Equity ownership of responsible investors and firms' green revenues

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Abstract

This paper examines how equity ownership by PRI signatories is associated with firms' green revenues. In this panel dataset between 2010-2024 that includes 16,520 unique firms across 79 countries, the results show a significant positive association between PRI ownership % in top 20 institutional investors and firm's green revenue %. Once selection effects are purged, continuous PRI ownership % increments in short-term do not predict growth in green revenue %. However, evidence from staggered difference-in-differences design shows that when firms receive equity ownership for the first time from PRI signatory investors, green revenue % rises gradually over multiple years in horizon-specific estimates, with no significant pre-trends. Because investor selection cannot be ruled out, this result is indicative rather than causal evidence.

Keywords: responsible investing; PRI signatories; institutional ownership; green revenues; green transition; stewardship; staggered difference-in-differences

JEL classification: G11; G23; G32; M14; Q56

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Introduction

Climate change, caused by the increase in greenhouse gas (GHG) emissions due to human activities, is considered one of the most serious challenges faced by the planet (*Causes - NASA Science*, 2022; *Effects - NASA Science*, 2022). International environmental treaties have been established to reduce GHG emissions and limit the rise in global average temperatures such as the Kyoto Protocol in 1997 and the Paris Agreement in 2015 (*The Kyoto Protocol | UNFCCC*, n.d.; *The Paris Agreement | UNFCCC*, n.d.). Firms may be intrinsically motivated to green their operations or externally compelled to develop low carbon operations and to implement policies that green their supply chains, while disclosing information transparently on their specific sustainability initiatives and actions. The sustainability initiatives and actions undertaken by firms depend on (i) the regions in which they operate, (ii) the sectors and industry groups to which they belong, (iii) market pressures, or (iv) the firm's own aspirations.

Trillions of dollars have been allocated to responsible investments to accelerate the green transition. Global sustainability initiatives such as Carbon Disclosure Project (CDP), United Nations Principles for Responsible Investment (UNPRI or PRI), Climate Action 100+ (CA100+), and Transition Pathway Initiative (TPI), have seen increased assets under management since their inceptions. Socially responsible investments (SRI) have grown multi-fold in the past four decades, from only 26 sustainable funds and USD 1.9 billion in assets under management (AUM) in 1994 (Liu, n.d.) to approximately USD 135 trillion AUM of UNPRI signatories (*About Us | The PRI*, n.d.) alone as of 2026. In parallel, regulators are investing in standard setting to enable

companies to produce transparent and comparable material disclosures (*IFRS - IFRS Sustainability Standards Navigator*, n.d.; *Sustainability Reporting | EFRAG*, n.d.). Up until 2021, the year that was hailed as the peak year of environment, social, and governance (ESG) investing, sustainability followed a rising trend for several decades with growth in SRI and increasing traction of sustainability disclosures. However, starting in 2023 the trends started to dip as ESG faced backlash especially from fossil fuel industries (*From Boom to Backlash*, 2025). Many asset managers, predominantly from the United States (US), started to exit the net zero alliances in 2023 and by the first quarter of 2025, the global ESG funds witnessed record outflows (Bioy & CFA, 2025). Although sustainability deregulation in the US has had a trickle-down effect that de-escalated disclosures across other regions (Bioy & CFA, 2025; *ESG Backlash in the U.S. and Europe*, 2024), some jurisdictions, such as Europe, United Kingdom, and Singapore, remain on track in their efforts to mitigate climate risk (*Public Consultation on Singapore's Sustainability Disclosure Standards*, n.d.; *Trans-Atlantic Divergence in ESG Agendas*, n.d.). Multinational firms, with presence in different jurisdictions, face uncertain climate regulations, which complicate their climate risk mitigation and compliance. This raises the question of how external pressures shape firms' response towards green transition and sustainability disclosures.

Regulators are implementing climate change policies and rolling out the mandatory disclosure requirements with implementation timelines and guidance for firms to comply (*Corporate Sustainability Reporting - European Commission*, n.d.; *Public Consultation on Singapore's Sustainability Disclosure Standards*, n.d.; *Sustainability Reporting Guidance 2025-26*, n.d.).

Alongside these regulations, asset managers are promoting ESG through voice strategies (such as private or public engagement with management or shareholder resolutions), or exit strategies (such as negative screening or thematic investments) (Atta-Darkua et al., 2022; Azar et al., 2021; Flammer, 2015; Harmes, 2025; Hirschman, 1972; Hong & Kacperczyk, 2009; Institutional Investors and Stewardship, 2022; Krueger et al., 2020; Luo & Balvers, 2014; Oehmke & Opp, 2024). Increasing regulatory risk of climate-specific policies and growing AUM under responsible investments are accelerating the need for investors to consider climate related information in their investment decisions (Flammer et al., 2021; Krueger et al., 2020). These arguments favor the increasing demand for standardized climate information.

In contrast, coal and oil states of the United States (West Virginia, North Dakota, Texas, and Oklahoma) initiated several anti-ESG bills in early 2021 that penalized financial institutions for boycotting fossil-fuel industries. SB-13 (*Texas SB13 | 2021-2022 | 87th Legislature*, n.d.), the anti-ESG bill that was passed in Texas, became a model anti-ESG bill for the Republican states, which led some of these states to ban BlackRock and a few other pro-ESG financial institutions from participating in state and municipal contracts. Legal concerns were raised over the fiduciary duties of pro-ESG asset managers who pursue ESG criteria over profit maximization. Thereafter, more pressure was exerted on pro-ESG asset managers through allegations that diverting resources towards ESG expectations violated the fiduciary duty to maximize returns (Harmes, 2025).

Firms are subject to a variety of financial and market pressures with respect to sustainability: first, to meet investors' demands for information (Flammer et

al., 2021; Krueger et al., 2020; Luo & Balvers, 2014), second, to comply with the regulations (Aragòn-Correa et al., 2020; *ESG Backlash in the U.S. and Europe*, 2024), third, to secure access to capital (Bolton & Kacperczyk, 2021; Chava, 2014; Dhaliwal et al., 2011), and lastly, to respond to peer effects and competition (Breuer et al., 2022; Cao et al., 2019; Jia et al., 2026). Firms differ in their sustainability activities, which can generate positive externalities (green firms) or negative externalities (brown firms) for society (Dai et al., 2022; Luo & Balvers, 2014). Firms are being rewarded or punished for their eco-friendly or eco-harmful behaviors as the transition to "green" settles in as an institutional norm (Flammer, 2013). The cost of capital is observed to be higher for brown firms than for green firms because investors providing either debt or equity capital take firms' GHG emissions into consideration (Chava, 2014; Hartzmark & Shue, 2022). Given this dichotomy, brown firms, which face a higher cost of capital than green firms, are observed to become browner, whereas green firms do not become greener than their base levels even with a lower cost of capital (Hartzmark & Shue, 2022). Polluting (brown) firms may consider reform only if this cost is higher than the cost of moving to cleaner technologies (Heinkel et al., 2001).

The external pressures described above can be mapped to the stakeholders that exert them on firms. (a) Investors exert pressure through equity ownership and stewardship by demanding climate-related information to reward or penalize firms through voice or exit (Atta-Darkua et al., 2022; Flammer, 2013; Harley, 2022; Hirschman, 1972; Institutional Investors and Stewardship, 2022; Krueger et al., 2020). Responsible investors or investors who are signatories to climate-led initiatives carry explicit commitments to incorporate sustainability

into their ownership and engagement practices (*About Climate Action 100+*, n.d.; *About Us | The PRI*, n.d.; *The Transition Pathway Initiative ('TPI')*, n.d.; *What Are the Principles | PRI*, n.d.). (b) Regulators and standard setters exert coercive pressures through mandatory and voluntary disclosure requirements, with timing, scope and enforcement phased differently across jurisdictions (*Corporate Sustainability Reporting - European Commission*, n.d.; *Public Consultation on Singapore's Sustainability Disclosure Standards*, n.d.; *Sustainability Reporting | EFRAG*, n.d.; *Sustainability Reporting and Assurance Requirements*, n.d.; *Sustainability Reporting Guidance 2025-26*, n.d.; *The Time Has Come: The KPMG Survey of Sustainability Reporting 2020*, 2020; Kothari & Zhang, 2022; Stanny, 2013). Firms anticipate what is likely to be required and enforced where they operate (Chang et al., 2023; Leuz & Wysocki, 2016; Liang & Zhang, 2026; Nardi, 2026). (c) Peer firms in the same industry and country exert mimetic pressures, as firms observe and follow their disclosure practices for competitive advantage (Cao et al., 2019; Jia et al., 2026; Seo, 2021). (d) Third-party intermediaries such as analysts (Adhikari, 2016; Lu & Abeysekera, 2021) or rating agencies (Institutional Investors and Stewardship, 2022) could further shape the demand for climate related information. Under institutional isomorphism (DiMaggio & Powell, 1983) these stakeholders correspond to coercive, mimetic or market pressures that firms face. These pressures may affect firms differently: they may change what a firm does, what it reports, or both, and they may matter for whether a firm starts to respond and, once it has responded, how far it goes.

This paper considers pressure from investors as stakeholders. The pressure is equity ownership by PRI signatories, and the response studied is the

commercial form, the green share of the firm's revenues (green revenue %), and whether it changes when responsible investors first hold the firm and as their ownership increases.

Uncertain regulatory environments, jurisdictional boom and backlash cycles in ESG, and market demand for climate information provide the motivation for this study. This paper examines firms' commercial green transition under equity investor pressure.

Assets under management for socially responsible investments (SRI) are increasing year over year. The Carbon Disclosure Project (CDP), which started in 2000 with 35 investors and 245 companies disclosing emissions information, has grown to 800 investors as of 2026, with USD 127 trillion in AUM and approximately 25,000 companies responding to its questionnaire ('Carbon Disclosure Project', 2026; *CDP A List 2025*, n.d.). Another investor-led initiative, the United Nations supported Principles for Responsible Investment (UNPRI), started in 2006 with 100 signatories and has grown in two decades to more than 5,000 signatories and an AUM of USD 135 trillion (*About Us | The PRI*, n.d.). Other initiatives such as Climate Action 100+, Transition Pathway Initiative have seen significant growth in AUM since their inception (*About Climate Action 100+*, n.d.; *The Transition Pathway Initiative ('TPI')*, n.d.). Growing responsible AUM is increasing investors' demand for climate information, both to fulfill their commitments as a signatory to these initiatives and to address climate-related risks in their portfolios (Flammer, 2015; Krueger et al., 2020).

