al. 2007; Fernando et al. 2017; Dyck et al. 2019; Gonzalez et al. 2020).

In the second cluster, Refinitiv groups institutional investors like hedge funds, investment banks, retail banks, and asset management companies. Despite their different nature in pursuing the

objective of maximizing the return on their assets under management, this large group can be classified, according to previous literature, all in all, as short-term investors category. Fernando et al. (2017) groups banks, hedge funds, and financial investment institutions as Norm-unconstrained institutional investors as opposed to pension plans, and employee stock ownership plans, easily attributable to the category of long-term investors, labelled as Norm-unconstrained institutional investors. Hedge fund could be considered as short-term investors since academic literature has repeatedly been questioned on the fact that their myopic activism leads them to the avoidance of investments promising to pay off only in the long term (Bebchuk et al. 2015; Coffee and Palia 2016).

Banks and the asset management companies have a clear incentive to the short-term investment horizon due to the intrinsic nature of their business which relies mainly on portfolio management professional service toward retail investors. ESMA, or European Securities and Markets Authority (2020) provides evidence on this, showing that the equities “are commonly held in portfolios for less than 5 years (50% of respondents)” by banks and asset management companies while “only a small minority of respondents (13%) apply a holding period that exceeds 9 years.” In addition to this, the activity of sell-side analyst, mostly provided by banks, according to the same source “contribute to short-term investment behaviour to a large extent.” The same source shows that due to their preference for short-term returns, investment companies may be less inclined to support green initiatives that require significant upfront investments and only yield long-term benefits. The delay in realizing profits from green strategies can deter these investors, as their primary objective is to maximize short-term performance, which often conflicts with the timeline needed for sustainable projects to deliver tangible results.

Pension funds, in contrast, represent the proportion of shares owned by entities managing retirement savings for employees. These investors have fundamentally different investment horizons, with a long-term focus that aligns with the nature of green initiatives aimed at promoting sustainability and generating benefits over extended periods. Unlike investment companies, pension funds can afford to wait for long-term financial gains from improved environmental performance. This makes them more likely to support corporate strategies prioritizing sustainability and environmental innovation. Their longer investment holding periods position pension funds as key supporters of green initiatives, as they are less constrained by the need for immediate returns and better aligned with the gradual progress required for environmental sustainability efforts.

Data regarding ownership by investment companies and pension funds are sourced from Refinitiv. Specifically, the Investment Company variable represents the percentage of shares held by investment banks or institutions, such as mutual funds and hedge funds. The Pension Fund variable measures the percentage of a company's shares owned by pension funds. Given their control over long-term retirement assets, pension funds are expected to support sustainable practices that enhance corporate environmental responsibility. Institutional ownership reported percentages reflect year-end holdings.

3.5 | Control Variables

The empirical framework incorporates a set of control variables identified in the literature as having an impact on both company performance and green initiatives (Habib et al. 2018). We include total assets, a widely used indicator of firm size, quantified by the natural logarithm of total assets. Larger companies typically possess greater financial resources to allocate toward environmental initiatives and benefit from economies of scale when implementing eco-friendly practices (Aouadi and Marsat 2018).

The price-to-book value is also included as a control variable, providing insights into how the market evaluates a company's market capitalization relative to its book value. This metric reflects investors' perspectives and growth expectations, which can influence a company's propensity to invest in environmentally friendly projects (Brulhart et al. 2019).

Cash flow is another important control variable, as companies with higher cash flows have greater internal financial resources to undertake eco-innovation projects without relying on external financing. This variable is calculated as operating cash flow divided by total assets (Gurun and Butler 2012).

We also incorporate the price-to-earnings ratio (PER) as a measure of market expectations regarding a company's future earnings growth.

Consistent with Zaman et al. (2021) and Xu et al. (2023), we include fixed effects to account for unobserved heterogeneity. Firm fixed effects (Firm F.E.) capture the unique, time-invariant characteristics of each firm while year fixed effects (Year F.E.) adjust for broader economic trends and global events that affect all firms uniformly in a given year.

3.6 | Descriptive Statistics and Correlation Matrix

Table 1 displays the descriptive statistics for the variables used in this study (Table A1 provides detailed variable descriptions). The average values for the financial performance metrics are as follows: ROE is 14.372, ROA is 6.739, ROIC is 10.084 and Tobin's Q is 2.099. The Environmental Innovation Score, which reflects a company's eco-innovation efforts, has a mean of 38.348 and a standard deviation of 33.716.

The average total assets are approximately 3.35 billion, indicating a diverse range of company sizes within the sample. The price-to-book value ratio has an average of 3.364, while the price-to-earnings ratio average is 27.835. The average sales are 9.459 and leverage 37.944. For ownership variables, investment company holdings have a mean value of 7.353% and pension fund holdings average 8.415%.

These descriptive statistics provide a comprehensive overview of the financial and environmental characteristics of the companies in the sample, forming a solid foundation for further analysis. Table A2 in the Appendix displays the correlation coefficients between the financial and environmental variables, offering insights into their relationships.

TABLE 1 | Descriptive statistics.

Variable	Obs	Mean	Std. Dev.	Min	Max
ROE	29,307	14.372	19.946	−60.49	105.760
ROA	29,640	6.739	10.642	−417.730	269.110
ROIC	29,712	10.084	11.504	−28.330	55.340
Tobin's Q	30,249	2.099	4.823	0.017	36.374
Green initiatives	23,511	38.348	33.716	0	99.890
Total assets	30,212	17.657	2.869	5.831	27.275
Cash flow	30,168	356.192	1138.271	.034	4873.574
Price-to-book value	28,445	3.364	4.682	−6.900	30.250
PER	26,070	27.835	36.691	3.100	278.100
Leverage	30,336	37.944	25.359	0	111.67
Sales revenues	29,610	9.459	13.906	−18.720	75.660
Pension Fund	29,304	8.415	2.589	0	72
Investment Company	29,304	7.353	7.037	0	71

Note: The return on equity (ROE) measures profitability relative to shareholders' equity, offering insight into how effectively a company utilizes its equity to generate profits. Return on assets (ROA) assesses how efficiently a company uses its assets to generate earnings. Similarly, the return on invested capital (ROIC) evaluates the efficiency in allocating capital to profitable investments. Tobin's Q captures a firm's market valuation relative to its assets' replacement cost, reflecting investors' expectations of future growth. Green Initiatives are proxied by the Environmental Innovation Score, which quantifies a company's efforts in developing environmentally friendly technologies and practices and indicates its commitment to sustainability. Total Assets, expressed in logarithmic form, represent the overall value of a company's holdings. At the same time, Cash Flow measures liquidity by showing the total money inflows and outflows, reflecting the financial health and flexibility of the company. The Price-to-book value (PTB) ratio compares a company's market value to its book value, helping to determine whether the stock is undervalued or overvalued. The Price to Earnings Ratio (PER) measures market expectations regarding a company's future earnings potential by comparing the current share price to earnings per share. Leverage indicates the firm's reliance on debt financing. Sales Revenues measure the total income generated from the sale of goods and services. The table also includes data on the proportion of shares held by pension funds and investment companies, indicating the level of institutional investment and confidence in the company. All variables have been winsorized at the 1st and 99th percentiles to reduce the influence of extreme outliers.

3.7 | Empirical Strategy

3.7.1 | Financial Performance and Green Initiatives

To address Hypothesis 1 (H1)—“The higher the level of green initiatives, the higher the level of financial performance”—we follow the approach of Iqbal et al. (2022) to examine the impact of green initiatives on financial performance, specifically measured by ROE, using the following model:

$$\begin{aligned} \text{ROE}_{it} = & \beta_0 + \beta_1 \text{Green Initiatives}_{it-1} + \gamma_1 \text{TA}_{i,t-1} \\ & + \gamma_2 \text{CF}_{i,t-1} + \gamma_3 \text{PTB}_{i,t-1} + \gamma_4 \text{PER}_{i,t-1} \\ & + \gamma_5 \text{LEV}_{i,t-1} + \gamma_6 \text{SAL}_{i,t-1} + \mu_i + \epsilon_{i,t} \end{aligned} \quad (1)$$

Subscripts i , j and t denote the firm, country, and time, respectively. These equations aim to quantify the direct relationship between Green Initiatives, proxied by the Environmental Innovation Score (EnvInnSco) and financial performance, measured by ROE. The model also incorporates key financial variables, including total assets ($\text{TA}_{i,t-1}$), cash flow ($\text{CF}_{i,t-1}$), price-to-book value ($\text{PTB}_{i,t-1}$), the price-to-earnings ratio ($\text{PER}_{i,t-1}$), leverage ($\text{LEV}_{i,t-1}$), and sales ($\text{SAL}_{i,t-1}$).

To control for unobservable, time-invariant differences among firms, we include firm fixed effects, ensuring that constant characteristics unique to each firm are accounted for over the study period.

3.7.2 | Environmental Innovation and Institutional Investors

Building on the methodology of Zhao et al. (2023), we test Hypotheses H2a and H2b to evaluate the impact of institutional investors on environmental innovation, we employ a set of equations to analyse how different types of investor holdings influence a company's approach to green initiatives.

In these models, the Green Initiatives serves as the dependent variable, capturing the extent to which companies are inclined toward green initiatives. The key independent variables are Investment Company Holdings (INVCO) and Pension Fund Holdings (PENSF), which measure shareholder ownership. The baseline models are formulated as follows:

$$\begin{aligned} \text{Green Initiatives}_{it} = & \beta_0 + \beta_1 \text{INVCO}_{it-1} + \gamma_1 \text{TA}_{i,t-1} \\ & + \gamma_2 \text{CF}_{i,t-1} + \gamma_3 \text{PTB}_{i,t-1} + \gamma_4 \text{PER}_{i,t-1} \\ & + \gamma_5 \text{LEV}_{i,t-1} + \gamma_6 \text{SAL}_{i,t-1} + \mu_i + \epsilon_{i,t} \end{aligned} \quad (2)$$

$$\begin{aligned} \text{Green Initiatives}_{it} = & \beta_0 + \beta_1 \text{PENSF}_{it-1} + \gamma_1 \text{TA}_{i,t-1} \\ & + \gamma_2 \text{CF}_{i,t-1} + \gamma_3 \text{PTB}_{i,t-1} + \gamma_4 \text{PER}_{i,t-1} \\ & + \gamma_5 \text{LEV}_{i,t-1} + \gamma_6 \text{SAL}_{i,t-1} + \mu_i + \epsilon_{i,t} \end{aligned} \quad (3)$$

In these models, we control for total assets ($\text{TA}_{i,t-1}$), cash flow ($\text{CF}_{i,t-1}$), price-to-book value ($\text{PTB}_{i,t-1}$), the price-to-earnings

ratio ($PER_{i,t-1}$), leverage ($LEV_{i,t-1}$), and sales ($SAL_{i,t-1}$) to isolate the effect of institutional holdings on green initiatives. Additionally, year fixed effects and firm fixed effects are included in all specifications to account for time-specific factors and unobserved, time-invariant firm characteristics, respectively.

4 | Main Results

4.1 | Baseline Models

This section presents the results of the OLS estimation, quantifying the average effects of green initiatives on financial performance. The analysis focuses on ROE as the dependent variable, with Green Initiatives, proxied by the Environmental Innovation Score, serving as the key independent variable.

Table 2 provides a detailed overview of the results. The findings indicate a positive relationship between green initiatives, as measured by Environmental Innovation Scores, and financial performance (ROE). Specifically, firms with higher Environmental Innovation Scores tend to demonstrate superior financial performance in terms of ROE. The positive coefficients in these models suggest that improved environmental innovation efforts are associated with enhanced financial outcomes, supporting Hypothesis 1 (H1), which posits a positive link between green initiatives and financial performance.

This positive relationship can be attributed to cost savings from increased resource efficiency, enhanced brand reputation, and alignment with shifting consumer preferences toward sustainability (Gangi et al. 2020; Iqbal et al. 2020; Ortiz-de-Mandojana and Bansal 2016). Additionally, compliance with environmental regulations reduces the risk of penalties, further contributing to improved financial performance (Chen and Ma 2021).

Consistent with the findings of Bătae et al. (2021), who analysed a sample of 39 European banks, our results similarly highlight the financial benefits of green initiatives. However, our study extends beyond the banking sector by utilizing a broader global data set that spans various industries and regions. This expanded scope captures diverse industry dynamics, enhancing the generalizability of our findings and providing a more comprehensive understanding of the impact of green initiatives across different sectors and geographic contexts. A three-point increase in the Green Innovation Firm Attitude (sample mean is approximately 14%, please see descriptive statistics provided at Table 1), given the estimated coefficient magnitude is around 20%, is associated, on average, with a 1% increase in the economic performance proxied by the ROE. This finding indicates a significant long-term financial benefit. Therefore, when managers assess green innovation strategies, they should weigh not only the costs but also the potential economic outcome. However, the statistical significance of this effect is relatively modest.