Institutional investors, who hold most of the equity capital (Dyck et al., 2019), are broadly classified as traditional profit-seeking and socially conscious investors (Oehmke & Opp, 2024; Starks, 2023). In the literature, there is a distinction between these two investor types in their motivations and investment strategies. Although it is difficult to define a single characteristic of socially responsible investors, they usually approach investing through different screening strategies such as sin-stock exclusions, thematic investing, best-in-class inclusions or, in some cases, impact driven investments (Luo & Balvers, 2014; Pastor et al., 2025). Unlike traditional investors, who are interested only in pecuniary benefits, responsible investors value non-pecuniary benefits, at the expense of financial returns, to keep their portfolios clean (Heinkel et al., 2001). Responsible investors opt to invest in firms that meet their ethical criteria, mainly in "green" firms (that create positive environment externalities) and are considered to exclude or boycott "brown" or "sin" firms (that create negative environmental externalities) (Luo & Balvers, 2014). Traditional investors do not make any such distinction in firms for their investment strategies, other than seeking profit-maximization (Atta-Darkua et al., 2022; Klausmann et al., 2024).

Given that climate change is considered one of the most serious challenges faced by the planet (Nations, n.d.), both traditional profit-seeking and responsible investors are needed to ensure that the funds are available to firms to drive impact through clean production (Oehmke & Opp, 2024). If responsible investors continue boycotting brown firms and invest only in green firms, their portfolio carbon footprint would start from a low base. Although this fulfills the fund's mandate, the fund itself may have limited

impact on emissions reductions relative to its original base level, because the portfolio is already clean (Oehmke & Opp, 2024). This also suggests that the SRIs are rewarding green firms while offloading the decarbonization efforts onto the conventional investor groups (Atta-Darkua et al., 2022). If green investors consider only ethical firms, then the other polluting (brown) firms are deprived of the total available investments in the market. This increases the cost of capital for the polluting firms because the risk of owning these firms is borne by the select profit-maximizing investors who demand higher returns, resulting in lower share price for the firm (Atta-Darkua et al., 2022).

Regulators have already started implementing climate change policies across various jurisdictions (for example, the EU Emissions Trading System and Singapore's carbon tax) (*Carbon Tax*, n.d.; *EU Emissions Trading System (EU ETS) - Climate Action - European Commission*, n.d.). Investors are keen to understand climate-related risks in their portfolio firms as they bear the burden of materialized or anticipated regulatory risks (Krueger et al., 2020). As these changes are already taking shape in the regulations and capital market environments, firms are compelled to meet the expectations of different stakeholders.

Firms approach corporate social responsibility (CSR) in diverse forms such as green business models, sustainability reporting, or philanthropic donations for different environmental or social causes (de Jong & van der Meer, 2017). However, not all firms consider CSR worth prioritizing. Firms may not always be willing or motivated to pursue CSR intrinsically but may be triggered externally by the mandatory policies and incoming regulations (de Jong & van

der Meer, 2017). Equity ownership by responsible investors is examined in relation to firms' behavior towards green revenues.

The analysis is in line with the CSR literature, in which firms consider "doing well by doing good" vital to their business, either due to self-driven values (Luo & Balvers, 2014) or through regulatory and investor pressure (Flammer et al., 2021; Krueger et al., 2020). Many studies address how firms clean up their polluting technologies in the presence of green investors (Heinkel et al., 2001), or whether investors become greener after becoming PRI signatories (Pastor et al., 2025) or, in a cross-sectional study, whether pre- and post-Paris Agreement responsible investor ownership is associated with green revenues (Klausmann et al., 2024). In this context, this study adds to the existing literature on green investments and firms' green transition. This study further investigates alternative strategies of firms for transitioning to green: (a) improved reporting through ESG scores (Drempetic et al., 2020) or (b) level of "greenness" in a firm's business activities through tier 1, tier 2 and tier 3 GR% (Klausmann et al., 2024).

This paper examines how equity ownership by responsible investors is associated with firms' green revenue % (GR%). The panel dataset between 2010-2024 includes 16,520 unique firms across 79 countries of which 4,410 unique firms from 62 countries have a positive green revenue percent. The results show a statistically significant positive association between PRI ownership % in top 20 institutional investors and firm's green revenue %. A 1-percentage point increase in PRI ownership % in top 20 institutional investors is associated with a 0.0254 percentage point increase in firm's GR%. Using the reverse-causality test proposed by (Godfrey et al., 2020), the results do not

support that a marginal increase in PRI ownership % predicts more green revenue % growth, which is consistent with, but does not establish, responsible investors selecting firms that are already on the path to green transition.

This study builds on the greenness measure proposed by (Klausmann et al., 2024). Green Revenue % is the reported or estimated green revenue as a proportion of total revenue, obtained from the FTSE Russell Green Revenues Classification System (GRCS) part of LSEG Workspace. In contrast to their cross-sectional panel study, in which the Paris Agreement is reported to accelerate firms' green revenue %, the evidence from the staggered difference-in-differences design (Callaway & Sant'Anna, 2021) shows that firms' green revenue % rises gradually over multiple years following the first-time onset of equity ownership of responsible investors, with no significant pre-trends prior to that. The average post-treatment effect is not statistically significant, and the gains are significant at specific horizons only. These results are not consistent with firms signaling to attract responsible investors through improved green revenues before ownership begins, although investor selection on unobserved characteristics cannot be ruled out.

Next, firms' responses after they receive responsible investor ownership are examined. First, whether firms increase their sustainability reporting, as measured by ESG scores (*ESG Scores and Data*, 2026), is examined. Second, the study uses the FTSE Russell GRCS tiering system (*Green Revenues Data Model | Data Analytics*, n.d.) that classifies green revenues into Tier 1 (significant and clear environmental benefits), Tier 2 (limited but net positive

environmental benefits), and Tier 3 (some benefits but net neutral or negative impact) GR%[1] to test the level of "greenness" in a firm's business activities.

Further heterogeneity tests at the investor and firm levels examine whether the effects are uniform across subgroups. The investor-specific heterogeneity test compares pension and sovereign wealth funds (SWF) with mutual funds to examine how the association varies with long-term versus flexible-term equity holdings. The results suggest that conventional ownership % of long-term pension funds and SWFs without the PRI signatory identity, and the ownership % for explicitly classified PRI signatory mutual funds are each significantly and positively associated with firms' GR%. This finding is consistent with other studies showing that firms' adoption of ESG practices for long-term value creation is (a) well aligned with the interests of long-horizon investors, PRI signatory or not (Bénabou & Tirole, 2010; Dai et al., 2022), and (b) aligned with explicit responsible investor commitment in the case of mutual funds (Becker et al., 2022; Riedl & Smeets, 2017). Firm-level heterogeneity tests – brown, neutral, and green firms classification based on EU Taxonomy (*EU Taxonomy for Sustainable Activities - European Commission*, n.d.) and Thomson Reuters Business Classification (TRBC) classification (*TRBC Sector Classification*, n.d.) suggest that the positive association between PRI ownership % in the top 20 institutional investors and firm's green revenue % is concentrated in brown firms compared to neutral

[1] The FTSE Russell GRCS tiering system (https://www.lseg.com/content/dam/data-analytics/en_us/documents/methodology/green-revenues-data-methodology.pdf) assesses the level of "greenness" based on seven environmental objectives. climate change mitigation, climate change adaptation, pollution prevention and control, protection of healthy ecosystems, sustainable use and protection of water and marine resources, transition to a circular economy, waste prevention and recycling, and sustainable and efficient agriculture, of which the first six objectives are set by European Commission and aligned with EU taxonomy.

and green firms. However, these results are not consistent when the brown, green and neutral classification is based on scope 1 and scope 2 emissions intensity terciles (sample available for panel period 2015-2024), where the association becomes insignificant.

This study contributes to the academic literature through both methodological and empirical extensions on socially responsible investing. First, at the macro level, this study contributes to the general literature on socially responsible investing (Gibson Brandon et al., 2022; Goel & Sahay, 2025; Heath et al., 2023; Heinkel et al., 2001; Oehmke & Opp, 2024; Renneboog et al., 2008; Zhang & Zi, 2021). Second, the finding from this study adds to the growing literature on green revenues measure of green transition proposed by (Klausmann et al., 2024). Third, it contributes methodologically by applying staggered difference-in-differences (Callaway & Sant'Anna, 2021) and reverse-causality tests (Godfrey et al., 2020) to separate responsible investor selection from firms' response to commercial green transition. Fourth, while most studies examine the association between responsible ownership and green transition over the short-term (Bassen et al., 2023; Berrone et al., 2013; Flammer, 2013; Gibson Brandon et al., 2022; Hartzmark & Shue, 2022; Heinkel et al., 2001; Klausmann et al., 2024), this study adds to this literature with evidence on firms' behavior over a longer horizon. In terms of policy implications, regulators incorporating sustainability criteria for firms and developing stewardship codes, for example, the UK and Singapore Stewardship Code (Harley, 2022; *UK Stewardship Code 2026*, n.d.), could consider including the impact-driven metrics such as the commercial green revenue % of the firms to assess the long-term impact of investments for

increased accountability. The sample spans 79 countries, including Asian markets, so the findings are relevant to investors and regulators in Asia.

Literature, Theoretical Framework, and Hypotheses Development

Climate risks are becoming important to institutional investors to understand the financial implications on their portfolio firms (Pedersen et al., 2021). Carbon risk is priced into lending decisions made by banks (Ehlers et al., 2022; Herbohn et al., 2019) and influences credit ratings and yield spreads (Seltzer et al., 2026; Starks, 2023). Increasing regulatory risk from climate-based policies is accelerating the need for investors to consider climate related information, from their portfolio companies, for their investment decisions and in some jurisdictions to comply with the regulatory requirements such as the European Union's Sustainable Finance Disclosure Regulations (EU SFDR) (Becker et al., 2022; Regulation (EU) 2019/2088 of the European Parliament and of the Council of 27 November 2019 on Sustainability-related Disclosures in the Financial Services Sector (Text with EEA Relevance), 2019).

"Greenness" of a firm

A "green" firm is generally defined as one that generates positive externalities for the environment and society (Luo & Balvers, 2014); the form through which these externalities are created can vary across firms. A firm's "greenness" can be classified into two broad categories: greening of production and operations within the firm (expense), and green products and services produced by the firm (possible revenue streams). Examples include Ericsson's 5G smart factory for clean production (Karp, n.d.), and Tesla/BYD electric vehicles as examples of green products. There could be various

sustainability indicators such as green innovation, green capital expenditure, ESG scores, emissions intensity, or green revenues that could proxy for the firm's greenness (Pupo & D'Ambrosio, 2026). Literature has focused extensively on ESG scores / ratings (Berg et al., 2022; Dyck et al., 2019; Eskildsen et al., 2024; Pastor et al., 2025) or emissions (Bolton & Kacperczyk, 2021; Hartzmark & Shue, 2022). Some studies use capex (Wiedemann, 2023), or green innovation (Berrone et al., 2013; Cohen et al., 2020; Yang & Jiang, 2023). These indicators are considered as primary proxies to measure sustainability or environmental performance of the firm. However, these indicators do not always capture firms' greenness holistically, nor are they uniform representations of one another. For example, green innovation does not suggest reduced GHG emissions (Bolton et al., 2023).