Table 3 presents the results of the regression models analysing the relationship between green initiatives—measured by the Environmental Innovation Score—and institutional investor holdings, in line with Hypothesis 2a/2b (H2a/H2b).

TABLE 2 | Green initiatives and performance.

Variables	ROE (1)	ROE (2)	ROE (3)
Green initiatives	0.176* [0.092]	0.169* [0.092]	0.177* [0.092]
Total assets	−12.719*** [2.205]	−12.599*** [2.221]	−12.607*** [2.207]
Cash flow	−0.002*** [0.000]	−0.002*** [0.000]	−0.002*** [0.000]
Price-to-book value	−0.041 [0.028]	−0.038 [0.028]	−0.036 [0.028]
PER	−0.005 [0.020]	−0.004 [0.020]	−0.008 [0.020]
Leverage	1.335*** [0.132]	1.276*** [0.133]	1.312*** [0.133]
Sales revenues	−0.003 [0.011]	−0.002 [0.011]	−0.003 [0.011]
Constant	151.042*** [35.370]	160.209*** [58.515]	157.183*** [54.256]
Observations	17,890	17,890	17,890
R-squared	0.012	0.022	0.021
Number of firms	1957	1957	1957
Year F. E.	Y	N	N
Firm F. E.	Y	N	N
Industry F. E.	N	Y	N
Country F. E.	N	N	Y
Country##Year	N	Y	N
Industry##Year	N	N	Y

Note: This table presents the results of regression models assessing the relationship between green initiatives and firm financial performance, measured by return on equity (ROE). Column (1) reports the baseline specification, including year and firm fixed effects. Column (2) adds country fixed effects to control for institutional and macroeconomic differences across countries. Column (3) includes both country and year fixed effects, allowing for time-varying country-level heterogeneity. The key independent variable, green initiatives, is proxied by the Environmental Innovation Score, which captures the extent of a firm's commitment to environmental innovation. Control variables include total assets, cash flow, price-to-book value, PER, leverage, and sales revenues, providing a comprehensive view of firm-specific financial characteristics. Statistical significance is denoted by *** $p < 0.01$; ** $p < 0.05$; * $p < 0.10$. Variable definitions are provided in Table A1. Standard errors are clustered at the firm-level.

Hypothesis 2a. *Short-term institutional investors, such as investment companies, are likely to be negatively associated with green innovation.*

Hypothesis 2b. *Long-term institutional investors, such as pension funds, are likely to be positively associated with green innovation.*

The analysis focuses on two primary categories of institutional investors, distinguished by their holding period: short-term investors (e.g., investment companies) and long-term investors

TABLE 3 | Green initiatives and institutional investors.

Variables	Green initiatives (1)	Green initiatives (2)	Green initiatives (3)	Green initiatives (4)	Green initiatives (5)	Green initiatives (6)
Investment Company	−0.095*** [0.028]	−0.089*** [0.028]	−0.109*** [0.028]			
Pension Fund				0.198* [0.102]	0.222** [0.099]	0.239** [0.099]
Total assets	0.000*** [0.000]	0.000*** [0.000]	0.000*** [0.000]	3.256*** [0.390]	5.435*** [0.281]	5.782*** [0.283]
Cash flow	0.000 [0.000]	0.000 [0.000]	0.000 [0.000]	0.004 [0.003]	0.003 [0.003]	0.004 [0.003]
Price-to-book value	−0.004** [0.002]	−0.004** [0.002]	−0.005*** [0.002]	0.023 [0.056]	0.057 [0.053]	0.151*** [0.053]
PER	−0.001 [0.001]	−0.001 [0.001]	−0.001 [0.001]	−0.008* [0.005]	−0.011** [0.004]	−0.008* [0.004]
Leverage	0.001 [0.001]	0.000 [0.001]	0.001 [0.001]	−0.001** [0.000]	−0.001** [0.000]	−0.001*** [0.000]
Sales revenues	0.001 [0.001]	0.001 [0.001]	0.001 [0.001]	0.000 [0.004]	−0.003 [0.004]	−0.004 [0.004]
Constant	10.903*** [2.935]	15.161** [3.579]	10.821*** [3.474]	−26.812*** [6.818]	−65.792*** [4.770]	−70.192*** [5.129]
Observations	18,490	18,490	18,490	20,059	20,059	20,059
R-squared	0.162	0.165	0.168	0.251	0.251	0.259
Number of firms	2021	2021	2021	2109	2109	2109
Year F. E.	Y	N	N	Y	N	N
Firm F. E.	Y	N	N	Y	N	N
Industry F. E.	N	Y	N	N	Y	N
Country F. E.	N	N	Y	N	N	Y
Country##Year	N	Y	N	N	Y	N
Industry##Year	N	N	Y	N	N	Y

Note: This table presents the results of regression models evaluating the impact of institutional investor ownership on the implementation of green initiatives, measured by the Environmental Innovation Score. Columns (1) to (3) examine the effect of ownership by investment companies, while columns (4) to (6) focus on pension fund ownership. The variables “Investment Company” and “Pension Fund” represent the proportion of firm shares held by each investor type. All models control for firm-specific financial characteristics, including total assets, cash flow, price-to-book value, PER, leverage, and sales revenues. Column (1) includes firm and year fixed effects. Column (2) removes firm fixed effects and retains year effects. Column (3) adds country fixed effects. Columns (4) to (6) replicate this sequence of specifications using pension fund ownership as the key explanatory variable. Statistical significance is denoted by *** $p < 0.01$; ** $p < 0.05$; * $p < 0.10$. Definitions of all variables are provided in Table A1. Standard errors are clustered at the firm-level.

(e.g., pension funds). The dependent variable across all models is the Environmental Innovation Score, representing a firm’s commitment to green initiatives.

Our model reveals a negative relationship between investment company holdings and green initiatives, indicating that higher levels of investment by these institutions are associated with lower environmental innovation. This result aligns with Hypothesis 2a (H2a) and is likely attributable to the short-term focus of investment companies, which often prioritize immediate financial gains over long-term sustainability goals. Their preference for short-term returns may result in underinvestment in green initiatives, as such projects typically require significant upfront costs and yield benefits only in the long term (Wahba 2010; Zhao et al. 2023). Consequently, investment companies may lack the incentives to advocate

for environmental improvements that do not align with their short-term financial objectives.

In contrast, Model 4 demonstrates a positive relationship between pension fund holdings and green initiative scores, confirming Hypothesis 2b (H2b). This finding suggests that pension funds as institutional investors are more inclined to support firms’ green initiatives. Pension funds’ long-term investment horizons align well with the extended timeline required for green initiatives to generate benefits, making them key drivers of corporate environmental innovation.

The link between institutional investor ownership and green innovation is statistically stronger for investment companies, but economically more impactful for pension funds. Specifically, a

5-percentage point increase in institutional ownership is associated with a 1% rise in firm-level green initiatives, based on an average coefficient of approximately 0.2. This suggests that pension funds may exert soft power—through voting at shareholder meetings or direct engagement with management or the board—to steer firms toward greater innovation in green technologies.

Our study builds on the work of Zhao et al. (2023), who explored the relationship between green initiatives and investor holdings, focusing specifically on two types of institutional investors: dedicated and transient. While their research provides valuable insights into how investor types influence firms' environmental strategies, it is limited to data from China. By contrast, our study adopts a global perspective, offering a more comprehensive analysis across different countries and industries. This broader approach represents a novel contribution to the literature, enabling cross-regional comparisons and providing a deeper understanding of the dynamics between institutional investors and green initiatives. Lastly, our results also aligned with Shi et al. (2024).

4.2 | Additional Analysis

Building on our baseline models, we further examine the relationship between green initiatives and financial performance, as well as the influence of institutional investors on green initiatives, by segmenting firms based on specific accounting and sustainability performance characteristics. In line with prior studies (Yang et al. 2024), we analyse firm-specific attributes such as size, overall performance on environmental, social, and governance issues, and emission levels. This approach allows us to explore how these relationships vary depending on company characteristics, thereby enhancing the generalizability and robustness of our baseline results.

Specifically, we examine the impact of green initiatives on ROE and the relationship between green initiatives and institutional investors for firms according to the size proxied by total assets. The additional models are as follows:

$$\begin{aligned} \text{ROE}/\text{TA}_{it}^{\text{HighorLow}} = & \beta_0 + \beta_1 \text{Green Initiatives}_{it-1} \\ & + \gamma_1 \text{TA}_{i,t-1} + \gamma_2 \text{CF}_{i,t-1} + \gamma_3 \text{PTB}_{i,t-1} \\ & + \gamma_4 \text{PER}_{i,t-1} + \gamma_5 \text{LEV}_{i,t-1} + \gamma_6 \text{SAL}_{i,t-1} \\ & + \mu_i + \epsilon_{i,t} \end{aligned} \quad (4)$$

$$\begin{aligned} \text{Green Initiatives}/\text{TA}_{it}^{\text{HighorLow}} = & \beta_0 + \beta_1 \text{INVCO}_{it-1} + \gamma_1 \text{TA}_{i,t-1} \\ & + \gamma_2 \text{CF}_{i,t-1} + \gamma_3 \text{PTB}_{i,t-1} + \gamma_4 \text{PER}_{i,t-1} \\ & + \gamma_5 \text{LEV}_{i,t-1} + \gamma_6 \text{SAL}_{i,t-1} + \mu_i + \epsilon_{i,t} \end{aligned} \quad (5)$$

$$\begin{aligned} \text{Green Initiatives}/\text{TA}_{it}^{\text{HighorLow}} = & \beta_0 + \beta_1 \text{PENSE}_{it-1} + \gamma_1 \text{TA}_{i,t-1} \\ & + \gamma_2 \text{CF}_{i,t-1} + \gamma_3 \text{PTB}_{i,t-1} + \gamma_4 \text{PER}_{i,t-1} \\ & + \gamma_5 \text{LEV}_{i,t-1} + \gamma_6 \text{SAL}_{i,t-1} + \mu_i + \epsilon_{i,t} \end{aligned} \quad (6)$$

In this specification, $\text{ROE}/\text{TA}_{it}^{\text{HighorLow}}$ represents the return on equity for firms with either high or low total assets, determined

based on whether their total assets are above or below the median. (An untabulated test considering group classification based on the mean criterion, not reported in the tables, also confirms our findings.) This analysis provides insights into how the relationship between green initiatives (EnvInnSco) and financial performance (ROE) varies across firms of different sizes and levels of total assets (TA).

Table 4 presents the results of the additional analysis. Overall, the findings confirm our baseline models. Notably, companies with lower total assets exhibit a stronger positive correlation between green initiatives and ROE compared to larger companies. This result may be attributed to the inherent complexity of larger organizations, which often encompass vast, integrated systems of technologies, data, products or services, and individuals. These complexities can result in diminished marginal benefits from adopting green initiatives. In contrast, smaller firms are more agile and can more readily achieve significant competitive advantages through green differentiation (Vijayvargy et al. 2017; Waddock and Graves 1997). Compared to the baseline finding (a 1% ROE increase per 3-point rise in green innovation attitude), the effect is about three times stronger among smaller firms, indicating that green initiatives yield higher profitability gains in such companies. However, from the perspective of pension funds, the positive influence of ownership on green innovation grows with firm size. Larger enterprises play a central role in global green development efforts, as they face heightened socio-economic and environmental pressures. According to resource-based theory, green innovation depends on financial resources, skilled R&D staff, and accumulated experience—all areas where large firms typically hold a competitive advantage over smaller ones.

Similarly, to deepen the evidence related to our second research hypothesis, we further explore the relationship between green initiatives and institutional investor holdings by segmenting firms based on their total assets, as presented in the same table. In these additional analyses, the Green Initiative Score serves as the dependent variable, while Investment Company (INVCO) and Pension Fund (PENSF) holdings are the key independent variables.

In these models, $\text{Green Initiatives}/\text{TA}_{it}^{\text{HighorLow}}$ represents the Environmental Innovation Score of firms with either high or low total assets, determined based on whether their total assets are above or below the mean or median. This segmentation enables us to evaluate how the influence of institutional holdings on green initiatives varies across firms of different sizes.

Consistent with our baseline results, the analysis of pension fund holdings reveals a positive correlation with green initiatives, particularly in companies with higher levels of total assets. In contrast, investment companies exhibit an inverse relationship with green initiatives aimed at promoting environmental innovation, especially in larger organizations. Firms with substantial total assets are often better positioned to absorb the initial costs of sustainability projects and tolerate the uncertainty of long-term returns, as they are less dependent on immediate profitability (Lel 2024). Additionally, larger firms benefit from economies of scale, making the adoption of

TABLE 4 | Green initiatives, financial performance, and institutional investors—size effect.

Subsample	High total asset			Low total asset		
	ROE (1)	Green initiatives (2)	Green initiatives (3)	ROE (4)	Green initiatives (5)	Green initiatives (6)
Green initiatives	0.234* [0.136]			0.600** [0.290]		
Investment company		-0.181*** [0.048]			-0.069** [0.034]	
Pension Fund			0.561*** [0.136]			0.320** [0.158]
Cash flow	-0.121*** [0.038]	0.006** [0.003]	0.005* [0.003]	3.330*** [0.694]	-0.008 [0.020]	5.689*** [1.930]
Price-to-book value	-0.095 [0.127]	-0.011 [0.008]	-0.011 [0.008]	-0.387*** [0.064]	-0.395** [0.198]	-0.003 [0.002]
PER	-0.016 [0.028]	-0.007 [0.020]	-0.009 [0.020]	0.006 [0.029]	-0.001 [0.001]	-0.005 [0.011]
Leverage	2.713*** [0.278]	0.052*** [0.016]	0.051*** [0.016]	2.473*** [0.401]	0.001 [0.001]	0.001 [0.001]
Sales revenues	0.004 [0.020]	-0.008 [0.017]	-0.006 [0.017]	-0.046 [0.266]	-0.012 [0.009]	-0.011 [0.010]
Constant	-98.624*** [12.872]	29.112*** [6.290]	29.267*** [6.282]	-89.941*** [17.563]	9.718** [4.252]	28.883*** [0.863]
Observations	10,592	10,696	10,696	8774	9211	9211
R-squared	0.011	0.174	0.185	0.013	0.168	0.001
Number of firms	1245	1250	1250	1047	1086	1086
Year F. E.	Y	Y	Y	Y	Y	Y
Firm F. E.	Y	Y	Y	Y	Y	Y

Note: This table presents the results of regression models estimated separately for firms with high and low total assets, based on the median split of the sample. Columns (1) and (4) assess the relationship between green initiatives and financial performance, measured by ROE, for high-asset and low-asset firms, respectively. Columns (2)–(3) and (5)–(6) examine how institutional investor types, investment companies and pension funds, influence the adoption of green initiatives within the two subsamples. The key explanatory variables are the Environmental Innovation Score (for green initiatives), Investment Company ownership, and Pension Fund ownership. All models include standard firm-level financial controls: cash flow, price-to-book value, PER, leverage, and sales revenues. Fixed effects for year and firm are included across all specifications to control for unobserved heterogeneity. Statistical significance is indicated as follows:

*** $p < 0.01$; ** $p < 0.05$; * $p < 0.10$. Definitions of all variables are provided in Table A1. Standard errors are clustered at the firm-level.

environmental innovation more cost-effective compared to smaller firms (Lel 2024).

This advantage enables larger firms to integrate sustainability into their business models more effectively, particularly over the long term. This economic rationale supports the idea that investors with long-term investment horizons are especially drawn to large companies. Conversely, short-term investors may perceive the complexity of large organizations as a deterrent rather than an incentive, discouraging their investment in such firms (Vijayvargy et al. 2017).

We also tested our hypotheses by grouping companies based on their overall social and environmental performance, as measured by their ESG Score. We analysed the influence of green initiatives on ROE for companies with both high and low ESG scores as it follows:

$$\begin{aligned} \text{ROE|ESG}_{it}^{\text{HighorLow}} &= \beta_0 + \beta_1 \text{GreenInitiatives}_{it-1} + \gamma_1 \text{TA}_{it-1} \\ &+ \gamma_2 \text{CF}_{it-1} + \gamma_3 \text{PTB}_{it-1} + \gamma_4 \text{PER}_{it-1} \quad (7) \\ &+ \gamma_5 \text{LEV}_{it-1} + \gamma_6 \text{SAL}_{it-1} + \mu_i + \epsilon_{i,t} \end{aligned}$$

$$\begin{aligned} \text{GreenInitiatives|ESG}_{it}^{\text{HighorLow}} &= \beta_0 + \beta_1 \text{INVCO}_{it-1} \\ &+ \gamma_1 \text{TA}_{it-1} + \gamma_2 \text{CF}_{it-1} + \gamma_3 \text{PTB}_{it-1} \quad (8) \\ &+ \gamma_4 \text{PER}_{it-1} + \gamma_5 \text{LEV}_{it-1} \\ &+ \gamma_6 \text{SAL}_{it-1} + \mu_i + \epsilon_{i,t} \end{aligned}$$

$$\begin{aligned} \text{GreenInitiatives|ESG}_{it}^{\text{HighorLow}} &= \beta_0 + \beta_1 \text{PENSE}_{it-1} \\ &+ \gamma_1 \text{TA}_{it-1} + \gamma_2 \text{CF}_{it-1} + \gamma_3 \text{PTB}_{it-1} \quad (9) \\ &+ \gamma_4 \text{PER}_{it-1} + \gamma_5 \text{LEV}_{it-1} \\ &+ \gamma_6 \text{SAL}_{it-1} + \mu_i + \epsilon_{i,t} \end{aligned}$$

Under this specification, $ROE|ESG_{it}^{HighorLow}$ represents the return on equity for companies with either high or low ESG ratings determined by whether their ESG scores exceed or fall below the average or median value. Similarly, we investigated the correlation between green initiatives and institutional investor ownership. In line with Hypothesis 2 (H2), the Green Initiative Score is used, as the dependent variable, with INVCO and Pension Fund (PENSF) holdings serving as the primary independent variables.

Table 5 presents the correlations between green initiatives, financial performance, and institutional investors. The findings support our expectations outlined in Hypothesis 1 (H1), while also revealing that only enterprises with superior environmental and social ESG performance exhibit a positive effect of green initiatives on ROE. The economic rationale for this result

lies in the increasing market demand for sustainable practices and products, which firms with high ESG scores are better positioned to meet. This suggests that companies with superior ESG performance are more capable of commercializing environmental innovations, thereby achieving financial benefits.

Additionally, firms with strong ESG performance often benefit from lower capital costs as investors and creditors perceive them as less risky due to their commitment to sustainability and long-term value creation (Goss and Roberts 2011). While the positive effect of green initiatives on financial performance is concentrated among ESG best-performing firms, a similar pattern holds for institutional investors: pension fund ownership positively influences green innovation, particularly among ESG leaders. Specifically, a 2-percentage point increase in pension fund ownership (estimated coefficient coupled to pension fund

TABLE 5 | Green initiatives, financial performance, and institutional investors: the effect of environmental, social, and governance performance.

Subsample	High social and environmental effect			Low social and environmental effect		
	ROE (1)	Green initiatives (2)	Green initiatives (3)	ROE (4)	Green initiatives (5)	Green initiatives (6)
Green initiatives	0.387** [0.183]			-0.048 [0.113]		
Investment Company		-0.037 [0.040]			-0.079** [0.034]	
Pension Fund			0.521*** [0.130]			0.291** [0.146]
Total assets	-27.784*** [5.339]			-7.974*** [2.645]	3.397*** [0.347]	
Cash flow	0.037 [0.076]	0.000 [0.004]	0.006 [0.005]	-0.244*** [0.036]	0.008** [0.004]	0.002 [0.004]
Price-to-book value	-2.398*** [0.126]	-0.102 [0.439]	-0.002 [0.002]	0.073*** [0.023]	-0.266 [0.207]	-0.000 [0.004]
PER	-0.043 [0.072]	-0.003 [0.003]	-0.001 [0.001]	-0.001 [0.014]	-0.001 [0.001]	-0.002 [0.003]
Leverage	2.182*** [0.258]	0.001 [0.002]	-0.000 [0.002]	0.805*** [0.147]	-0.000 [0.002]	0.001 [0.002]
Sales revenues	0.123 [0.281]	-0.008 [0.013]	0.001 [0.009]	-0.018 [0.147]	-0.005 [0.009]	-0.005 [0.008]
Constant	343.292*** [90.078]	-41.043*** [7.316]	-119.450*** [6.661]	111.189*** [39.883]	-35.854*** [5.475]	-57.760*** [6.369]
Observations	10,348	10,509	9398	8785	9398	10,661
R-squared	0.034	0.211	0.061	0.0154	0.145	0.139
Number of firms	1421	1411	1605	1538	1605	1421
Year F. E.	Y	Y	Y	Y	Y	Y
Firm F. E.	Y	Y	Y	Y	Y	Y

Note: This table presents regression results for two subsamples of firms based on their environmental and social (ESG) scores, split at the median into high and low ESG performance groups. Columns (1) and (4) examine the effect of green initiatives on financial performance (measured by ROE) within the two subsamples. Columns (2)–(3) and (5)–(6) evaluate the influence of institutional investor types—investment companies and pension funds—on the adoption of green initiatives, proxied by the Environmental Innovation Score. Control variables include total assets, cash flow, price-to-book value, PER, leverage, and sales revenues. All models are estimated using firm and year fixed effects. Statistical significance is denoted by

*** $p < 0.01$; ** $p < 0.05$; * $p < 0.10$. Detailed definitions of all variables are available in Table A1. Standard errors are clustered at the firm-level.

ownership is equal to about 0.5) corresponds to a 1% increase in green innovation attitude.

In Table 5, we also analyse the influence of institutional investor holdings on green initiatives. The findings confirm our baseline results, showing that pension fund holdings have a positive and significant impact on green initiatives, particularly for firms with high ESG scores. These results highlight the critical role of long-term sustainability-focused investors in driving green initiatives within firms.

Conversely, investment companies exhibit a negative impact on green initiatives in firms with lower ESG scores, indicating a preference for short-term returns over long-term sustainability objectives. This disparity aligns with the differing investment strategies and goals of these two types of investors. Pension funds, motivated by the need to ensure long-term financial security for retirees, are more likely to support firms prioritizing sustainability, as such firms are better positioned to deliver stable, long-term returns (Alda 2019). In contrast, investment companies, which often manage funds emphasizing short-term performance, may be hesitant to invest in green initiatives due to the significant upfront costs and the longer time horizon required to realize financial benefits (Bose et al. 2024). This divergence underscores the importance of aligning investor types with corporate sustainability goals to promote meaningful environmental innovation (Alda 2019; Cornett et al. 2007; Gonzalez et al. 2020).

Finally, we examine the relationship between green initiatives and financial performance (H1) as well as the relationship between green initiatives and institutional investors (H2) by segmenting companies based on their emission scores (High vs. Low Polluters) as measured by the LSEG Emission Score ($EMIS_{it}^{HighorLow}$). The objective of this analysis is to explore how the correlation between green initiatives and financial performance varies across firms with differing emission profiles.

Firms with higher emissions may operate under distinct market conditions, face greater regulatory pressures, and experience different investment dynamics compared to lower emission firms. These factors can significantly influence the effectiveness of green initiatives in driving financial performance, shedding light on how environmental and financial strategies interact across varying emission levels. In line with the above, we consider the following econometric specification:

$$ROE|EMIS_{it}^{HighorLow} = \beta_0 + \beta_1 Green\ Initiatives_{it-1} + \gamma_1 TA_{i,t-1} + \gamma_2 CF_{i,t-1} + \gamma_3 PTB_{i,t-1} + \gamma_4 PER_{i,t-1} + \gamma_5 LEV_{i,t-1} + \gamma_6 SAL_{i,t-1} + \mu_i + \epsilon_{i,t} \quad (10)$$

$$Green\ Initiatives|EMIS_{it}^{HighorLow} = \beta_0 + \beta_1 INVCO_{it-1} + \gamma_1 TA_{i,t-1} + \gamma_2 CF_{i,t-1} + \gamma_3 PTB_{i,t-1} + \gamma_4 PER_{i,t-1} + \gamma_5 LEV_{i,t-1} + \gamma_6 SAL_{i,t-1} + \mu_i + \epsilon_{i,t} \quad (11)$$

$$Green\ Initiatives|EMIS_{it}^{HighorLow} = \beta_0 + \beta_1 PENSEF_{it-1} + \gamma_1 TA_{i,t-1} + \gamma_2 CF_{i,t-1} + \gamma_3 PTB_{i,t-1} + \gamma_4 PER_{i,t-1} + \gamma_5 LEV_{i,t-1} + \gamma_6 SAL_{i,t-1} + \mu_i + \epsilon_{i,t} \quad (12)$$

The emissions score, $EMIS_{it}^{HighorLow}$, serves as a critical metric, reflecting a company's commitment to reducing harmful emissions, including greenhouse gases. The level of emissions a firm produces is particularly relevant given the increasing regulatory focus on emission reductions, as highlighted by directives from the European Central Bank (ECB) and the European Commission. The European Commission has set ambitious targets for carbon emission reductions through initiatives such as the EU Green Deal seeks to attain carbon neutrality by 2050.

Simultaneously, the ECB⁶ has emphasized the integration of climate-related risks into financial stability assessments, encouraging firms to improve their emissions metrics to comply with stricter environmental standards. These combined regulatory pressures underscore the growing significance of emissions-related performance metrics within the European regulatory framework.

The empirical findings in Table 6 reveal that companies with a high Emission Score experience a positive impact on their ROE through environmental green initiatives, particularly when firms are categorized based on a high (low) median value.