Recent work by (Klausmann et al., 2024) introduces a green revenues measure that captures the commercial side of green products and services. The authors argue that the commercial form of a firm's greenness (green revenues) may not be directly linked to the company's emissions or ESG ratings. For example, a car maker's environmental efficiency in production and the emissions released when the car is driven could each indicate the firm's efforts to address its overall environmental footprint. ESG ratings provided by third party platforms such as Refinitiv and MSCI, through their proprietary methods, assess firm's approach and conduct towards implementing sustainability in their operations and how environmental issues are managed. The authors suggest that firms profiting from the shift to a green economy can be captured by green revenues. Their green revenues measure is used as a proxy for firm's tangible commercial greenness, contributing to the nascent literature on this measure.

Equity ownership of responsible investors and green transition

Friedman's shareholder view holds that a business's focal agenda is to maximize shareholder profit (Friedman, 2007) whereas Freeman's stakeholder view holds that a firm should meet the expectations of not only shareholders but also various stakeholders associated with it (Freeman et al., 2010). This has driven capital providers to tackle value vs. values motivations (Starks, 2023) and firms to comply and navigate the complex expectations and requirements across the board of interested and involved parties.

Based on corporate finance theory, investments from traditional profit-seeking investors or socially conscious investors are expected to influence the firm's cost of capital and firm value (Del Brio et al., 2003; Zhang & Zi, 2021). Owing to financial (climate risk) and social motivations (impact), investors have started accounting for sustainability related information from the firms in their investment decisions. In their pursuit to address sustainability, investors and firms spend millions of dollars on green transition. Firms spend more than half a million dollars annually to produce climate-related disclosures, and institutional investors spend more than double this amount to collect and analyze climate information to make informed investment decisions (Moyo, 2022). Various climate specific investor-led initiatives have also been set in motion in the last three decades, so that investors, as signatories to sustainability stewardship, can enable firms to green their operations or products and address climate-risk.

Institutional investors serve as catalysts in the low-carbon economy, motivating firms towards carbon disclosure and emissions reduction (Krueger

et al., 2020). With an overall increase in total investable capital, the responsible investments percentage has seen a significant growth in signatories and AUM in each of these climate initiatives over these three decades. It can be argued that asset managers are driven by reputation to become signatories to the climate-specific initiatives to gain prominence (Majoch et al., 2017). However, their prominence may not always get translated to exerting influence on firms. For example, BlackRock, Vanguard and State Street (the Big Three) are observed not to defy management and to take a backseat in environmental stewardship (Baines & Hager, 2023). Adding to this case are the financial motivations or uncertainties in fiduciary duties that hinder US based PRI signatories to meet their commitments (Gibson Brandon et al., 2022). In another argument, researchers find that responsible investment AUM is associated with firms' ESG performance. While institutional investors have an impact on environment and social scores of the firm, responsible investors are shown to have double the impact on firm's E&S performance, measured as environment and social scores (Dyck et al., 2019). Outside the US, PRI signatories have higher portfolio ESG scores compared to non-signatories (Gibson Brandon et al., 2022). Similarly, firms with high levels of SRI ownership before the Paris Agreement are reported to show higher green revenue growth after the Paris Agreement (Klausmann et al., 2024). Past studies have constructed the equity ownership of responsible investors based on their signatory status in UNPRI, CA 100+ or CDP (Atta-Darkua et al., 2022; Gibson Brandon et al., 2022; Klausmann et al., 2024). Here, the equity ownership of responsible investors follows the construction in

these studies, using PRI signatories among a firm's top 20 institutional investors.

This paper is motivated by the argument in the literature that responsible investor ownership is associated with better sustainability performance by the firm, measured as green revenue %.

Hypothesis 1: The equity ownership of responsible investors is positively associated with firm's green revenue percent.

With the investor strategies of voice vs. exit (Hirschman, 1972), it can be argued that responsible investors select firms that are already green or they engage with the portfolio firms to transition to green. While these strategies make the causal identification of the baseline hypothesis challenging, the identification strategy section in the methodology section addresses these investor strategies directly along with firm's behavior upon the inception of first-time ownership by PRI signatories.

Responsible investor strategies

Unlike debt capital providers, equity investors decarbonize their portfolios by (a) reducing their stakes in polluting firms, (b) rebalancing their holdings towards green firms, (c) engaging with the portfolio firms to green their supply chain and operations (Berk & van Binsbergen, 2025; Flammer et al., 2021). At a high level, traditional profit-seeking investors and responsible investors approach their investment decision-making through (a) selection, (b) divestment, and (c) engagement. However, their specific strategies vary depending on the value vs. values motivations (Starks, 2023). The literature

below addresses responsible investors' core strategies under these broad approaches.

Responsible investors – Selection

This includes various screening strategies such as (a) boycotting sin-stocks, (b) positive or best-in-class screening, (c) ESG integration (d) thematic investing and (e) impact investing. These responsible investors are further categorized into consequentialists, focused on real world impacts such as emissions reduction, and non-consequentialists with moral or ethical motivations regardless of the real-world impact (Pastor et al., 2025). The dominant technique used by non-consequentialist investors is investing in green firms and shunning of polluting / sin / brown firms. They reward the green firms by lowering their cost of capital and punish the brown firms by raising these costs through reduced incentives or as a result of systematic boycotted risk premium (Bolton & Kacperczyk, 2021; Chava, 2014; Luo & Balvers, 2014; Pastor et al., 2025). However, with such a tilting strategy they may be pushing the decarbonization efforts onto the other investor groups who may not be equally motivated to address climate change agenda (Atta-Darkua et al., 2022). In another study, such strategies are associated with greater innovation towards cleaner technologies by polluting firms. (Cohen et al., 2020) show that energy sector firms boycotted by responsible investors produce more green patents. Also researchers suggest that when socially conscious investors reward firms that fulfill their moral or ethical fund mandate, the characteristics of the firm they invest in may not differ much upon receiving these investments (Hartzmark & Shue, 2022; Heath et al., 2023).

Responsible investors – Divestment

Many sustainable investors divest from high carbon emitting entities, such as fossil fuels, and opt for tilting strategies to decarbonize their portfolios (Atta-Darkua et al., 2022). Investors are found to underreact to long term physical risks whereas they overreact to disasters or climate change news instances (Pastor et al., 2025). Long term institutional investors (pension funds) are generally heavily invested in economically foundational industry groups, for example cement, steel, utilities. However, if there is a stricter legislation, the firms from these industry groups may lose the incentive to continue their businesses, eventually leading to a slow decline (Klausmann et al., 2024). Also, treating these industry groups as brown and hence divesting such industry groups in the process of cleaning their portfolios may not create true impact or achieve net zero goals set up by the regions (Baker, 2023). Across various approaches taken by the investors to include climate risks into their investment decision making, divestment is considered the least preferred strategy owing to its small impact in secondary markets (Berk & van Binsbergen, 2025; Krueger et al., 2020).

Responsible investors – Engagement

Awareness of climate risks and engagement with portfolio companies are associated with the decarbonization of investor portfolios. When portfolio companies improve environmental policies, investors observe lower portfolio risk. In parallel, if investors incorporate climate criteria into their investment decision making, they can reduce their portfolio risk (Krueger et al., 2020). In some cases, they do this actively through responsible investing initiatives,

such as becoming signatories to UNPRI, CA100+, TPI etc. One study observes that CDP signatories are more inclined towards tilting strategies whereas CA100+ are more aligned to engage with portfolio firms (Atta-Darkua et al., 2022).

Studies show that responsible investors benefit from engaging with the portfolio firms rather than divesting to address climate-specific risks (Appel et al., 2016; Berk & van Binsbergen, 2025; Krueger et al., 2020). Multiple channels were considered in the literature to address responsible investor influence on firm's sustainability behavior or performance. Examples include capital allocation (Cohen et al., 2020; Kölbel et al., 2020), green innovation (Klausmann et al., 2024), cost of capital (Hartzmark & Shue, 2022), and shareholder proposals (Dyck et al., 2019; Flammer et al., 2021; Gillan & Starks, 2000; Heath et al., 2023). Responsible investors through their private discussions with the management could also encourage firms to make policy specific changes to address sustainability (Lydenberg, 2013). While some studies suggest causal evidence, not all channels have sufficient evidence to indicate the causal mechanisms through which responsible investors could influence firm's green transition. The literature on these channels is briefly discussed.

Shareholder proposals are often considered as the means for investors to express their right of control over firm's sustainability performance (Flammer et al., 2021), but the availability of global data on the proposals is limited. Also, except for the proxy votes on shareholder resolutions, most investor engagement with portfolio firms is unobservable (McCAHERY et al., 2016)

and surveys have been the most preferred tool to understand the investor engagement strategies.

Investments influence cost of capital and thereby affect the way firms pursue capital investments (Modigliani & Miller, 1958). Capital allocation decisions depend on the investments received from debt investors and ownership holdings by equity investors (Cella, 2009; Runyon, 1983; Stenbacka & Tombak, 2002). Total capital expenditure, however, is a coarse proxy for green spending: it does not distinguish green from other investment and is influenced by both debt and equity investors. On the one hand, responsible investors influence green capital expenditures by increasing green debt issuance (Wiedemann, 2023); on the other, even if capital investments are not categorized as green capex, the new investments may inherently be more energy efficient than the vintage capital (Benhabib & Rustichini, 1991; Díaz & Puch, 2019; Hartzmark & Shue, 2022).

Changes in green capital expenditure and in GR% are likely to occur at the same time under the same investor pressure, so a test of one on the other says little about the mechanism. Also, equity ownership acquired in the secondary market does not bring new cash to the firm, so any effect would have to operate through hurdle rates, governance or reallocation of existing funds rather than through the financing received.

Responsible investors may lower the cost of capital of green firms if their demand for green stocks increases prices and reduces the returns required of those firms (Hartzmark & Shue, 2022; Heinkel et al., 2001). A lower cost of capital could in turn make green projects viable and raise GR% over time.

Although the cost of capital could be a potential mechanism, this paper does not test this channel, which is left to future research that could combine estimates of the implied cost of equity and cost of debt with the ownership of responsible investors.

Active versus passive investing

Large institutional investors who hold sizable ownership in firms are exposed to the climate risks that are increasing their concerns and the need to integrate these risks into their investment decisions. The inability of the large institutional investors to divest or exit their positions is forcing them to integrate climate related information into their investment decision making (Krueger et al., 2020). Active institutional investors could engage directly with management to improve firm's sustainability performance through discussions with management or voting on environment specific shareholder resolutions. When management performs poorly, they could exit their positions (Appel et al., 2016; Flammer, 2015; Flammer et al., 2021). In contrast, passive investors investing in index funds with a low-cost agenda may not deploy resources to manage climate risks. They adopt general diversification or analyze firms' carbon footprints, with no direct engagement with the management. Passive investors with little or no power to exert influence over managers could indirectly weaken the governance and performance of the firms, and at the same time are not in a position to easily divest or exit their positions (Appel et al., 2016; Krueger et al., 2020).

The increase in institutional ownership AUM, along with the passive investment strategies, has led the regulators to consider both mandatory

requirements and voluntary stewardship codes to address the concern of investors' under-engagement or monitoring of the portfolio firms. Because ownership engagement plays a significant part in capital allocation and governance, some jurisdictions have included sustainability in their stewardship codes, as the social and economic value of engagement could be much higher (Institutional Investors and Stewardship, 2022). Although passive investing strategies have raised concerns of under-engagement with portfolio firms, these concerns may be partly alleviated by passive investors' indirect engagement, which leverages data from third-party providers to incorporate sustainability criteria into investment decisions.

Pension funds and SWFs versus Mutual funds

Firm's adoption of sustainability practices in the pursuit of long term value creation aligns with the interests of the long-term investors such as pension funds and sovereign wealth funds (Bénabou & Tirole, 2010; Dai et al., 2022). While pension funds and sovereign wealth funds introduce climate related criteria into investment decision making (Liang & Renneboog, 2020), mutual funds with varying investment horizons are observed to have a negative association with firm's CSR (Li et al., 2021). However, responsible investors as opposed to conventional investors hold socially responsible mutual funds (Riedl & Smeets, 2017).

This study investigates the relationship of active and passive investor ownership with firm's green revenue %. It also examines how long-term pension and sovereign wealth fund investors differ from mutual funds, both in their own identity and in explicitly becoming PRI signatories.

Firm's behavior towards green transition

Many jurisdictions are moving towards mandatory sustainability reporting aiming for transparency and cohesiveness of the disclosures by the firms to improve comparability over time and also for benchmarking against peer companies (Christensen et al., 2021). A few jurisdictions, such as Europe and Singapore, have developed taxonomies defining certain business economic activities with the potential to transition to green through operations, innovations or products, preventing greenwashing and enabling access to capital (*EU Taxonomy for Sustainable Activities - Finance - European Commission*, n.d.; *FAQ: What Is the EU Taxonomy and How Will It Work in Practice?*, n.d.; *Taxonomy*, n.d.). Given the EU Taxonomy's classification, investors could potentially consider investing in high-emitting firms for their transition, such that these transitions create opportunities to deliver real impact on environment and foster sustainable innovations, rather than just choosing to invest in green firms to green their portfolios (Hartzmark & Shue, 2022). An average brown firm has 261 times the emissions of an average green firm, which is an opportunity for investors to engage with brown firms to create more environmental impact. Brown firms reducing their emissions by 1% may not be the same as green firms reducing their emissions by 100% (Hartzmark & Shue, 2022). While all firms are expected to increase their firm value, some do so intrinsically or extrinsically through mandated policies and incoming regulations towards corporate social responsibility (Flammer et al., 2021). Firms may take different approaches to address CSR and sustainability agenda within their business. Some strategies include implementing sustainability in operations or policies, sustainability reports and emissions reduction targets,

or the commercial green revenues. Firms are said to enjoy a lower cost of capital and higher firm value when they improve their environmental policies (Chava, 2014; Krueger et al., 2020).

To understand alternative sustainability strategies that firms may pursue upon receiving responsible investments, two approaches are considered alongside green revenues %. First, firms may improve their sustainability performance, measured as ESG scores (Barko et al., 2022; Dai et al., 2022; Drempetic et al., 2020; Ioannou & Serafeim, 2012). Second, firms could increase their level of greenness by increasing their tier 1 green revenues rather than the controversial tier 3 green revenue percentages (Klausmann et al., 2024). The LSEG Workspace GRCS (*Green Revenues Data Model | Data Analytics*, n.d.) which classifies the activities into tier 1, tier 2 and tier 3 green revenue percentages, has been subject to controversies. Examples of these controversies include (a) the electric vehicles, which are considered green, leverage rare earth mineral mining (tier 3) (*Rare Earth Elements: Why They're Now Strategic Assets*, n.d.) and produce toxic foam that pollutes rivers (*China's Rare Earth Mining Could Cause Irreversible Environmental Harm*, n.d.), (b) nuclear energy (tier 3) while not adding to GHG emissions produces radioactive waste (Klausmann et al., 2024).

Figure 1.1 showcases the theoretical framework and alternate explanations considered for this paper based on the literature and theory.

Methodology

Variables

Green revenues – GR% (company_gr_pct)

This is the dependent variable for this study where green transition is operationalized as green revenues, a real commercial benefit from a firm's products or services. This variable is based on the measures proposed by (Klausmann et al., 2024) and is different from ESG scores because companies with higher green revenue % do not always have higher ESG scores, or vice versa. For example, in 2016, Tesla's GR% was 100% with an ESG score of 31.30, compared with Occidental Petroleum Corp's GR% of 2.05% and ESG score of 67.91. In contrast to their dependent variable for green transition, measured in green sales revenues, the green revenue share (GR%) is used here. LSEG Green Revenues Data Model classifies percentage of revenues derived from green products or services as green revenues, based on the Green Revenues Classification System (GRCS)[2], a taxonomy that defines and measures green transition across 10 sectors, 64 subsectors and 133 micro sectors. This system also classifies firm's revenue exposure into three different tiers based on the greenness of business activities - tier 1 (greenest), tier 2 (greener), and tier 3 (green but net neutral/negative) green revenue percentages. Most of these data in LSEG are captured from companies' public documents, and LSEG also applies a proprietary estimation model to calculate the green revenues data (*Green Revenues Data Model | Data Analytics*, n.d.).

[2] GRCS system dates back to 2008 initially developed by FTSE Russell with latest iteration launched in 2020 (*Green Revenues Data Model | Data Analytics*, n.d.).

Equity ownership of responsible investors (pri_top20)

This is the independent variable for this paper, operationalized as cumulative equity ownership percent of PRI signatories in the top 20 institutional investors. Each of the top 20 institutional investors obtained from FactSet is manually mapped against the PRI signatory list over the period 2010-2024, following this measure proposed in the literature (Dyck et al., 2019; Klausmann et al., 2024; Oehmke & Opp, 2024). While literature also considers CA100+ or CDP signatories, this study focuses on the PRI because its signatories are institutional investors, including asset owners and asset managers, unlike CDP and CA100+, which also have corporations as supporters. UNPRI is considered to have the largest global database specific to institutional investors. Signatories of UNPRI commit to the six principles[3] set forth by investors for investors (*What Are the Principles | PRI*, n.d.). This commitment spans across all stages of the investment process from stewardship to investments and reporting. The decision by an asset owner or investment manager to become a PRI signatory could be motivated by intrinsic beliefs and values, reputation, or regulatory compliance (Majoch et al., 2017). The signatories are expected to meet the minimum reporting requirements set forth by PRI to maintain their signatory status and avoid the

[3] UNPRI Six Principles are: 1) incorporate ESG issues into investment-decision making and analysis, 2) to be active owners incorporate ESG issues into their ownership policies and practices 3) seek appropriate disclosure on ESG issues by the entities in which they invest 4) promote the acceptance and implementation of the Principles within the investment industry 5) work together to enhance the effectiveness in implementing the Principles. 6) report on investing activities and progress towards implementing the Principles. (*What Are the Principles | PRI*, n.d.)

risk of being delisted (*About Us | The PRI*, n.d.). The PRI signatories included are both historical and current across the years 2010-2024[4].

Conventional investors (Traditional profit-maximizing equity investors)

This variable represents the conventional investors, that is, the remaining non-PRI-signatory investors among the top 20 institutional investors. This is calculated as *pri_top20* subtracted from top 20 institutional ownership (*total_top20*). To understand how responsible investors are different from traditional investors, *non_pri_top20* ownership is included as a control. Considering the baseline hypothesis of this paper, this variable is expected to have either negative or no association with GR%.

Control variables

Time-variant financial variables are included in the tests to account for the financial capacity of the firm: size of the firm *(ln_assets)*, market to book ratio *(ln_mtb)*, return on assets *(w_roa)*, leverage *(w_leverage)* calculated as total debts divided by total assets, free cash flow scaled to assets *(w_fcf_assets)*, and dividend payout ratio *(w_dpr5)*. Consolidated variable definitions are in Appendix A.

[4] The PRI signatory list provides the currently active signatory list along with their joining year (*Supporters | PRI*, n.d.). However, if a signatory has been delisted or chose to exit voluntarily, PRI signatory directory does not provide this information. This information was further captured through wayback machine web crawler for historical PRI signatories based on the dates available in the panel period 2010-2024 and included them into the firm-year observations (*Wayback Machine*, n.d.). Also, PRI signatories joined in 2025 and beyond are not included in this study's 2010-2024 panel. In the cases where a parent investor entity is a signatory, all subsidiaries are marked as responsible investors, and if the subsidiary alone is the signatory, only that entity is marked as responsible investor and not any of its sister entities or its parent.

Data and Sample

The data for this study are obtained from FACTSET, LSEG Workspace and the UNPRI signatory directory. The panel has 188,624 firm-year observations that include publicly listed firms disclosing green revenue percent (inclusive of 0) during the period 2010-2024. There are 36,225 observations that have positive green revenue percent (19.2% of the panel having GR% > 0), starting with 800 unique firms reporting in 2010 and gradually increasing to 3,900 firms by 2024 with 4,410 unique companies disclosing it over the entire panel period. 34,000 observations have both PRI ownership > 0 and GR% > 0 in this panel.

Identification strategy

All variables used in the panel for this paper are time-varying firm level variables. Below is the baseline specification:

$$company_gr_pct_{it} = \beta_0 + \beta_1 \cdot pri_top20_{i,t-1} + \gamma \cdot X_{i,t-1} + \lambda_i + \eta_{j,t} + \varepsilon_{i,t} \quad \text{---- (1)}$$

$X_{i,t-1}$ represents control variables: non_pri_top20, firm financial capacity variables mentioned in the other variables section above.

λ_i represents firm fixed effects and $\eta_{j,t}$ represents industry-year fixed effects.