Firms with higher emissions are often subject to stricter regulatory requirements, which amplify the potential benefits of green initiatives. By reducing emissions, these companies not only achieve regulatory compliance but also improve operational efficiency, lower costs, and enhance their public image. These factors collectively lead to significant long-term financial benefits (Safiullah et al. 2022).

For firms with a higher emission profile, the financial returns from environmental innovation are particularly pronounced as they can leverage both regulatory compliance and market incentives for sustainability (Chen et al. 2020).

Table 6 also presents the empirical findings on the relationship between green initiatives and institutional investor ownership, segmented by firm-specific emission levels.

Consistent with our baseline results, green initiative levels are positively associated with pension fund holdings. The magnitude of this effect remains consistent across both high- and low-emission groups, indicating that pension funds play a significant role in promoting sustainability regardless of a firm's emission profile. However, the overall effect is slightly greater for low-emission firms. These findings align with the rationale that pension funds are inclined to support firms undertaking green initiatives, as these efforts are vital for ensuring long-term financial stability and meeting increasing regulatory pressures, particularly regarding pollution reduction.

Conversely, when considering investment companies, the findings confirm a negative relationship between green initiatives

TABLE 6 | Green initiatives, financial performance, and institutional investors: emission level effect.

Subsample	High emissio score			Low emission score		
	ROE (1)	Green initiatives (2)	Green initiatives (3)	ROE (4)	Green initiatives (5)	Green initiatives (6)
Green initiatives	0.578** [0. 278]			0.036* [0. 019]		
Investment Company		−0.052 [0. 036]			−0.089** [0. 042]	
Pension Fund			0.482*** [0. 154]			0.509*** [0. 131]
Total assets	−15.167 [15.332]	3.792*** [0.232]	8.156*** [0.528]	−12.178*** [3.659]	0.000*** [0.000]	3.980*** [0.228]
Cash flow	−0.001 [0.003]	−0.000* [0.000]	−0.006 [0.004]	0.000*** [0.000]	−0.000 [0.000]	−0.000** [0.000]
Price-to-book value	−27.255*** [1.983]	0.075 [0.065]	−0.576*** [0.198]	0.152** [0.059]	−0.263*** [0.058]	0.098 [0.065]
PER	0.288* [0.166]	−0.052 [0.036]	−0.002 [0.002]	−0.006*** [0.002]	−0.003 [0.002]	−0.004 [0.006]
Leverage	3.038*** [0.408]	−0.001 [0.001]	0.001 [0.002]	0.904* [0.471]	0.027* [0.016]	0.004 [0.003]
Sales revenues	−0.194 [0.451]	0.061*** [0.016]	0.003 [0.004]	−0.044 [0.038]	−0.026* [0.016]	−0.012 [0.009]
Constant	237.072 [280.902]	−41.100*** [4.063]	−100.320*** [9.778]	166.321*** [46.647]	41.011*** [1.268]	−43.065*** [4.046]
Observations	10,276	9483	10,622	8855	10,422	9483
R-squared	0.025	0.250	0.059	0.028	0.0174	0.0197
Number of firms	1433	1584	1460	1518	1426	1584
Year F. E.	Y	Y	Y	Y	Y	Y
Firm F. E.	Y	Y	Y	Y	Y	Y

Note: This table presents the regression results for two subsamples of firms based on their greenhouse gas emission scores, divided at the sample median into high and low emission groups. Columns (1) and (4) examine the relationship between green initiatives and financial performance (measured by ROE) within each group. Columns (2)–(3) and (5)–(6) explore the impact of institutional investors—specifically investment companies and pension funds—on the adoption of green initiatives, proxied by the Environmental Innovation Score. Control variables include total assets, cash flow, price-to-book value, PER, leverage, and sales revenues. All models are estimated using firm and year fixed effects, and selected specifications additionally include country fixed effects. Statistical significance is denoted by *** $p < 0.01$; ** $p < 0.05$; * $p < 0.10$. Definitions of all variables are available in Table A1. Standard errors are clustered at the firm-level.

and investment company ownership, as observed in the baseline model. This negative effect is particularly significant for firms in the low-emission group. This evidence supports the rationale that investment companies' short-term investment focus is even more pronounced for high-polluting companies, where the long-term benefits of green initiatives may be less immediately apparent.

Overall, these results suggest that different categories of institutional investors exert distinct influences on companies based on their environmental performance, specifically in terms of emission levels. Overall, the results in Table 6 reinforce those in Table 5, showing that the positive impact of green initiatives on financial performance is more pronounced among firms with strong carbon emission performance. Notably, the influence of institutional investors remains consistent across both high and low carbon performers. This suggests that pension funds may

respond more to a company's overall CSR performance—as reflected in Table 5—rather than focusing solely on carbon-specific metrics.

4.3 | Robustness Check

This section presents a series of robustness checks related to Hypotheses 1 (H1) and 2 (H2). As the first robustness check, we re-examine the relationship between green initiatives and financial performance (H1) by incorporating three additional financial performance indicators: ROA, ROIC, and Tobin's Q . This approach aligns with previous research (Chen et al. 2018; Duque-Grisales et al. 2020; Farza et al. 2021; Li et al. 2017) and provides further validation of our findings. The model specification is as follows:

$$\begin{aligned}
(\text{ROA})\text{ROIC}/\text{Tobin's } Q_{it} = & \beta_0 + \beta_1 \text{Green Initiatives}_{it} \\
& + \gamma_1 \text{TA}_{i,t-1} + \gamma_2 \text{CF}_{i,t-1} \\
& + \gamma_3 \text{PTB}_{i,t-1} + \gamma_4 \text{PER}_{i,t-1} \quad (13) \\
& + \gamma_5 \text{LEV}_{i,t-1} + \gamma_6 \text{SAL}_{i,t-1} \\
& + \mu_i + \epsilon_{i,t}.
\end{aligned}$$

These equations confirm our results, demonstrating consistency across multiple financial performance indicators, thereby deepening our understanding of the correlation between green initiatives and profitability.

The findings in Table 7 show that the Green Initiative Score consistently has a positive effect across all specifications, albeit with a smaller magnitude. This suggests that green initiatives positively influence firm performance, although the strength of this impact diminishes slightly when ROA, ROIC, and Tobin's Q are used as performance measures instead of ROE. In the end, when alternative performance measures are used in place of ROE, the empirical findings remain broadly consistent with

the baseline results. The estimated effects are stable across indicators in terms of both magnitude and statistical significance.

In the second robustness analysis, we examined the relationship between green initiatives and financial performance by modifying the variable used to represent green initiatives. Specifically, we considered whether a company engages in producing Environmental Products (EnvProd)—defined as products and services that positively impact the environment, such as those enhancing energy efficiency, reducing greenhouse gas emissions, and promoting sustainable resource use. These products aim to minimize negative environmental footprints and foster sustainability.

To incorporate this metric, we adjusted our models by introducing the EnvProd variable from Refinitiv, as both an independent and dependent variable. The Environmental Product variable captures a firm's involvement in producing goods and services that contribute to reducing environmental impact, promoting resource efficiency, and minimizing carbon footprints. Examples include renewable energy technologies, sustainable

TABLE 7 | Green initiatives and performance: changes in financial performance outcome.

Variables	ROA (1)	ROA (2)	ROIC (3)	ROIC (4)	Tobin's Q (5)	Tobin's Q (6)
Green initiatives	0.009*** [0.002]	0.007*** [0.002]	0.006** [0.003]	0.010*** [0.003]	0.004** [0.002]	0.005*** [0.001]
Total assets	-2.442*** [0.103]	-2.307*** [0.082]	-4.607*** [0.163]	-2.273*** [0.085]	-2.189*** [0.070]	-1.004*** [0.044]
Cash flow	0.005*** [0.001]	0.004*** [0.001]	0.022*** [0.003]	0.013*** [0.003]	0.002*** [0.001]	0.001 [0.001]
Price-to-book value	0.0134* [0.070]	0.304*** [0.061]	0.366*** [0.018]	0.487*** [0.017]	-0.002 [0.003]	0.062 [0.040]
PER	-0.003 [0.003]	-0.006** [0.003]	-0.005** [0.002]	-0.014*** [0.002]	-0.003 [0.002]	-0.004* [0.002]
Leverage	-0.000 [0.000]	-0.000 [0.000]	-0.002*** [0.001]	-0.002*** [0.001]	-0.000 [0.000]	-0.000 [0.000]
Sales revenues	-0.006** [0.003]	-0.006** [0.003]	-0.006* [0.003]	-0.008** [0.003]	0.001 [0.002]	0.002 [0.002]
Constant	50.655*** [1.830]	42.212*** [1.342]	91.333*** [2.854]	44.132*** [1.382]	42.451*** [1.638]	17.044*** [0.715]
Observations	19,285	19,285	19,338	19,338	19,114	19,114
R-squared	0.087	0.185	0.132	0.303	0.054	0.082
Number of firms	2041	2041	2043	2043	1983	1983
Year F. E.	Y	Y	Y	Y	Y	Y
Firm F. E.	Y	N	Y	N	Y	N
Industry F. E.	N	Y	N	Y	N	Y
Country F. E.	N	Y	N	Y	N	Y

Note: This table reports the results of robustness checks assessing the relationship between green initiatives, measured by the Environmental Innovation Score, and multiple indicators of firm financial performance. Specifically, columns (1) and (2) use return on assets (ROA), columns (3) and (4) use return on invested capital (ROIC), and columns (5) and (6) use Tobin's Q as dependent variables. Each pair of columns introduces an incremental set of fixed effects to test the consistency of the results across model specifications: columns (1), (3), and (5) include firm and year fixed effects; columns (2), (4), and (6) add country fixed effects. Control variables include total assets, cash flow, price-to-book value, PER, leverage, and sales revenues. All models are estimated using fixed-effects regressions. Statistical significance is denoted by *** $p < 0.01$; ** $p < 0.05$; * $p < 0.10$. Variable definitions can be found in Table A1. Standard errors are clustered at the firm-level.

agricultural products, and eco-friendly consumer goods. The equations for these models are as follows:

$$\begin{aligned} \text{ROE}_{it} = & \beta_0 + \beta_1 \text{EnvProd}_{it-1} + \gamma_1 \text{TA}_{i,t-1} + \gamma_2 \text{CF}_{i,t-1} \\ & + \gamma_3 \text{PTB}_{i,t-1} + \gamma_4 \text{PER}_{i,t-1} + \gamma_5 \text{LEV}_{i,t-1} \\ & + \gamma_6 \text{SAL}_{i,t-1} + \mu_i + \epsilon_{i,t} \end{aligned} \quad (14)$$

$$\begin{aligned} \text{EnvProd}_{it} = & \beta_0 + \beta_1 \text{INVCO}_{it-1} + \gamma_1 \text{TA}_{i,t-1} + \gamma_2 \text{CF}_{i,t-1} \\ & + \gamma_3 \text{PTB}_{i,t-1} + \gamma_4 \text{PER}_{i,t-1} + \gamma_5 \text{LEV}_{i,t-1} \\ & + \gamma_6 \text{SAL}_{i,t-1} + \mu_i + \epsilon_{i,t} \end{aligned} \quad (15)$$

$$\begin{aligned} \text{EnvProd}_{it} = & \beta_0 + \beta_1 \text{PENSEF}_{it-1} + \gamma_1 \text{TA}_{i,t-1} + \gamma_2 \text{CF}_{i,t-1} \\ & + \gamma_3 \text{PTB}_{i,t-1} + \gamma_4 \text{PER}_{i,t-1} + \gamma_5 \text{LEV}_{i,t-1} \\ & + \gamma_6 \text{SAL}_{i,t-1} + \mu_i + \epsilon_{i,t} \end{aligned} \quad (16)$$

Equation (14) examines the effect of environmental products on financial performance, specifically ROE. In Equations (15) and (16), the focus shifts to assessing how institutional investors influence the adoption of environmental products, making environmental products the dependent variable.

The empirical findings are presented in Table 8. In Model 1, where environmental products are treated as an independent variable, the results indicate a positive effect on ROE. This suggests that firms investing in environmentally friendly products experience enhanced financial performance. This outcome is consistent with our baseline model, which also demonstrated a positive impact of green initiatives on financial performance. The finding aligns with the growing consumer demand for sustainable products, which translates into improved financial outcomes for firms prioritizing environmental considerations in their product offerings.

Models 2 and 3 investigate how institutional investors influence the development of environmental products by considering environmental products as the dependent variable. These results corroborate the baseline model, showing that pension fund holdings are positively associated with the development of environmental products. This highlights the importance of long-term, sustainability-focused investment strategies in promoting green innovation.

Conversely, investment company holdings exhibit a negative association with the development of environmental products, consistent with our baseline findings. This supports the assumption that short-term investors are less inclined to support long-term sustainability goals, as their investment strategies prioritize immediate financial returns over environmental innovation.