All independent variables are lagged by one year to establish temporal ordering, but this does not eliminate the endogeneity concerns related to the independent variable of interest, which include (a) the investor's interest in becoming a PRI signatory and (b) the general reverse-causal selection bias, where a PRI signatory investor may select a firm that is already trending

towards green transition. Because an investor's interest in becoming a PRI signatory can be observed only after it becomes a signatory, it is mostly unobservable unless captured through surveys or policy shocks. While Paris Agreement (Hartzmark & Shue, 2022; Klausmann et al., 2024) and EU SFDR (Becker et al., 2022) are considered shocks, they do not directly address the motivations behind investors' choice to become a signatory of PRI or other climate-led initiatives. Investors' pre-signatory triggers for becoming a signatory of any climate-specific initiative are not addressed.

To address the second concern, investors selecting firms that are transitioning to green, the reverse-causality method proposed by (Godfrey et al., 2020) is applied. In contrast to the simple reverse-causality check where the firms with green revenues lagged by 1 or 2 years are tested for correlations with contemporary pri_top20, the method proposed by (Godfrey et al., 2020) corrects the coefficient by purging from pri_top20 the component related to past green revenue %. This is done by splitting pri_top20 to GR%-related and GR% unrelated components through equations (2) and (3) below.

$$pri_top20_{i,\,t-1} = \beta_0 + \beta_1' \cdot company_gr_pct_{\,i,t-2} + \lambda_i + \eta_{c,t} + \varepsilon_{i,t} \qquad \text{---- (2)}$$

$$pri_unrelated_{\,i,\,t-1} = pri_top20_{i,\,t-1} - \beta_1' \cdot company_gr_pct_{\,i,t-2} \qquad \text{---- (3)}$$

$pri_unrelated_{\,i,\,t-1}$ represents the pri_top20 (t-1) that is purged of GR% lagged by (t-2) driven component, which is included in the main regression specification to test for the selection effects that isolates the short-run continuous treatment of the pri ownership variable.

While the specification above addresses investors' choice to select firms that are trending towards green, another specification addresses firm's signaling effects, that is, whether a firm receives equity ownership for the first time from PRI signatory investors because it is transitioning to green and how firms respond upon the onset of pri ownership. The staggered difference-in-differences approach proposed by (Callaway & Sant'Anna, 2021) is used to examine whether a firm improves its green revenue % to attract PRI signatory investors.

Most studies apply difference-in-differences to policy interventions in order to evaluate causality. Staggered difference-in-differences extends the baseline design, which has two periods and two groups, to a setting with multiple treatment periods and cohorts. Firms are considered treated upon the onset of first-time pri ownership, as the timing differs across firms, and treatment is not tied to any specific policy intervention but reflects investors' own volition to invest in a firm. This strategy does not eliminate the endogeneity of first-time PRI-ownership, nor does it establish engagement as the mechanism; it provides indicative evidence on whether green revenues were already trending upward before ownership began and how they evolve afterwards. The parallel-trends assumption is assessed through the pre-treatment coefficients and the comparison is conditional on the "not yet treated" group because the "never-treated" group in this panel is too small for comparisons (Callaway & Sant'Anna, 2021).

Results and Analysis

The descriptive statistics and the correlations tables are presented in Table 1.1 and Table 1.2 respectively.

The main results to test the baseline hypothesis are presented in Table 1.3. Across all models, the pri ownership variable (pri_top20) is significantly and positively associated with Green Revenue %. The main model (3) in the table suggests that after controlling for the time-variant financial capabilities of a firm, controlling for time-invariant firm characteristics through firm fixed effects and industry specific shocks in a particular year through industry-year fixed effects, the residual variation of pri ownership is positively and significantly associated with a company's GR%. In terms of economic significance, a 1-percentage point increase in PRI ownership in the top 20 is associated with a 0.0254 percentage point increase in firm's GR%. A 1-standard-deviation increase in PRI ownership (13.0 percentage points) is associated with a 0.33 percentage point increase in GR%. In dollar terms, evaluated at each firm's revenue in the estimation sample and holding revenue constant, a 1-percentage-point increase in PRI ownership is associated with about USD 0.23 million more green revenue for the median firm (USD 0.08 million at the 25th percentile and USD 0.76 million at the 75th), and a 1-standard-deviation increase with about USD 3.0 million for the median firm (95% confidence interval: USD 1.2 to 4.8 million). The amounts rise with firm size: the median 1-standard-deviation amount is USD 0.9 million in the smallest size tercile, USD 3.6 million in the middle tercile and USD 16.0 million in the largest. This result is consistent with the baseline hypothesis

(Hypothesis 1). This is further examined through extensive and intensive margins (Table 1.4) to understand the transition of a firm from zero to positive GR% - extensive margin, as presented in model (1), and conditional on a firm having positive GR%, the incremental growth of GR% associated with pri ownership – intensive margin, as presented in model (2). The results indicate that a 1-percentage point increase in pri ownership is associated with a 0.19 percentage point higher probability of a firm transitioning from zero to positive green revenue %. However, conditional on having a positive GR%, the association between pri ownership and GR% in the intensive margin is not statistically significant and no conclusions are drawn from this result.

Various variables were explored to test for mediation between pri ownership and firm's green revenue percent. Total capex is a coarse proxy for green spending, and changes in green capex and in GR% are likely to occur at the same time under investor pressure, so the test is uninformative about the mechanism. As a check, capex scaled to assets was also regressed on pri ownership lagged 3 to 10 years. The coefficients are close to zero and show no consistent pattern: they are negative and significant at lags 3 to 7, insignificant at lag 8, and positive and significant at the 5% level at lags 9 and 10, while the sample falls from 83,254 to 23,831 observations. GR% regressed on the same lags is not significantly associated with pri ownership, except weakly at lag 10 (10% level). These results are not tabulated and do not change the conclusion above. Also, due to a potential concern of omitted variable bias with regards to the debt capital, green bond data was considered for exploration. However, due to data limitations, the data for green bond for this panel is available only for the years 2022-2024, where the association of pri ownership with GR% in

this period was found to be insignificant. Owing to significant drop in firm-year observations, this variable was not pursued further. Similar data limitations were observed for shareholder proposals, green capex, research and development expenses. As the number of firm year observations dropped significantly for these variables, no further tests were conducted (exploratory tables are not presented in this document).

Alternative explanations: Investor strategies

Investor selection

To understand the endogenous investor selection strategy – responsible investors select firms that are already green is examined through reverse causality tests as presented in Table 1.5. After controlling for financial variables, with firm fixed effects and industry-year fixed effects, green revenues % lagged at (t-1) is used to examine its association with pri ownership, as in Model (2). GR% in previous year (t-1) is positively associated with pri ownership in the current year (t), consistent with responsible equity investors selecting firms that are already transitioning to green. Model (3) tests if the same effect can be observed in the unsplit total institutional ownership (total_io), and there is no comparable selection effect, which suggests that the selection of green firms is specific to responsible equity investors. Model (4) presents the reverse-causality examination proposed by (Godfrey et al., 2020), by purifying any previous GR% effect in the pri ownership variable as specified in the identification strategy. The evidence suggests that there is no significant association between unrelated pri ownership: PRI Top 20 (t-1) ownership purged of GR% (t-2) driven

component (as in equation 2 in identification strategy section), on GR%. Conditional on firm having a positive GR%, pri ownership and GR% are not significantly associated in either direction (not shown in the table).

First time PRI ownership

To follow up on the investor selection effects above, a staggered difference-in-differences test proposed by (Callaway & Sant'Anna, 2021) is applied to examine whether firms are already trending towards green in order to attract ownership from PRI signatories. A firm's receipt of PRI signatory equity ownership is endogenous to (a) investors' choice and (b) the timing of the investor's decision to become a PRI signatory. Although this test may not alleviate these endogeneity concerns, it can still examine whether firms signal to attract responsible investors for the first time, and whether the green transition trajectory changes upon onset. The evidence is presented in Graph 1.1 and Table 1.6. Treated firms are those that receive PRI equity ownership in any year during the panel years 2010-2024, starting with the year tp0; they remain treated for the rest of the post-period. The pre-period is tm (t-minus) and post-period (after treatment) is tp (t-plus)[5]. Firms without pre-treatment observations are excluded from the estimation[6]. The control group consists of firms that are not-yet-treated until they become treated at tp0 (receipt of ownership from a PRI signatory for the first time). This event study has

[5] Example: For a firm whose pri_top20 onset is in 2015(tp0) (g), it will be part of the control group until tm1 = 2014 and tm2 = 2013…so forth backwards until 2010, and part of treated group tp1: 2016, tp2:2017 and so forth forwards until tp9:2024. Tm13 and Tp13 represent the time horizon of the panel with staggered onset of the PRI ownership % for firms in different years with pre and post treatment.

[6] a firm that already has a pri ownership starting in 2010, start of the panel itself, which does not have a pre-trend to compare is dropped from this test. Or, if a firm is listed publicly in 2016 and has PRI ownership already at the time of this listing is also dropped from this test.

46,080 pair-balanced[7] observations. Control variables are not included in this test due to the severe drop in firm year observations. Firms are grouped into cohorts according to their first treatment year and compared with untreated firms in that year. The evidence indicates that following a firm's first time pri ownership, green revenue % rises gradually and the horizon-specific estimates are statistically significant from tp1 to tp7 (multi-year effect), after which they become imprecise although positive between tp8 to tp13. The average post-treatment effect (1.026, p=0.125) is not statistically significant, so the evidence rests on the horizon-specific estimates and not on a precisely estimated overall effect. The later horizons (tp8-tp13) are identified from fewer and earlier cohorts, which also have shorter pre-treatment histories. The pre-treatment coefficients are statistically indistinguishable from 0 (0.004, p = 0.924), which is consistent with parallel trends and suggests that firms were not on a visibly upward green path before receiving first time pri-ownership. These results do not support a firm signaling story based on pre-ownership green revenue growth and are less consistent with the selection effects presented in Table 1.5, but they do not rule these explanations out, because investors may select on information that is not visible in the green revenue trend. In other words, if a firm is trending towards green and is selected by the PRI signatory investor, then the pre-trends should ideally showcase a significant positive trend, which is not the case in Table 1.6 and Graph 1.1. One possible reading is that investors select firms based on their internal assessment, which may not always show green trends of the firm in process,

[7] Keeping the observations at both pre- and post-treatment reference periods so that same firms are observed for comparison in each year

and that the subsequent rise in green revenues could reflect engagement with the portfolio firm over a long horizon, which is not tested in this paper.