Overall, a particularly notable result is the positive impact of selling environmental products on firm performance (measured by ROE). On average, firms engaged in such sales experience, on average, an ROE increase of approximately 3%, that is, roughly 20 (corresponding to the estimated coefficient magnitude) by the 14% ROE mean (please see descriptive statistics provided at Table 1), highlighting the financial

relevance of environmentally focused product strategies. This evidence aligns with the growing need for companies to also generate benefits for society by actively responding to a very wide class of “values-driven” consumers. According to Candriam Asset Management, more than half of the population can be classified as “values-driven” consumers.⁷ These individuals are distinguished by actions such as boycotting certain brands or divesting from companies within their investment portfolios (Barko et al. 2022).

Third, consistent with prior studies (Adalet McGowan et al. 2018; Ignatov 2023), we control for cyclical influences that could affect firm performance and shape both political and economic landscapes in various ways. To this end, we reanalyze our baseline models by excluding the years impacted by the global financial crisis. The aim of this adjustment is to mitigate the potential distortions that severe economic volatility might introduce to the results.

The findings in Table 9 confirm the robustness of our baseline model. Excluding the global financial crisis years does not significantly alter the results. The positive impact of green initiatives on ROE remains consistent, demonstrating a comparable relationship with financial performance, as observed in the baseline analysis.

In this postcrisis analysis, the influence of institutional investor ownership on promoting green initiatives (Models 2 and 3) persists, both in terms of the directional impact (coefficient signs) and statistical significance. This indicates that the observed patterns in the baseline model are resilient, even when the financial crisis period is excluded.

Finally, we employed the instrumental variable approach (Table 10) to address potential endogeneity biases arising from omitted variables, simultaneity, or reverse causality. Consistent with prior research (Aouadi and Marsat 2018; El Ghoul et al. 2016), we re-estimated our baseline models, which align with our two research questions (H1) and (H2a/H2b), using the GMM Instrumental Variable approach. We run IV strategies testing H1 and H2a and H2b by making use of two different instruments. First, we use the industry-mean of the Refinitiv ESG Scores at country headquartered level (CountryESG) in a given year as the instrument for the Green Initiatives indicator, following Aouadi and Marsat (2018) and El Ghoul et al. (2016). We expect that countries with a greater emphasis on overall CSR engagement are likely to engage more in green innovation activities. Furthermore, given this instrument is related to other firms' overall CSR engagements in the country, it is likely to have no significant effect on the firm's financial performance. Second, we use the industry-mean of the Refinitiv Social Scores at country headquartered level (CountrySocial) in a given year as the instrument for the Institutional ownership, following Wang et al. (2021) and Kim et al. (2014). We expect that countries with a greater emphasis on social engagement are likely to attract institutional investors because of social pressures they face (Dyck et al. 2019). This instrument is related to overall social engagements at the country level so it should be considered as endogenous with respect to the green initiatives at firm

TABLE 8 | Change in green initiatives definition—environmental products.

Variables	ROE (1)	ROE (2)	Environmental products (3)	Environmental products (4)	Environmental products (5)	Environmental products (6)
Environmental Products	20.266** [9.905]	11.098* [5.988]				
Investment Company			−0.001** [0.000]	−0.001** [0.000]		
Pension Fund					0.007*** [0.002]	0.007*** [0.002]
Total assets	−31.062*** [8.775]	−11.937*** [2.067]	0.000*** [0.000]	0.000*** [0.000]	0.176*** [0.005]	0.087*** [0.003]
Cash flow	−0.001* [0.001]	−0.001*** [0.000]	−0.000 [0.000]	0.000 [0.000]	−0.000 [0.000]	−0.000*** [0.000]
Price-to-book value	−0.371*** [0.048]	−0.054* [0.028]	−0.005 [0.004]	−0.006** [0.003]	0.002*** [0.001]	0.003*** [0.001]
PER	0.003 [0.020]	−0.009 [0.018]	0.000 [0.000]	−0.000 [0.000]	−0.000 [0.000]	0.000 [0.000]
Leverage	2.698*** [0.250]	1.301*** [0.126]	0.000 [0.000]	0.000 [0.000]	0.000 [0.000]	0.000 [0.000]
Sales revenues	−0.029 [0.180]	0.005 [0.145]	0.000	−0.000 [0.000]	0.000 [0.000]	−0.000 [0.000]
Constant	456.465*** [152.500]	145.392*** [52.010]	0.593*** [0.004]	0.299*** [0.050]	−2.556*** [0.085]	−0.996*** [0.052]
Observations	19,033	19,033	19,821	19,821	19,821	19,821
R-squared	0.011	0.021	0.017	0.177	0.077	0.063
Number of firms	2036	2036	2089	2089	2089	2089
Year F. E.	Y	Y	Y	Y	Y	Y
Firm F. E.	Y	N	Y	N	Y	N
Industry F. E.	N	Y	N	Y	N	Y
Country F. E.	N	Y	N	Y	N	Y

Note: This table presents the regression results exploring the role of environmental products in firm performance and the determinants of their adoption. Columns (1) and (2) evaluate the impact of environmental products on firm profitability, using return on equity (ROE) as the dependent variable. Columns (3)–(6) investigate the factors influencing the extent of environmental product development, with a focus on ownership by institutional investors, namely investment companies and pension funds, as well as firm-level financial characteristics. Control variables include total assets, cash flow, price-to-book value, PER, leverage, and sales revenues. All regressions apply firm and year fixed effects, while selected models additionally include country and industry fixed effects as specified. Statistical significance is indicated by *** $p < 0.01$; ** $p < 0.05$; * $p < 0.10$. Full definitions of all variables are reported in Table A1.

level. As shown by the empirical findings in Table 10, our baseline results still hold.

4.4 | Moderator and Mediator Analysis

4.4.1 | Role of Corporate Governance Quality

Good corporate governance is essential for efficient capital allocation—an important condition for building sustainable businesses over the long term. Unsustainable businesses are unlikely to deliver appropriate long-run returns to shareholders, provide stable employment, or contribute meaningfully to

sustainable development. From this perspective, poor governance imposes costs not only on shareholders but also on other stakeholders. Moreover, regulatory interventions have increasingly pushed firms to revise their corporate governance structures to ensure legal compliance and improve ESG-related outcomes.

This section seeks to examine how corporate governance systems influence a firm's attitude toward green innovation, particularly considering the role played by institutional investors. To do so, we adopt two widely used indicators of Corporate Governance Quality: the Management Score and the Shareholder Category Score. The Management Category Score captures a company's

TABLE 9 | Time dependent effects: no global financial crisis sub-sample.

Variables	ROE (1)	ROE (2)	Green initiatives (3)	Green initiatives (4)	Green initiatives (5)	Green initiatives (6)
Green initiatives	0.509** [0.199]	0.191* [0.103]				
Investment Company			-0.089*** [0.030]	-0.089*** [0.030]		
Pension Fund					0.468*** [0.112]	0.182* [0.107]
Total assets	-38.703*** [11.408]	-14.629*** [2.463]	0.000*** [0.000]	0.000*** [0.000]	9.859*** [0.329]	5.167*** [0.295]
Cash flow	0.000 [0.001]	0.000 [0.001]	0.000 [0.000]	0.000 [0.000]	0.005 [0.003]	0.005 [0.003]
Price-to-book value	-0.348*** [0.048]	-0.043 [0.029]	-0.004** [0.002]	-0.004** [0.002]	0.271*** [0.057]	0.060 [0.054]
PER	0.006 [0.024]	-0.005 [0.022]	-0.001 [0.001]	-0.001 [0.001]	-0.005 [0.005]	-0.008* [0.004]
Leverage	2.732*** [0.299]	1.481*** [0.148]	0.001 [0.001]	0.001 [0.001]	-0.002*** [0.001]	-0.002*** [0.001]
Sales revenues	-0.001 [0.013]	-0.003 [0.012]	0.001 [0.001]	0.001 [0.001]	-0.001 [0.004]	-0.003 [0.004]
Constant	572.782*** [198.235]	169.084*** [38.760]	14.934*** [2.959]	14.934*** [2.959]	-138.322*** [5.906]	-59.201*** [5.005]
Observations	15,910	15,910	16,437	16,437	17,868	17,868
R-squared	0.011	0.012	0.167	0.167	0.065	0.252
Number of firms	1954	1954	2021	2021	2107	2107
Year F. E.	Y	Y	Y	Y	Y	Y
Firm F. E.	Y	N	Y	N	Y	N
Industry F. E.	N	Y	N	Y	N	Y
Country F. E.	N	Y	N	Y	N	Y

Note: This table reports the results of the regression models investigating the relationship between green initiatives, environmental products, and financial performance (measured by ROE), after excluding the years of the global financial crisis (2009–2010). Columns (1) and (2) assess the effect of environmental products on ROE, while columns (3) to (6) analyse the determinants of green initiatives, focusing on the role of institutional investors (investment companies and pension funds). Control variables include total assets, cash flow, price-to-book value, PER, leverage, and sales revenues. All specifications include firm and year fixed effects, while some also control for industry and country fixed effects as indicated. Statistical significance is denoted by

*** $p < 0.01$; ** $p < 0.05$; * $p < 0.10$. Variable definitions are provided in Table A1. Standard errors are clustered at the firm-level.

commitment to and effectiveness in applying best practices in corporate governance. This includes mechanisms such as board composition (e.g., diversity, proportion of independent directors, board size), and the strategic design of executive compensation policies. The Shareholder Category Score measures how effectively a company ensures equal treatment of shareholders and its use (or avoidance) of antitakeover provisions. For both indicators, we include interaction terms with institutional investor ownership to assess moderating effects. The empirical results are presented in Table 11. The analysis examines the moderating influence of corporate governance on the relationship between institutional investors and firms' environmental strategies. The results indicate that governance quality shapes this relationship. For Investment Companies, the positive coefficients on the interaction terms Inter IC*MS (Management Score) and Inter

IC*SS (Shareholders Score) imply that stronger internal governance attenuates their otherwise negative association with green initiatives. Likewise, the interaction terms Inter PF*MS and Inter PF*SS suggest that good governance not only reinforces the positive impact of Pension Funds but also enhances their effectiveness in promoting environmental practices.

4.4.2 | Climate Change Attention

In recent years, climate change has emerged as a critical global issue, impacting both the real economy and financial markets (Giglio et al. 2021). Growing awareness of environmental risks has prompted investors to reallocate capital toward more sustainable firms. This shift is driven by two main mechanisms:

TABLE 10 | Instrumental variable.

Summary results for first-stage regressions			
ESG Score	0.939 [0.039]		
<i>F</i> (1,13914)	391.420		
Under Identification SW $X^2(1)$	391.620		
Weak Identification SW <i>F</i> (1,13914)	391.420		
Social Score – Investment Company	−0.039[0.005]		
<i>F</i> (1,13914)	344.290		
Under Identification SW $X^2(1)$	317.211		
Weak Identification SW <i>F</i> (1,13914)	394.847		
Social Score–Pension Fund	0.029 [0.001]		
<i>F</i> (1,13914)	344.290		
Under Identification SW $X^2(1)$	317.211		
Weak Identification SW <i>F</i> (1,13914)	394.847		
Variables	[1] ROE	[2] Green initiatives	[3] Green initiatives
First stage instrument	Country ESG	Country Social	Country Social
Green initiatives	3.162** [1.222]		
Investment Company		−26.80*** [7.658]	
Pension Fund			26.32*** [2.125]
Total assets	−45.166*** [18.29]	31.19*** [6.370]	3.891*** [0.927]
Cash flow	−0.001 [0.001]	−0.001 [0.001]	−0.083*** [0.014]
Price-to-book value	−0.316 [0.339]	−0.009 [0.014]	0.457*** [0.093]
PER	0.007 [0.009]	0.013* [0.008]	−0.029** [0.012]
Leverage	2.664*** [0.979]	0.038*** [0.014]	−0.001** [0.001]
Sales revenues	−0.005 [0.003]	−0.004 [0.004]	0.001 [0.007]
Observations	17,701	18,301	19,947
<i>R</i> -squared	0.005	46.495	2.178
Number of firms	1768	1832	1997
Year F. E.	Y	Y	Y
Firm F. E.	Y	Y	Y

Note: This table reports the results of instrumental variable (IV) regressions evaluating the causal relationship between green initiatives and firm performance (ROE), using ESG Score and Social Score as instruments. First, we use the industry-mean of the Refinitiv ESG Scores at country headquartered level (CountryESG) in a given year as the instrument for the Green Initiatives indicator, following Aouadi and Marsat (2018) and El Ghoul et al. (2016). Second, we use the industry-mean of the Refinitiv Social Scores at country headquartered level (CountrySocial) in a given year as the instrument for the Institutional ownership, following Wang et al. (2021) and Kim et al. (2014). The upper panel shows the first-stage statistics, including F-tests and Sanderson-Windmeijer (SW) tests for under-identification and weak identification, confirming the strength and relevance of the instruments used. Cragg-Donald Wald F statistics and Kleibergen-Paap Wald F statistics exceed the Stock-Yogo critical values, indicating strong instruments across specifications. All models include year, firm, industry, and country fixed effects as indicated. Robust standard errors are reported in parentheses. Statistical significance is denoted by *** $p < 0.01$; ** $p < 0.05$; * $p < 0.10$. Variable definitions are detailed in Table A1. Standard errors are clustered at the firm-level.