Investor engagement

To test if investors engage with the portfolio firms to help them transition to green, the same identification strategy as the baseline regression is applied with firm fixed effects and industry-year fixed effects. Institutional investors engage with portfolio firms regarding corporate policies and governance (Coffey & Fryxell, 1991). Investors observe lower portfolio risk when firms improve their environment policies (Krueger et al., 2020). To test this, environmental supply chain policy score is considered as a proxy. The LSEG Workspace provides this score when a firm has a policy to include its supply chain to minimize its overall negative environmental impact and reduce operational level emissions through supplier collaborations. The results are presented in Table 1.7. Evidence suggests that pri ownership lagged at (t-1) is not significantly associated with policy score (t) in model (1), but the lagged (t-2) variable is significantly and positively associated with policy score at (t) as in model (2). Also to note in these models (1) and (2), non-pri ownership has a significant negative relationship with policy score, which could suggest that traditional investors are less concerned with, or less likely to engage with firms on environment-specific policies. As the policy score is a noisy and indirect proxy for investor engagement, and a change in policy score may occur at the same time as changes in green capex and GR% under the same investor pressure, the results are read as descriptive associations.

Alternative explanations: Firm responses

Firms' sustainability scores

Firms may choose alternate strategies other than greening the commercial products or services aspect of transition. ESG scores are considered as an alternative strategy a firm might pursue with an increase in responsible investor holdings. Also, firms may not always be in a position to isolate green revenues if their transition focuses on internal operations such as emissions reduction in their operations. Such a transition may not show up in GR% but could be captured in ESG scores[8]. This test considers ESG scores as proxy for firms choosing to report on their greening activities and initiatives. These data are sourced from LSEG Workspace, which has an elaborate process to capture and calculate ESG scores (*ESG Scores and Data*, 2026). Results are presented in Table 1.8. A similar identification strategy as the baseline regression is applied with financial control variables, firm fixed effects, and industry-year fixed effects. Pri ownership (t-1) and (t-2) are positively and significantly associated with ESG scores (t), as in models (1) and (2). Similar to environmental policies, changes in ESG scores could occur at the same time as changes in GR% under the same investor pressure, the results are read as descriptive associations. Appendix Table C.4 tests for first differential to observe the association of change in pri ownership to change in GR% (models (1), (2)) and change in ESG scores (models (3), (4)). Change in pri ownership

[8] LSEG Workspace (https://www.lseg.com/en/data-analytics/sustainable-finance/sustainability-ratings-and-data) has introduced a new "ESG Score Plus" in 2026 that integrates risk and impact metrics alongside its existing ESG quality and performance scores. For this study, the existing ESG quality and performance scores are considered and not the ESG score plus

is positively associated with change in GR% and the results are statistically significant. However, this is not observed in the case of change in ESG scores.

Firms' greenness levels

In another signaling strategy, firms could improve their level of greenness. This is examined through the tier level GR% classification provided by LSEG Workspace through FTSE Russell Green Revenue Classification System. Based on LSEG Workspace's GRCS - Green Revenue tiering system (*Green Revenues Data Model | Data Analytics*, n.d.), the green revenues are classified into:

Tier 1 (greenest): significant and clear environmental benefits

Tier 2 (greener): limited but net positive environmental benefits

Tier 3 (green): some benefits but net neutral or negative impact

If firms provide data to claim easy or softer green revenues, then most of the pri ownership association could be concentrated in the Tier 3 GR%. The results in Table 1.9 suggest otherwise. Models (1), (2) and (3) have different dependent variables each for Tier 1, Tier 2, and Tier 3 GR% respectively. Evidence suggests that most of the association of pri ownership is with Tier 1 GR% (model (1)). Non-pri ownership is also positively and significantly associated with firm's tier 1 GR%. This suggests that the tier 1 GR% of the firm is not specific to pri signatories. Model (3) shows that pri ownership has a significant negative association with Tier 3 GR%. Pri ownership is positively associated with Tier 2 GR% with no significance, as in model (2). The evidence suggests that the pri ownership is associated with revenues that

deliver significant and clear environmental benefits (Tier 1 GR%). As a check on changes in tier levels, the year-on-year change in each tier's GR% was regressed on the change in pri ownership, with the same controls and firm and industry-year fixed effects. The change in pri ownership is not significantly associated with the change in Tier 1 (0.0034, p = 0.39), Tier 2 (0.0013, p = 0.66) or Tier 3 GR% (-0.0038, p = 0.32; 95,627 observations), so short-run changes do not show a shift towards Tier 3 and are consistent with the baseline pattern in which the association builds gradually over several years. These results are not tabulated.

Heterogeneity tests

Investor types

Active versus passive investing

Active and passive investors engage with the portfolio firms differently. Active investors directly engage with the management to decide whether to continue or exit their holdings based on performance, while passive investors, with low cost agenda and their inability to exit their position, leverage third party tools as an indirect engagement strategy for investment decisions (Appel et al., 2016; Flammer, 2015; Flammer et al., 2021; Institutional Investors and Stewardship, 2022). To test the heterogeneity, active top20 and passive top20 investor holdings[9] data are captured from FactSet Ownership. Active top20 ownership is the share of the combined holdings of the firm's top 20

[9] FactSet Ownership classifies each institutional investor by their investment style. Investors with holding style as "index" are classified as Passive. Investors with holding styles "Growth", "Aggressive Growth", "Deep Value", "Value", "GARP", "Yield" are classified as Active.

institutional investors that is held by active investors, and passive top20 ownership is the remaining share, so the two sum to 100%. The regressions are presented in Table 1.10. All three models are sample matched for non-missing active top 20 investor ownership. Model (1) – baseline for comparison, model (2) includes active top 20 at (t-1) and model (3) shows interaction. No separate active or passive pri ownership was constructed. The results are exploratory and should be read cautiously. The more detailed active and passive pri ownership could be one of the future research areas to understand the isolated effects of active and passive investing among responsible investors.

Pension funds and SWFs versus Mutual funds

This heterogeneity test enables the long-horizon view of the pension funds and SWFs versus the flexible mutual funds to examine how the effect of responsible investors in pension funds and SWFs compares with that of responsible mutual funds. Table 1.11 presents the results. The data for holdings, investors and investor types is provided by FactSet Ownership where the investor types for each institutional investor in top20 is flagged as 1 or 0 for each pension, SWF and mutual funds. The firm year observations for pension_swf_top20 are 102,440, pri_pension_swf_top20 are 33,869, mutualfund_top20 are 160,844 and pri_mutualfund_top20 are 122,414. In model (2) the top 20 institutional ownership having pension and SWF is included and in model (3) for top 20 mutual fund ownership. The results indicate that pension and SWF ownership have a significant relationship with firm's green revenue % ($p<5\%$ level), which is aligned with the long-term view of these funds and suggests that their associations are similar to those of

PRI signatory investors. PRI-specific pension and SWF ownership is not significantly associated with firm's GR% in model (4). But these results are to be treated cautiously given the low firm year observations (33,869) for this model. The results reverse for mutual funds when ownership is not restricted to PRI signatories, as in model (3), which may reflect the flexible investment horizons of mutual funds; when mutual fund ownership by PRI signatories is isolated, the association is positive and significant, as in model (5). Model (6), the full model, shows similar results.

Firm heterogeneity

Brown, Green and Neutral firms

Based on EU Taxonomy (*EU Taxonomy for Sustainable Activities - Finance - European Commission*, n.d.) for environmentally sustainable economic activities and EU extended taxonomy (*EU Taxonomy Regulation Extended across Economy | XBRL*, n.d.; European Union, 2022; Segal, 2022) the firms are classified into 6 specific categories through a stepwise procedure (additional details are provided in Appendix B): (1) Thomson Reuters Business Classification (TRBC) industry codes are mapped to EU taxonomy economic activities using the taxonomy's NACE alternate classification mapping (*EU Taxonomy Navigator*, n.d.) in reference to the EU extended taxonomy document; (2) for the activity codes that were left unclassified by step 1, specific classifications were generated with the AI search at the six-digit TRBC industry group, and every activity (ten-digit code) within this group for classification as neutral, light brown or dark brown; (3) based on the LSEG Workspace's TRBC (*Industry Classifications Data | LSEG*, n.d.), and

EU taxonomy, the Standard green, Enabling and Transitional industry group firms are classified as "green" firms; (4) Remaining industry groups are then classified to neutral, light brown and dark brown firms based on EU extended taxonomy and AI search as in step (2); (5) neutral firms continue to remain in the "neutral" category, and the light brown and dark brown industry groups are classified into "brown" firms. The detailed observations for each TRBC classification are provided in Appendix B. Table 1.12 presents the models for each of these firm level heterogeneity tests. The results indicate that the estimated effect of pri ownership in the top 20 institutional investors is larger for brown firms (especially light-brown firms, as observed in Appendix Table C.1 for detailed classification results).

Owing to limitations of the EU taxonomy classification, a few brown (light brown or dark brown) firms are observed to have more than 70% Green revenues. For example, Opal Fuels Inc and AleAnna Inc (having TRBC industry code 501020 and TRBC industry name "Oil & Gas") provide renewable natural gas have green revenue percentage > 70%. To address concerns associated with these high green revenue % in the high-emitting sectors, exclusion tests are conducted by dropping observations having GR% above 30%, 50%, and 70% in these sectors. In all the models for firms classified as brown through the EU taxonomy, pri ownership is observed to be significantly associated with green revenue % (Appendix Table C.2).

The classifications of "brown", "green" and "neutral" are also done through scope 1 and scope 2 emissions intensity (Hartzmark & Shue, 2022) especially during the panel period 2015-2024, because data on scope 1 and 2 emissions in LSEG Workspace are available only from 2015. In this test, none of the

models indicate a significant association between pri ownership and GR% (Appendix Table C.3).

Next, the relationship between GR% and the emissions trajectory are also examined. After excluding 2017 specific observations because of a data spike that appears to be a data provider discrepancy, the evidence suggests no association between pri ownership and emissions intensity, as in model (1). Emissions intensity has a near-zero association with GR%, as in model (2), and change in emissions intensity has a slightly significant negative association, close to zero, with change in GR% (model (3)). The observations are exploratory and inconclusive. Refer to Graph 1.2 and Appendix Table C.5 for the regression results.

Contributions

This paper contributes to the academic literature in many ways. First, this paper contributes to the literature on socially responsible equity investors and their association with firms' behavior towards green transition (Hartzmark & Shue, 2022; Heinkel et al., 2001; Klausmann et al., 2024). Second, the findings from this study add to the literature on green revenues as a tangible commercial green outcome by a firm in their pursuit of green transition (Bassen et al., 2023; Klausmann et al., 2024). Third, in addition to the short-term analysis in the literature for the baseline effect where responsible investors select firms having green revenues, this paper contributes to that research with evidence of flat pre-trends, that is, no significant green revenue trend before ownership, followed by a gradual growth of firm's green revenues over multiple years after the first-time responsible investor

ownership onset. These results are suggestive because investor selection into ownership cannot be ruled out. Fourth, the association is larger in brown firms (especially the light-brown firms) than in green and neutral firms when firms are classified using the EU taxonomy and TRBC map, which is aligned with the argument that responsible investing could matter more for brown firms than for green firms (Hartzmark & Shue, 2022). These results depend on the classification method, as these effects disappear in the sample period 2015-2024 when the classification is based on emission intensity terciles. Fifth, the findings from this study on pension funds having a significant positive association to firm's green revenues is aligned with the finding that pension funds with their long-term mindset have better environment and social performance (Dyck et al., 2019). Similarly, responsible mutual funds also show a significant positive association with GR%, consistent with the responsible mutual funds study (Riedl & Smeets, 2017). Lastly, it also contributes to the practical implementation of methods such as reverse causality tests proposed by (Godfrey et al., 2020) and staggered difference-in-differences methods with multiple time periods such as investor ownership for a firm (Callaway & Sant'Anna, 2021).

These contributions address the question of whether external pressure is associated with firms starting to change (the extensive margin). This paper contributes evidence on this question for investor pressure and green revenue percentage (firm's commercial aspect to green transition), with causal caveats noted above.

In terms of practical implications, green revenue % rises gradually after the onset of responsible investment rather than in the short term. This is

suggestive of, but does not demonstrate, engagement by responsible investors with firm's management. Given the six principles to which PRI signatories commit, investors could benefit from evaluating the progress of their portfolio firms over multiple years rather than in the short term. For asset owners, sustainability-specific stewardship mandates can be fulfilled by capturing long-term value from portfolio firms. For asset managers, the results help in understanding the resource allocation decisions in their investments. Brown firms may consider that transitioning to greener outcomes could help attract responsible investors, although the cost of capital effects are not tested. Regulators could include impact-driven metrics in their stewardship codes.

Limitations and Future Research

This study has several limitations. First, investor-level endogeneity remains a concern: (a) investors' voluntary participation in climate-specific initiatives, such as becoming a PRI signatory, and (b) responsible investors selecting firms that are already trending towards green. Future research could address investors' participation in initiatives, or their firm selection, exogenously. Second, there are method-level limitations: (a) the staggered difference-in-differences was estimated without controls because their inclusion caused the number of observations to drop, (b) exogenous shocks that could strengthen the staggered difference-in-differences (DiD) findings are not exploited, (c) the average post-treatment effect is not statistically significant and early cohorts have a thin pre-history, (d) the limitations of the Godfrey purification method for possible over-purging, (e) the classification dependence of the brown/green result. Third, the mechanism through which responsible investors are associated with higher GR% is not identified, because changes in green

capex, GR% and policy scores are likely to occur together under the same investor pressure; this area could be explored with other engagement measures.

Future research could extend the analysis to responsible debt instruments, because the firm-year observations with green bond score, amount or ratio were severely underpowered, as these data are available for this panel only for 2022, 2023 and 2024. A similar sample issue was observed with green capital expenditure data, which could be explored in future research by distinguishing debt- and equity-specific responsible investments.

Conclusions

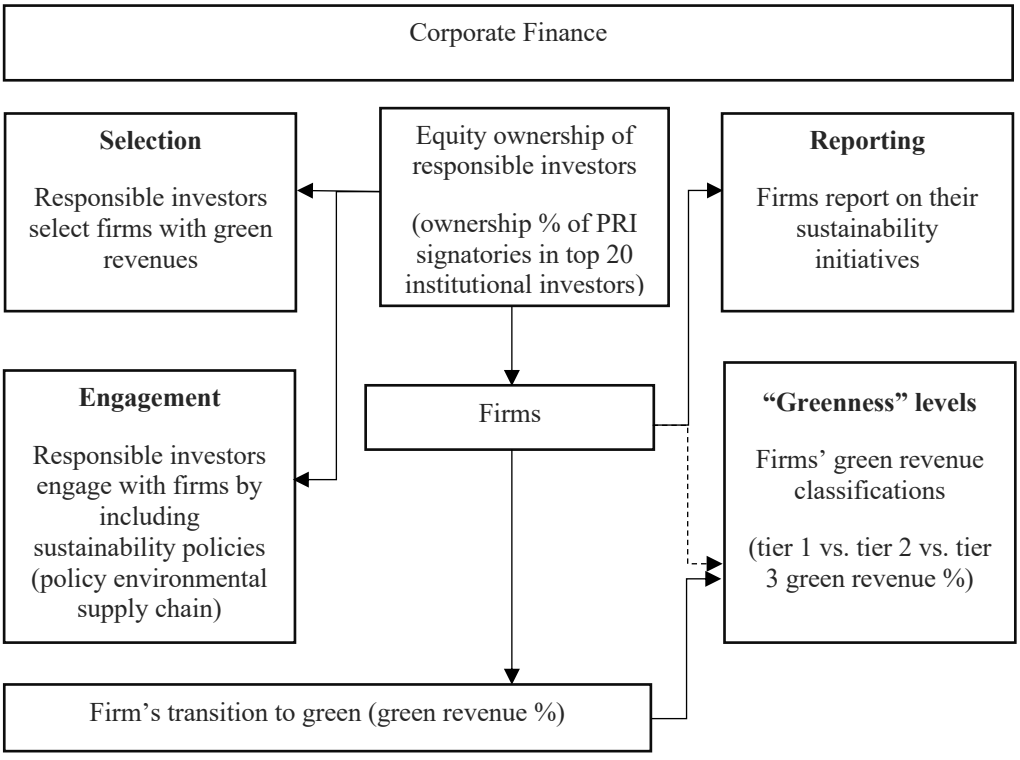
The main findings from this paper are two-fold: (a) the reverse causality checks suggest that the baseline association is consistent with responsible investors selecting firms that are trending towards green, and that incremental increases in pri ownership are not associated with significant short-term green revenue growth; and (b) if such selection were occurring, firms signaling to attract responsible investors could be a potential explanation, but the flat pre-trends in the staggered difference-in-differences design do not support this, although it cannot be ruled out. Firms show a gradual upward trend in green revenues only after first receiving responsible investor equity ownership, and this is concentrated in light-brown firms under the EU taxonomy and TRBC classification mapping (it is not found when firms are classified by emissions intensity). The average post-treatment effect is not statistically significant, and the gains are significant at specific horizons only. These results should be interpreted cautiously because investors' endogenous selection into becoming

a PRI signatory is not addressed, whether because the investor is already investing responsibly and anchors itself by becoming a signatory, or because reputational motives lead to become a signatory first and then invest in green firms.

For responsible equity investors, this finding suggests that greener revenue % rises over the long term after first-time investment in a firm, which is consistent with, but does not establish, the stewardship engagement and monitoring expected of a signatory. For sustainability teams within firms, these findings suggest that their actions may be reflected in tangible outcomes such as green revenue %.

Figures

Figure 1.1: Theoretical framework for equity ownership and firm's green revenues



Tables

Table 1.1: Descriptive statistics

Variables	N	Mean	SD	Min	p25	Median	p75	Max
Green Revenue %	188624	5.396	18.067	0	0	0	0	100
Green Revenue > 0	188624	.192	0.394	0	0	0	0	1
PRI Top-20 Ownership (t-1)	160000	11.061	12.995	0	1.347	6.104	16.166	98.152
Non-PRI Top-20 Ownership (t-1)	159993	13.147	13.707	0	2.751	8.653	19.215	100
Firm Size, Ln(Assets) (t-1)	167832	7.018	2.194	.002	5.735	7.002	8.355	15.656
Market-to-Book, Ln, Winsorized	164053	.142	1.100	-2.718	-.558	.094	.846	3.015
Leverage (t-1)	155325	.24	0.196	0	.074	.208	.361	.898
Return on Assets (t-1)	169453	.19	19.201	-115.08	.363	3.173	7.257	31.98
Dividend Payout Ratio, Winsorized	133574	36.343	33.005	0	9.602	29.985	53.267	117.647
Free Cash Flow/Assets (t-1)	167894	-.011	0.164	-.976	-.029	.016	.06	.271
Capex/Assets (t-1)	167912	.042	0.049	0	.008	.027	.057	.26
Total Institutional Ownership, (t-1)	159999	29.568	28.615	.011	6.896	19.03	44.959	100

Table 1.2: Correlations

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
(1) Green Revenue %	1.000								
(2) PRI Top-20 Ownership (t-1)	0.058***	1.000							
(3) Non-PRI Top-20 Ownership (t-1)	-0.032***	0.327***	1.000						
(4) Firm Size, Ln, (t-1)	0.057***	0.182***	-0.012***	1.000					
(5) Market-to-Book, Ln, (t-1)	-0.022***	0.075***	0.092***	-0.350***	1.000				
(6) Leverage (t-1)	0.062***	0.016***	0.023***	0.145***	-0.354***	1.000			
(7) Return on Assets (t-1)	0.006***	0.079***	-0.024***	0.328***	-0.010***	-0.110***	1.000		
(8) Dividend Payout Ratio (t-1)	0.022***	0.044***	-0.061***	0.091***	0.004	0.035***	-0.036***	1.000	
(9) Free Cash Flow/Assets (t-1)	-0.013***	0.131***	-0.006**	0.352***	-0.034***	-0.117***	0.769***	0.101***	1.000
*** p<0.01, ** p<0.05, * p<0.1									

Table 1.3: Baseline regression

Dependent variable: Green Revenue % (GR%); Independent variable: pri_top20: Investor ownership of PRI signatories in Top 20 Institutional investors. Models (1) represents pooled OLS without any fixed effects. Model (2) with firm and year fixed effects specification. Model (3) is the main specification for the baseline regression with firm and industry-year fixed effects. Panel period: 2010-2024. Firm year observations where GR % is > = 0. Model (4) is the test to find the results with total institutional ownership. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively. Standard errors are clustered at firm level and reported in parentheses.