TABLE 11 | Moderator and mediator analysis—role of Corporate Governance Quality.

Variables	(1) Green initiatives	(2) Green initiatives	(3) Green initiatives	(4) Green initiatives
Investment Company	−0.245*** [0.062]	−0.222*** [0.053]		
Management score	0.090*** [0.009]			
Inter IC* MS	0.002** [0.001]			
Shareholders score		0.032*** [0.008]		
Inter IC*SS		0.002*** [0.001]		
Pension Fund			0.424* [0.230]	0.279* [0.153]
Management score			0.089*** [0.009]	
Inter PF*MS			0.008** [0.003]	
Shareholders score				0.051*** [0.006]
Inter PFPF*SS				0.009*** [0.002]
Constant	15.832*** [2.931]	9.189*** [2.967]	42.005*** [3.503]	31.197*** [0.706]
Observations	18,490	18,490	12,929	24,632
R-squared	0.161	0.165	0.0929	0.00617
Number of firms	2021	2021	1353	2303
Controls	Y	Y	Y	Y
Year F. E.	Y	Y	Y	Y
Firm F. E.	Y	Y	Y	Y

Note: This table presents regression results examining the relationship between institutional investors and firms' engagement in green initiatives, with a specific focus on governance-related moderating factors. Columns (1) and (2) report the interaction effects between Investment Companies and governance dimensions, including the Management Score and Shareholders Score. The Management Category Score captures a company's commitment to and effectiveness in applying best practices in corporate governance. This includes mechanisms such as board composition (e.g., diversity, proportion of independent directors, board size), and the strategic design of executive compensation policies. The Shareholder Category Score measures how effectively a company ensures equal treatment of shareholders and its use (or avoidance) of antitakeover provisions. Columns (3) and (4) extend the analysis to Pension Funds. Interaction terms (e.g., InterMSIC2, InterSSIC3, InterMSPF2, InterSPPF3) capture the moderating influence of governance quality on the relationship between institutional investors and green initiatives. All regressions include year, firm, industry, and country fixed effects. Statistical significance is indicated by *** $p < 0.01$; ** $p < 0.05$; * $p < 0.10$. Standard errors are clustered at the firm-level.

(i) sustainable investors, as their environmental sensitivity increases, tend to divest from high-risk (“toxic”) firms and reinvest in those aligned with ESG principles (El Ouadghiri et al. 2021; Gutsche and Ziegler 2019) and (ii) rising public concern may also influence traditional investors to revise their preferences in favour of sustainability (El Ouadghiri et al. 2021).

To capture global awareness of climate change, we rely on the Google Search Volume Index (GSVI) from Google Trends Analytics ([google.com/trends](https://www.google.com/trends)), following the approach of prior studies that used GSVI as a proxy for environmental concern and attention to climate change topics (e.g., Da et al. 2011; El Ouadghiri et al. 2021). This index is available from 2004 onward

for all countries worldwide and includes searches made via Google's search engine, Google Images, Google News, Google Shopping, and YouTube. Specifically, we selected the search terms “climate change,” “climate concern,” and “green innovation” as our key topics. The resulting GSVI captures the online salience of each search term relative to the peak volume within the selected time frame. Google Trends normalizes the data by time and location, dividing each data point by the total number of searches in a given time period and region. A relative search volume (RSV) value of 100 indicates the highest proportion of queries for that topic during the selected period or location, while an RSV of 50 represents half of that peak interest. Table 12 presents the corresponding results. For

TABLE 12 | Moderator and mediator analysis: climate change attention.

Variables	(1) Green initiatives	(2) Green initiatives	(3) Green initiatives	(4) Green initiatives	(5) Green initiatives	(6) Green initiatives
Investment Company	−0.407*** [0.071]	−0.221*** [0.042]	−0.906*** [0.073]			
Climate Change Attention	3.824*** [0.180]					
Inter IC*CCA	0.046*** [0.010]					
Climate Concern Attention		0.410*** [0.020]				
Inter IC*CCOA		0.005*** [0.001]				
Green Innovation Attention			0.127*** [0.021]			
Inter IC*GIA			0.023*** [0.002]			
Pension Fund				−0.439 [0.452]	−0.311 [0.236]	−0.034 [0.230]
Climate Change Attention				1.806*** [0.114]		
Inter PF*CCA				0.102* [0.053]		
Climate concern attention					0.292*** [0.016]	
Inter PF*CCOA					0.019*** [0.006]	
Green innovation attention						0.335*** [0.015]
Inter PF*GIA						0.021*** [0.006]
Constant	−7.779** [3.202]	1.386 [3.046]	29.374*** [2.160]	20.326*** [1.072]	26.010*** [0.786]	20.654*** [2.115]
Observations	18,490	18,490	20,083	24,632	24,632	20,083
R-squared	0.162	0.162	0.057	0.003	0.004	0.054
Number of firms	2021	2021	2109	2303	2303	2109
Controls	Y	Y	Y	Y	Y	Y
Year F. E.	Y	Y	Y	Y	Y	Y
Firm F. E.	Y	Y	Y	Y	Y	Y

Note: This table presents the results of regression models investigating the relationship between green initiatives and institutional investor behaviour, with a focus on the role of climate change attention, climate concern, and green innovation attention. The interaction terms capture how different dimensions of environmental awareness and concern moderate the influence of institutional investors (Investment Companies and Pension Funds) on firms' engagement in green initiatives. All regressions control for firm-level and time-varying unobserved heterogeneity through year, firm, industry, and country fixed effects as indicated. Standard errors are reported in parentheses. Statistical significance is denoted by

*** $p < 0.01$; ** $p < 0.05$; * $p < 0.10$. To capture global awareness of climate change, we rely on the Google Search Volume Index (GSVI) from Google Trends Analytics ([google.com/trends](https://www.google.com/trends)), following the approach of prior studies that used GSVI as a proxy for environmental concern and attention to climate change topics (e.g., Da et al. 2011; El Ouadghiri et al. 2021). Specifically, we selected the search terms "climate change," "climate concern," and "green innovation" as our key topics. The resulting GSVI captures the online salience of each search term relative to the peak volume within the selected time frame. Standard errors are clustered at the firm-level.

Investment Companies, the interaction effects with Climate Change Attention (Inter IC*CCA), Climate Concern Attention (Inter IC*CCOA), and Green Innovation Attention (Inter IC*GIA) are all positive. These results suggest that increased salience of climate issues among stakeholders mitigates the detrimental impact of investment company ownership on environmental engagement. A similar pattern is observed for Pension Funds, where the corresponding interaction terms (Inter PF*CCA, Inter PF*CCOA, and Inter PF*GIA) are also positive, indicating that heightened climate awareness among external stakeholders amplifies the positive contribution of pension ownership to corporate green innovation.

4.4.3 | Strength and Concern ESG Performance Characteristics

To better understand the mechanism underlying the relationship between ESG performance and institutional ownership, we aim to disentangle the positive (strengths) and negative (concerns) components of firm-level ESG performance. Building on Fernando et al. (2017), we examine how institutional ownership breadth responds to a set of firm-specific environmental characteristics by using KLD data to assess corporate environmental policies. Specifically, for each firm, KLD provides six sub-indicators of environmental strengths—including the sale of environmentally beneficial products and services (Product responsibility), pollution prevention, recycling, clean energy initiatives, environmental management systems, and other strengths—and seven sub-indicators of environmental concerns—including regulatory noncompliance, substantial emissions, climate change risks, negative environmental impact of products and services, land use and biodiversity risk, non-carbon emissions, and other concerns. First, we operate a pairwise match between KLD indicators and LSEG database. In turn, we get a list of five sub-indicators of environmental strengths (we do not consider the KLD residual indicator, namely, “other strengths”) and six sub-indicators of environmental concerns (similarly, we do not consider the KLD residual indicator, namely, “other concerns”). Second, we normalize all sub-indicators in terms of score (ranging between 0 and 100) to mimic the same sub-indicator type as appears in KLD. The dichotomy variables have been turned into score by adopting the same LSEG criteria when considering this indicator category along their ranking process to get their overall and sub-pillars ESG scores (see the guide “Environmental, Social and Governance Scores from Refinitiv” at https://www.lseg.com/content/dam/data-analytics/en_us/documents/methodology/lseg-esg-scores-methodology.pdf for details). Lastly, to get overall measures of strengths and concerns, we aggregate the sub-indicators according to their category (strengths and concerns, respectively). Table 13 shows empirical findings for the overall strength and concern category group while in the Appendix we report sub-indicators analysis in Tables A3 (strengths sub-indicators) and A4 (concerns sub-indicators). Table 13 shows empirical findings investigating the role of firm-level ESG performance in moderating investor influence, captured through Strength and Concern indexes. Results show that the interaction term Inter IC*ST is positive, indicating that Investment Companies’ negative association with green initiatives is less pronounced in firms with strong ESG

credentials. The same holds for Inter PF*ST, suggesting that Pension Funds are more likely to support environmental engagement in firms exhibiting greater ESG strengths.

Table A3 disaggregates the ESG Strength Index into its component sub-indicators to examine more granular moderating effects. For Investment Companies, positive and significant interaction effects emerge for Product Responsibility (Inter IC*PR), Clean Energy (Inter IC*CE), and Environmental Management Systems (Inter IC*EMS), suggesting that the negative influence of these investors is attenuated in firms with robust performance in these areas. Regarding Pension Funds, the interaction terms Inter PF*PP and Inter PF*EMS are both positive, indicating greater support for environmental engagement in firms with strengths in pollution control and management systems. Interestingly, Inter PF*RI is negative, implying a weaker alignment with recycling-oriented strengths.

Finally, Tables A4a and A4b (in the Appendix) present results based on ESG Concern sub-indicators for investment company and pension fund, respectively. A few significant moderating effects are observed for Investment Companies (Table A4a). Inter IC*RNC (Regulatory noncompliance) and Inter IC*NCE (Non-Carbon Emissions) display positive interaction effects, suggesting that in contexts of specific environmental controversies, these investors may respond with increased support for green initiatives, potentially as a reputational hedge. The pattern is even less pronounced for Pension Funds (Table A4b), where none of the interaction terms across the ESG concern dimensions reach statistical significance.

5 | Discussion

The empirical results in Section 4 show insights into the connection between green initiatives, financial performance, and the influence of institutional investors.

First, the positive association between green initiatives and firm profitability, measured through ROE, ROA, ROIC, and Tobin’s Q, suggests that sustainability efforts are not merely compliance mechanisms or reputational strategies but represent tangible value-creating activities. Firms with higher environmental concerns benefit from cost reductions, improved operational efficiency, and increased attractiveness to environmentally conscious consumers and investors. These outcomes align with the resource-based view (RBV), in which green capabilities act as strategic resources to yield sustainable competitive advantages (Hart 1995; Iqbal et al. 2022).

Economically, the magnitude of the coefficients implies that even moderate improvements in environmental innovation are associated with financially meaningful gains in performance (empirical findings are reported in Table 3). A three-point increase in the Green Innovation Firm Attitude with a 1% increase in the economic performance proxied by the ROE. This effect suggests a meaningful economic benefit over time. Hence, when managers evaluate the implementation of green innovation strategies, they should consider not only the associated costs but also this expected financial return. However, the statistical significance of this effect is relatively modest. These benefits are

TABLE 13 | Moderator and mediator analysis: strength and concern ESG performance characteristics.

Variables	(1) Green initiatives	(3) Green initiatives	(2) Green initiatives	(4) Green initiatives
Investment Company	-0.195*** [0.036]	-0.167* [0.088]		
Strength index	0.091*** [0.009]			
Inter IC*ST	0.002** [0.001]			
Concern index		0.066*** [0.016]		
Inter IC*CN		0.002 [0.002]		
Pension Fund			0.588*** [0.132]	0.903*** [0.271]
Strength index			0.099*** [0.009]	
Inter PF*ST			0.005* [0.003]	
Concern index				0.075*** [0.016]
Inter PF*CN				-0.003 [0.006]
Constant	32.916*** [0.590]	7.417*** [2.559]	29.854*** [1.717]	30.900*** [0.879]
Observations	24,084	24,084	23,425	24,084
R-squared	0.155	0.164	0.110	0.0163
Number of firms	2247	2247	2199	2247
Controls	Y	Y	Y	Y
Year F. E.	Y	Y	Y	Y
Firm F. E.	Y	Y	Y	Y

Note: This table presents regression results analysing the relationship between institutional investors and firms' green initiatives, with a focus on the moderating effects of the Strength Index and Concern Index. Columns (1) and (3) explore the interaction between Investment Companies and the strength and concern measures (Inter IC*ST, Inter IC*CN), while Columns (2) and (4) focus on Pension Funds and their interactions (Inter PF*ST, Inter PF*CN). These indices capture how firms' strengths and concerns regarding CSR at firm level influence the relationship between investors and green initiatives (see Section 4.4.3 for details). All models include year, firm, industry, and country fixed effects, as well as standard control variables as defined in Table A1. Statistical significance is denoted by *** $p < 0.01$; ** $p < 0.05$; * $p < 0.10$. Standard errors are clustered at the firm-level.

strong for small and medium-sized firms, which is free from organizational inertia, can more rapidly integrate green innovations into their operations. The agility of such firms allows them to derive higher marginal benefits from green investments, positioning environmental innovation as a lever for differentiation in competitive markets (Waddock and Graves 1997; Vijayvargy et al. 2017). Relative to the baseline result (a 1% ROE increase for every 3-point rise in green innovation attitude), the effect among smaller firms ("Low Total Assets") is roughly three times stronger. This implies that green initiatives are particularly effective in enhancing profitability among smaller companies.

Second, our findings provide clear evidence of heterogeneity in institutional investor behaviour. Investment companies

typically adopt short-term, performance-driven strategies and are negatively associated with green initiatives. This suggests that firms with high levels of investment company ownership may face disincentives to pursue environmental innovation due to pressure for immediate financial returns. The economic implication is that a firm's capital structure can influence not only its financing costs but also its sustainability strategy. Conversely, pension funds, representative of long-term institutional investors, demonstrate a positive relationship with firms' green initiatives. This confirms that the investor time horizon is crucial in shaping corporate sustainability behaviour. Pension funds, driven by long-term liabilities and a need for inter-generational equity, appear to reward firms that align with sustainable development goals and demonstrate credible long-

term value creation. This finding supports previous studies (Zhao et al. 2023) and suggests that long-term investors can serve as a governance mechanism that enhances firms' environmental performance. The relationship between institutional investor ownership and green innovation is statistically more significant for investment companies than for pension funds (please see results showed at Table 4). Yet, the economic magnitude is stronger for the latter: a 5-percentage point increase in institutional ownership leads to an estimated 1% increase in firm-level green initiatives. This may suggest that pension funds exert a form of soft power over firms—by exercising their voting rights during annual shareholder meetings or by engaging directly with management or the board of directors—guiding them toward enhancing their capacity for innovation in green technologies. Moreover, from the perspective of institutional investors, in the form of pension fund, the impact of ownership on green innovation is more positive as firm size increases (Table 4). Large enterprises are at the core of the international debate in promoting green development, as they face greater social, economic, and environmental pressures. From the perspective of resource-based theory, green technological innovation within companies depends on financial backing, highly skilled R&D personnel, and extensive accumulated experience. Compared to smaller firms, large enterprises inherently possess advantages in funding, technological capabilities, and experiential knowledge.

Additional segmentation by ESG performance and emissions further refines the economic interpretation. In firms with higher ESG scores or higher emission levels, the financial benefits of green innovation appear even more pronounced. With respect to the former criteria, the positive effect of green initiatives on financial performance is concentrated among ESG best-performing firms. This suggests that the incremental benefit of adopting green practices is greater for firms already endowed with substantial ESG-related resources and capabilities. This can be attributed to external pressures (e.g., regulation, stakeholder expectations) and internal capabilities (e.g., governance, absorptive capacity). In these contexts, green innovation improves firm image and risk management, reduces regulatory costs, and enhances market positioning, leading to superior financial outcomes. A similar pattern holds for institutional investors: pension fund ownership positively influences green innovation, particularly among ESG leaders. Specifically, a 2-percentage point increase in pension fund ownership corresponds to a 1% increase in green innovation attitude. Interestingly, regarding the clustering method based upon emission levels (Table 6), the role of institutional investors appears consistent across both carbon-emission best and worst performers, suggesting that pension funds may be more responsive to broader CSR performance (as depicted in Table 5) rather than to carbon-specific metrics alone.

Lastly when adopting a different metric to assess the green innovation, that is the firm's involvement in producing goods and services aiming to contribute at environmental impact reducing, a particularly notable result is the positive impact of selling environmental products on firm performance (measured by ROE). On average, firms engaged in such sales experience, on average, an ROE increase of approximately 3%, highlighting the financial relevance of environmentally focused product

strategies. This evidence aligns with the growing need for companies to also generate benefits for society by actively responding to a very wide class of “values-driven” consumers. According to Candriam Asset Management, more than half of the population can be classified as “values-driven” consumers.⁸ These individuals are distinguished by actions such as boycotting certain brands or divesting from companies within their investment portfolios (Barko et al. 2022). Overall, the empirical evidence highlights the importance of aligning investor profiles with firms' sustainability goals from a policy perspective. Regulators and financial intermediaries may be key in channelling long-term capital, such as pension fund assets, toward firms with credible environmental strategies.

6 | Conclusion

This study, first, analysis the relationship between financial performance and green initiatives, as well as the institutional investors' impact on green innovation. We examine and find support for the hypothesis that green initiatives—encompassing eco-friendly products, resource efficiency, and sustainable organizational processes—are identified as significant drivers of company performance. This suggests that firms engaging in green initiatives not only comply with environmental regulations—which reduces the risk of penalties—but also gain financial benefits through increased resource efficiency and improved brand reputation. In addition, we hypothesize and test for a positive impact on firms' green innovation from institutional investors who have a long-term rather than a transient vision.

The findings indicate that institutional investors vary according to their investment horizons. Investors with short-term expectations, such as investment company, are inclined to focus on immediate returns by applying active trading strategies, which can lead to managerial myopia and pressure investee firms to prefer short-term financial performance rather than long-term share holdings (Alvarez et al. 2018; Bushee 1998; Chen et al. 2007). In contrast, long-term Institutional Investors, like pension funds, usually focus their investment policy on more passive trading approaches, actively monitor their investee firms, and promote green and environmental innovation and by this way increase sustained long-term value (Chen et al. 2007; Luong et al. 2017).

By investigating the nexus between green innovation and institutional investors' horizon, we also consider in our work the influence of various moderating mechanisms aimed at capturing the role of: (i) climate change public attention; (ii) firm-specific corporate governance characteristics; and (iii) environmental strengths and concerns indicators as proposed by Fernando et al. (2017).

6.1 | Findings and Theoretical Contributions

Our findings offer valuable insights into the role of sustainability in enhancing financial performance and advancing both economic and environmental objectives. Theoretically, this study contributes to the growing body of literature on the relationship between green initiatives and firm performance. Specifically, in line with stakeholder theory, our empirical findings add to a better

understanding of how to go beyond the assumption of stakeholder preference homogeneity, which is a core premise of classical agency theory which only takes financial returns into account and overlooks environmental and social sustainability concerns (Basse Mama and Mandaroux 2022; Velte 2023). On the other hand, more recent interpretations, such as stakeholder-oriented management theories, refuse to consider the assumption of homogeneity among institutional investors (Schaltegger et al. 2022), basing its view on the nature and special types of institutional investors (Velte 2023). From this point of view, specific categories of investors might consider environmental expenditures—such as those associated with green innovation strategies—as worthwhile investments, especially when they contribute to investment risk reduction (Dyck et al. 2019). In this line, we can position our research, assuming that specific characteristics of institutional investors, such as investment horizon, might positively affect the firm's orientation to promote green innovation. To this end, contrary to classical agency theory, institutional investors should not be classified as a homogeneous group of shareholders. Instead, considering their different preferences and characteristics, it could be worthwhile to distinguish between short-term and long-term oriented investors (Velte 2023). In this line, our work might provide some important theoretical findings.

To clarify the positive role of institutional investors in financing companies promoting green innovation, our findings highlight that green innovation investments are shown to be more effective as the holding time horizon of an institutional investor is consistent with the medium-long term permanence to best favour the realization and full exploitation of the innovation related to green investments. In this way, it is crucial to allow the right matching between investor and its financing.

To the best of our knowledge, this study is the first to demonstrate the substantial influence of institutional investors in facilitating the global transition to environmentally sustainable technologies across diverse economic activities, extending with new empirical evidence the output of recent papers in the same field (Velte 2023; Xu et al. 2023; Zhao et al. 2023; Shi et al. 2024; Slama et al. 2025). By examining the specific targets of institutional investors' strategy mandates, this study provides fresh insights into their roles. In doing so, we partially build on the work of Zhao et al. (2023), who explored the relationship between green initiatives and investor holdings, though their analysis was confined to Chinese financial markets. Our research also diverges from Miller et al. (2023) by disentangling investor types not by holding periods or embedded asset management strategies, but by distinguishing between local and distant institutional investors. Overall, this study addresses several academic motivations, providing significant contributions to the literature and actionable insights for stakeholders.

Second, to better comprehend how the relationship between ESG performance and institutional ownership works, we untangle the positive (strengths) and negative (concerns) elements of firm-level ESG performance. Basing on Fernando et al. (2017), we study how institutional ownership range reacts to a set of firm-specific environmental characteristics.

Lastly, the objective of our green innovation analysis is to cover a wide range of green initiatives at firm level without being

confined to investigating only a single topic (e.g., Xu et al. 2023 and Shi et al. 2024). In line with the above, we consider our work is able to offer a better reading of the institutional investors role in enhancing the company green innovation on a global level while also providing significant contributions to the literature and practicable tools for stakeholders.

6.2 | Managerial and Policymaking Implications

Our research contains implications for stakeholders like managers as well as policymakers. It is crucial for stakeholders to favour collaboration with institutional investors to promote common aims (e.g., addressing environmental issues). Managers for whom it is central to analyse carefully and promptly the attitude of their Institutional Investors' vision and their preferences for green innovation development. For the policymakers' point of view, it is crucial to underline the principal influence of investment impact on sustainable products and services in the future.

Actually, regulators should take into account the impact of the different preferences of Institutional Investors on corporate sustainability. The debate and reform initiatives on the accuracy of sustainability reporting (e.g., the European Commission) and corporate governance should craft incentives to attract both long-term and transient institutional investors as well as managers to promote corporate sustainability strategies. Regulations on sustainable finance unable stimulation of the investors and firms' motivations to embrace corporate sustainability and an ethical mindset. Collaboration between companies and institutional investors should be realized leveraging other stakeholders to reach sustainability goals like a climate neutral economy by 2050 within the European Union.

Policies designed to create more effective incentives for sustainability can target and engage long-term institutional investors. By fostering an environment where these investors are encouraged to prioritize green initiatives, such policies can leverage their investment power to advance broader environmental goals.

Policymakers can leverage these insights to design incentives that encourage both investors and firms to prioritize sustainability, thereby advancing broader environmental goals. Corporate managers should also recognize the strategic importance of environmental innovation in enhancing financial returns and competitive positioning, particularly in light of growing consumer and regulatory demands for sustainable practices.

From a market point of view, our study could aid other stakeholders of companies to make informed decisions by pinpointing the diverse attitudes of institutional investors.

On the other hand, we have to consider that long-term institutional investors are able to promote green innovation benefits; while, transient ones are unable favour it because of their speculative focus.

This reinforces the idea that green innovation assists companies' stakeholders in the aim for long-term competitive advantage

instead of short-term objectives. Our study suggests stakeholders rather than institutional investors should acknowledge that vigilance is needed to discourage transient institutional investors from overlooking the priority of environmental care instead of focusing on their immediate interests.

6.3 | Limitations and Future Research Directions

This study has several limitations. A key limitation is the lack of micro-level data to further segment institutional investors beyond the two categories analysed: pension funds and investment companies. This restricts our ability to perform a more detailed analysis of how specific investor subgroups influence green initiatives. Among the others, the absence of data on insurance companies—well-known as long-term investors—limits our understanding of their role in fostering sustainability. Additionally, the lack of detailed information on the specific green initiatives undertaken by firms constrains our ability to analyse the types and intensities of sustainable practices across different sectors.

Future research should incorporate more granular data to better capture the diverse behaviours of different investor subtypes and the specific green initiatives they support. This would offer a more thorough comprehension of the interactions between institutional investors and sustainability efforts across various industries.

In addition, a more profound examination of some characteristics of Institutional Investors' types (e.g., a combination of foreign, long-term, and sustainable ownership) is necessary to have a more detailed framework of the monitoring role as well as heterogeneity and their effect on corporate sustainability. In the end, the Institutional Investors influence on the composition of boards, e.g. of gender diversity, sustainable executive compensation systems, as a potential means of green performance should be analysed in future scientific work.

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The authors have nothing to report.

Conflicts of Interest

The authors declare no conflicts of interest.

Data Availability Statement

The data that support the findings of this study are available on request from the corresponding author.

Endnotes

¹The data presented by the Environmental Protection Agency indicates that China, the United States, the European Union, and India are the leading contributors to global CO₂ emissions (Zhou et al. 2018). Notably, China and India account for 37% of the total CO₂ emissions produced by the rest of the world (Zhang et al. 2021).

²According to the OECD, an urgent annual investment of 6.9 trillion USD in infrastructure is required to fulfil global climate and sustainable development objectives (Chen et al. 2018).

³In line with the last Principles for Responsible Investment (PRI) Annual Report (2024), owners and asset managers being committed to responsible investment practices into their decision-making processes, owned an asset under management (AUM) overall value equals to US \$128.4 trillion.

⁴https://www.lseg.com/content/dam/marketing/en_us/documents/methodology/refinitiv-esg-scores-methodology.pdf.

⁵A list of the institutional ownership data is available at:

www.bwl.uni-mannheim.de/media/Lehrstuehle/bwl/Maug/Database_info/Datastream_datatypes.pdf.

⁶<https://www.ecb.europa.eu/ecb/climate/html/index.en.html>.

⁷https://www.candriam.com/en/SysSiteAssets/medias/theme/esg/2021_09_the-evolution-of-thematic-investing-and-esg_en_web.pdf.

⁸https://www.candriam.com/en/SysSiteAssets/medias/theme/esg/2021_09_the-evolution-of-thematic-investing-and-esg_en_web.pdf.

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Appendix A

TABLE A1 | Variables definition.

Variable	Definition	Source
ROE	Return on equity measures profitability relative to shareholders' equity.	LSEG
ROA	Return on assets assesses how efficiently a company uses its assets to generate earnings.	LSEG
ROIC	Return on invested capital evaluates the efficiency in allocating capital to profitable investments.	LSEG
Tobin's Q	Measures a firm's market value relative to the replacement cost of its assets. A higher Tobin's Q suggests that the firm's market valuation exceeds the cost of its assets.	LSEG
Green initiatives (Environmental Innovation Score)	Quantifies a company's efforts in developing environmentally friendly technologies and practices.	LSEG
Total assets	Represents the overall value of a company's holdings.	LSEG
Cash flow	Measures the liquidity by showing total money inflows and outflows.	LSEG
Price-to-book value	Compares a company's market value to its book value.	LSEG
PER	Measures market expectations regarding earnings potential by comparing the current share price to earnings per share.	LSEG
Leverage	Represents the proportion of a company's capital structure that is financed through debt. It is used to assess financial risk and capital structure efficiency.	LSEG
Sales revenues	Indicates the total income generated from the sale of goods or services, reflecting the firm's scale of operations and market activity.	LSEG
Pension Fund	Proportion of shares held by pension funds indicating their level of investment and confidence in the company.	LSEG
Investment Company	Proportion of shares held by investment companies indicating their level of investment and confidence in the company.	LSEG
Environmental Products	Measures the proportion of a company's products and services that have a positive environmental impact, such as energy efficiency solutions, renewable energy offerings, or technologies that reduce carbon emissions.	LSEG

Note: This table lists the variables used in the analyses, along with their definitions and the source from which each variable was obtained. All data were sourced from LSEG.

TABLE A2 | Correlation.

	ROE	ROA	ROIC	Tobin's Q	Green initiatives	Total assets	Cash flow	PBV	PER	Leverage	Sales revenues	Pension Fund	Investment Company
ROE	1.000												
ROA	0.108	1.000											
ROIC	0.120	0.717	1.000										
Tobin's Q	-0.001	-0.012	-0.005	1.000									
Green initiatives	0.002	-0.099	-0.054	-0.098	1.000								
Total assets	-0.004	-0.054	-0.026	-0.001	0.090	1.000							
Cash flow	-0.010	-0.038	-0.028	-0.006	0.055	0.316	1.000						
Price-to-book value	0.079	0.279	0.206	0.013	-0.126	-0.071	-0.117	1.000					
PER	-0.004	-0.026	-0.014	0.002	-0.033	-0.016	-0.013	0.076	1.000				
Leverage	0.028	-0.0631	-0.046	-0.002	0.033	0.024	-0.013	-0.036	-0.021	1.000			
Sales revenues	-0.005	-0.001	-0.006	0.006	-0.143	-0.017	-0.024	0.067	0.042	-0.018	1.000		
Pension Fund	-0.009	-0.045	-0.032	-0.032	0.032	0.221	0.633	-0.087	-0.001	-0.011	-0.009	1.000	
Investment Company	0.000	0.025	0.037	0.037	-0.117	-0.063	-0.115	0.053	0.027	0.031	-0.047	-0.052	1.000

Note: This table shows the correlation coefficients between key financial and environmental variables, illustrating the relationships between them. The variables include financial performance metrics (ROE, ROA, and ROIC), Environmental Innovation Score, Total Assets, Cash Flow, Price-to-book value, PER, Pension Fund, and Investment Company. Correlations range from -1 to 1, indicating the strength and direction of the linear relationship between pairs of variables. Positive values indicate a positive relationship, whereas negative values suggest an inverse relationship. Variables description is reported at Table A1.

TABLE A3 | Strengths ESG performance sub-indicators.

Variables	(1) Green initiatives	(2) Green initiatives	(3) Green initiatives	(4) Green initiatives	(5) Green initiatives	(6) Green initiatives	(7) Green initiatives	(8) Green initiatives	(9) Green initiatives	(10) Green initiatives
Investment Company	-0.177*** [0.035]	-0.195*** [0.038]	-0.106*** [0.027]	-0.141*** [0.026]	-0.159*** [0.030]					
Product Responsibility	0.034*** [0.005]									
Inter IC*PR	0.001* [0.001]									
Pollution prevention		0.054*** [0.006]								
Inter IC*PP		0.001 [0.001]								
Recycling Initiatives			0.035*** [0.007]							
Inter IC*RI			0.000 [0.001]							
Clean Energy				0.020*** [0.005]						
Inter IC*CE				0.002*** [0.001]						
Env. Manag. Systems					0.029*** [0.005]					
Inter IC*EMS					0.001* [0.001]					
Pension Fund						0.667*** [0.127]	0.491*** [0.126]	0.169* [0.098]	0.643*** [0.103]	0.548*** [0.109]
Product Responsibility						0.021*** [0.005]				

(Continues)

TABLE A3 | (Continued)

Variables	(1) Green initiatives	(2) Green initiatives	(3) Green initiatives	(4) Green initiatives	(5) Green initiatives	(6) Green initiatives	(7) Green initiatives	(8) Green initiatives	(9) Green initiatives	(10) Green initiatives
Inter PF*PR						0.000 [0.002]				
Pollution prevention							0.050*** [0.006]			
Inter PF*PP							0.004** [0.002]			
Recycling Initiatives								0.028*** [0.007]		
Inter PF*RI								-0.005* [0.003]		
Clean Energy									0.027*** [0.006]	
Inter PF*CE									0.004 [0.003]	
Env. Manag. Systems										0.031 ***
Inter PF*EMS										[0.005] 0.004** [0.002]
Constant	31.965*** [1.771]	31.964*** [1.822]	21.993*** [1.929]	34.901*** [0.600]	34.265*** [0.592]	18.434*** [2.498]	30.456*** [1.812]	30.212*** [3.362]	34.149*** [0.623]	31.146*** [1.822]
Observations	24,084	21,523	21,456	24,084	24,084	23,425	23,425	20,850	20,850	23,425
R-squared	0.0867	0.0901	0.0779	0.0370	0.0875	0.158	0.0824	0.0816	0.0131	0.0766
Number of firms	2247	2211	2208	2247	2247	2199	2199	2165	2165	2199
Controls	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Year F. E.	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Firm F. E.	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y

Note: This table presents the regression results investigating the influence of institutional investors on green initiatives, moderated by various indicators of environmental friendliness. Specifically, the analysis explores the role of five corporate environmental practices: Product Responsibility, Pollution prevention Process, Recycling Initiatives, Clean Energy, and the presence of an Environmental Management Systems. Interaction terms (e.g., Inter IC*PR, Inter PF*PP) capture how each practice conditions the effect of Investment Companies and Pension Funds on firms' green initiatives (see Section 4.4.3 for details). All models include standard control variables and fixed effects for year, firm, industry, and country to account for unobserved heterogeneity. Statistical significance is denoted by; *** $p < 0.01$; ** $p < 0.05$; * $p < 0.10$. Descriptions of the variables are provided in Table A1. Standard errors are clustered at the firm-level.

TABLE A4a | Concerns ESG performance sub-indicators—investment company.

Variables	(1) Green initiatives	(2) Green initiatives	(3) Green initiatives	(4) Green initiatives	(5) Green initiatives	(6) Green initiatives
Investment Company	-0.072*	-0.104**	0.266	-0.065*	0.034	-0.075***
	[0.039]	[0.043]	[0.319]	[0.039]	[0.154]	[0.025]
Reg. noncompliance	0.020**					
	[0.008]					
Inter IC*RNC	0.002*					
	[0.001]					
Substantial emissions		0.021***				
		[0.006]				
Inter IC*S*E		0.001				
		[0.001]				
Climate change risks			0.004			
			[0.022]			
Inter IC*CR			-0.003			
			[0.003]			
Neg. Env. Impact				0.010*		
				[0.005]		
Inter IC*NEI				-0.000		
				[0.001]		
BiodivRisk					-0.002	
					[0.010]	
Inter IC*BR					-0.001	
					[0.002]	
Non-Carbon Emission						0.011**
						[0.005]
Inter IC*NCE						0.001
						[0.001]
Constant	10.381***	9.399***	10.068***	10.480***	10.736***	10.206***
	[2.456]	[2.456]	[3.304]	[2.454]	[2.640]	[2.549]
Observations	24,084	24,084	24,084	24,084	24,084	24,084
R-squared	0.156	0.163	0.155	0.157	0.155	0.158
Number of firms	2247	2247	2247	2247	2247	2247
Controls	Y	Y	Y	Y	Y	Y
Year F. E.	Y	Y	Y	Y	Y	Y
Firm F. E.	Y	Y	Y	Y	Y	Y

Note: This table reports the regression results examining the impact of controversies related to environmental practices on firms' green initiatives, with a specific focus on the moderating role of institutional investors – Investment Company. Key dimensions of environmental controversies include Regulatory noncompliance, Substantial emissions, Climate change risks, Negative environmental impact of products and services, Land use and biodiversity risk and Non-carbon emissions (see Section 4.4.3 for details). The interaction terms evaluate how these factors influence the effect of Investment Companies on green initiatives. All regressions control for firm-level and macroeconomic factors through fixed effects for year, firm, industry, and country. Statistical significance is indicated by

*** $p < 0.01$; ** $p < 0.05$; * $p < 0.10$. Definitions of variables are provided in Table A1. Standard errors are clustered at the firm-level.

TABLE A4b | Concerns ESG performance sub-indicators—Pension Fund.

Variables	(1) Green initiatives	(2) Green initiatives	(3) Green initiatives	(4) Green initiatives	(5) Green initiatives	(6) Green initiatives
Pension Fund	0.778*** [0.090]	0.779*** [0.111]	1.001 [0.910]	0.773*** [0.090]	0.941** [0.463]	0.779*** [0.094]
Reg. noncompliance	0.019** [0.009]					
Inter PF*RNC	-0.007 [0.006]					
Substantial emissions		0.026*** [0.006]				
Inter PF*SE		-0.000 [0.002]				
Climate change risks			-0.005 [0.022]			
Inter PF*CR			-0.002 [0.009]			
Neg. Env. Impact				0.006 [0.005]		
Inter PF*NEI				-0.000 [0.004]		
BiodivRisk					0.001 [0.011]	
Inter PF*BR					-0.002 [0.005]	
Non-Carbon Emission						0.015*** [0.005]
Inter PF*NCE						-0.000 [0.002]
Constant	33.964*** [0.624]	33.314*** [0.618]	34.459*** [2.311]	33.979*** [0.613]	33.878*** [1.221]	33.791*** [0.612]
Observations	24,084	24,084	24,084	24,084	24,084	24,084
R-squared	0.00144	0.0128	0.00107	0.00177	0.00104	0.00630
Number of firms	2247	2247	2247	2247	2247	2247
Controls	Y	Y	Y	Y	Y	Y
Year F. E.	Y	Y	Y	Y	Y	Y
Firm F. E.	Y	Y	Y	Y	Y	Y

Note: This table reports the regression results examining the impact of controversies related to environmental practices on firms' green initiatives, with a specific focus on the moderating role of institutional investors – Pension Funds. Key dimensions of environmental controversies include Regulatory noncompliance, Substantial emissions, Climate change risks, Negative environmental impact of products and services, Land use and biodiversity risk and Non-carbon emissions (see Section 4.4.3 for details). The interaction terms evaluate how these factors influence the effect of Pension Funds on green initiatives. All regressions control for firm-level and macroeconomic factors through fixed effects for year, firm, industry, and country. Statistical significance is indicated by

*** $p < 0.01$; ** $p < 0.05$; * $p < 0.10$. Definitions of variables are provided in Table A1. Standard errors are clustered at the firm-level.