Variable Labels	(1) (Pooled OLS)	(2) (Firm + Year FE)	(3) MAIN	(4) (Total IO-unsplit)
	Green Revenue %	Green Revenue %	Green Revenue %	Green Revenue %
PRI Top-20 Ownership (t-1)	0.117***	0.0213***	0.0254***	
	(0.0115)	(0.00821)	(0.00766)	
Non-PRI Top-20 Ownership (t-1)	-0.0809***	-0.000134	-0.00562	
	(0.00824)	(0.00710)	(0.00651)	
Firm Size, Ln(Assets) (t-1)	0.270***	-0.0330	0.161	0.176
	(0.0725)	(0.179)	(0.173)	(0.174)
Market-to-Book, Ln (t-1)	0.566***	0.481***	0.452***	0.471***
	(0.155)	(0.118)	(0.112)	(0.112)
Leverage (t-1)	7.475***	1.471**	1.883***	1.931***
	(0.817)	(0.579)	(0.551)	(0.551)
Return on Assets (t-1)	0.0457**	0.0109	0.0114	0.0117
	(0.0186)	(0.00911)	(0.00875)	(0.00875)
Dividend Payout Ratio (t-1)	0.00940**	0.00217	0.00343**	0.00360**
	(0.00387)	(0.00165)	(0.00150)	(0.00150)
Free Cash Flow/Assets (t-1)	-14.85***	-0.119	-1.023*	-1.053*
	(1.431)	(0.555)	(0.545)	(0.546)
Total Institutional ownership (t-1)				0.00548
				(0.00535)
Constant	1.574**	5.415***	3.838***	3.761***
	(0.622)	(1.352)	(1.302)	(1.301)
Observations	117385	116459	116297	116297
R-squared	0.018	0.852	0.874	0.874
Within R-squared		0.001	0.002	0.001
Firm	No	Yes	Yes	Yes
Year	No	Yes	No	No
Industry # Year	No	No	Yes	Yes

Table 1.4: Extensive/Intensive margins
Model (1) has the dependent variable as a binary to address the extensive margin, where a firm having GR%>0 is flagged as 1, else 0. Model (2) tests for intensive margin for the absolute GR% for observations conditional on having extensive margin flag 1 (where GR% > 0). *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively. Standard errors are clustered at firm level and reported in parentheses.

	(1) Extensive margin	(2) Intensive margin
	Green Revenue Flag (0 or 1)	Green Revenue %
PRI Top-20 Ownership (t-1)	0.00186*** (0.000210)	0.0350 (0.0217)
Non-PRI Top-20 Ownership (t-1)	-0.000140 (0.000164)	0.00572 (0.0207)
Firm Size, Ln(Assets) (t-1)	-0.00504 (0.00373)	0.787 (0.610)
Market-to-Book, Ln (t-1)	0.00553** (0.00257)	0.143 (0.305)
Leverage (t-1)	0.0339** (0.0140)	2.209 (2.132)
Return on Assets (t-1)	0.000235 (0.000195)	0.0192 (0.0308)
Dividend Payout Ratio (t-1)	0.0000824** (0.0000384)	0.000119 (0.00385)
Free Cash Flow/Assets (t-1)	-0.0642*** (0.0127)	2.435 (1.728)
Constant	0.241*** (0.0280)	18.02*** (4.861)
Observations	116297	26645
R-squared	0.825	0.941
Within R-squared	0.004	0.002
Firm FE	Yes	Yes
Industry # Year FE	Yes	Yes

Table 1.5: Investor selection

Investors select firms that are already trending towards green transition. Model (1) is the baseline effect of pri ownership on GR% for comparison. Model (2): GR% is lagged at (t-1) and the dependent variable is pri_top20 at (t). Model (3) is the placebo test for GR% lagged at (t-1) and its effect on total institutional ownership. Model (4) presents Godfrey purification test (Godfrey et al., 2020) where unrelated pri ownership is tested for an effect on GR%. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively. Standard errors are clustered at firm level and reported in parentheses.

	(1) Baseline	(2) Reverse Causality	(3) Placebo	(4) Godfrey purification
	Green Revenue %	PRI Top-20 Ownership	Total IO	Green Revenue %
PRI Top-20 Ownership (t-1)	0.0254*** (0.00766)			
Non-PRI Top-20 Ownership (t-1)	-0.00562 (0.00651)			-0.0142** (0.00695)
PRI Top-20 (t-1), purged of GR% (t-2) driven component (unrelated pri)				0.00261 (0.00781)
Green Revenue % (t-1)		0.0116*** (0.00429)	0.00273 (0.00599)	
Firm Size, Ln(Assets) (t-1)	0.161 (0.173)	1.187*** (0.105)	2.335*** (0.164)	0.192 (0.181)
Market-to-Book, Ln (t-1)	0.452*** (0.112)	1.491*** (0.0747)	3.310*** (0.116)	0.529*** (0.118)
Leverage (t-1)	1.883*** (0.551)	1.262*** (0.431)	-0.555 (0.605)	1.968*** (0.573)
Return on Assets (t-1)	0.0114 (0.00875)	0.0148** (0.00660)	0.0205** (0.00971)	0.00565 (0.00896)
Dividend Payout Ratio (t-1)	0.00343** (0.00150)	0.00499*** (0.00114)	0.000188 (0.00149)	0.00345** (0.00152)
Free Cash Flow/Assets (t-1)	-1.023* (0.545)	-1.827*** (0.377)	-3.101*** (0.581)	-0.825 (0.573)
Constant	3.838*** (1.302)	2.181*** (0.790)	11.73*** (1.240)	4.131*** (1.376)
Observations	116297	116840	116840	106675
R-squared	0.874	0.858	0.944	0.881
Within R-squared	0.002	0.017	0.042	0.001
Firm FE	Yes	Yes	Yes	Yes
Industry # Year FE	Yes	Yes	Yes	Yes

Table 1.6: Staggered Difference-in-Differences
(Callaway & Sant'Anna, 2021) with first time onset of PRI ownership effect on GR%. Panel A highlights the aggregate average treatment effect on the treated and Panel B shows the effect for each period before, represented as t-minus (tm1, tm2..tm13) and period after the treatment, represented as t-plus (tp1, tp2..,tp13) representative of the panel 2010-2024 for this study. Tp0 is the onset year where a firm receives first time equity ownership from PRI signatories. 46,080 pair-balanced observations. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

Panel A				
Aggregate	**Coefficient**	**S.E**	**p-value**	**95% CI**
Pre-treatment average (Pre_avg)	0.004	0.039	0.924	[-0.072, 0.080]
Post-treatment average (Post_avg)	1.026	0.668	0.125	[-0.285, 2.336]

Panel B				
Period	**coefficient**	**se**	**p-value**	**95%CI**
Tm13	0.01	0.008	0.179	[-0.005, 0.025]
Tm12	-0.055	0.083	0.51	[-0.218, 0.108]
Tm11	0.016	0.021	0.435	[-0.025, 0.057]
Tm10	-0.291	0.268	0.278	[-0.817, 0.235]
Tm9	-0.195*	0.104	0.061	[-0.399, 0.009]
Tm8	-0.009	0.125	0.941	[-0.254, 0.235]
Tm7	0.117	0.282	0.677	[-0.435, 0.669]
Tm6	0.067	0.218	0.758	[-0.361, 0.496]
Tm5	0.066	0.197	0.737	[-0.319, 0.451]
Tm4	-0.27	0.167	0.105	[-0.597, 0.057]
Tm3	0.161	0.13	0.217	[-0.095, 0.417]
Tm2	0.092	0.133	0.49	[-0.169, 0.353]
Tm1	0.338*	0.179	0.058	[-0.012, 0.688]
Tp0	0.126	0.111	0.256	[-0.092, 0.344]
Tp1	0.389**	0.189	0.04	[0.018, 0.759]
Tp2	0.782***	0.253	0.002	[0.285, 1.279]
Tp3	0.92***	0.324	0.005	[0.285, 1.554]
Tp4	0.814**	0.378	0.031	[0.074, 1.555]
Tp5	1.132**	0.45	0.012	[0.251, 2.013]
Tp6	1.292**	0.519	0.013	[0.275, 2.309]
Tp7	1.415**	0.618	0.022	[0.204, 2.625]
Tp8	1.354*	0.782	0.083	[-0.179, 2.887]
Tp9	1.395	0.993	0.16	[-0.550, 3.340]
Tp10	1.321	1.172	0.26	[-0.976, 3.617]
Tp11	1.389	1.307	0.288	[-1.173, 3.951]
Tp12	0.763	1.504	0.612	[-2.185, 3.712]
Tp13	1.264	1.936	0.514	[-2.530, 5.058]

Table 1.7: Investor engagement
The dependent variable policy score is policy environmental supply chain score from LSEG Workspace database. Model (1) pri ownership lagged at (t-1) has no significant effect on policy score, but the lagged (t-2) variable has a significant positive effect on policy score as in model (2). Also to note in these models (1) and (2), the non-pri ownership has a significant negative relationship with policy score. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively. Standard errors are clustered at firm level and reported in parentheses.

	(1)	(2)
	Policy Score (t)	Policy Score (t)
PRI Top-20 Ownership (t-1)	0.0238 (0.0316)	
Non-PRI Top-20 Ownership (t-1)	-0.100*** (0.0298)	-0.112*** (0.0288)
PRI Top-20 Ownership (t-2)		0.0571** (0.0291)
Firm Size, Ln(Assets) (t-1)	6.451*** (0.727)	6.561*** (0.762)
Market-to-Book, Ln (t-1)	-1.989*** (0.495)	-1.823*** (0.504)
Leverage (t-1)	-7.872*** (2.667)	-8.300*** (2.758)
Return on Assets (t-1)	0.0433 (0.0371)	0.0308 (0.0376)
Dividend Payout Ratio (t-1)	0.0183*** (0.00634)	0.0187*** (0.00640)
Free Cash Flow/Assets (t-1)	9.591*** (2.714)	8.780*** (2.773)
Constant	-11.76* (6.291)	-12.36* (6.555)
Observations	55881	52651
R-squared	0.721	0.728
Within R-squared	0.010	0.010
Firm FE	Yes	Yes
Industry # Year FE	Yes	Yes

Table 1.8: Firms report
The dependent variable is ESG score. Model (1) indicates a positive and significant effect of pri ownership (t-1) on ESG scores. Model (2) considers pri ownership lagged at (t-2). *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively. Standard errors are clustered at firm level and reported in parentheses.

	(1) PRI (t-1)	(2) PRI (t-2)
	ESG Score	ESG Score
PRI Top-20 Ownership (t-1)	0.0351***	
	(0.0120)	
PRI Top-20 Ownership (t-2)		0.0243**
		(0.0112)
Non-PRI Top-20 Ownership (t-1)	-0.0144	-0.0322***
	(0.0112)	(0.0105)
Firm Size, Ln(Assets) (t-1)	4.989***	4.959***
	(0.293)	(0.303)
Market-to-Book, Ln (t-1)	-0.239	-0.101
	(0.192)	(0.196)
Leverage (t-1)	-2.214**	-2.106**
	(1.010)	(1.037)
Return on Assets (t-1)	0.00272	-0.00567
	(0.0146)	(0.0148)
Dividend Payout Ratio (t-1)	0.0123***	0.0121***
	(0.00242)	(0.00242)
Free Cash Flow/Assets (t-1)	4.787***	4.691***
	(1.120)	(1.147)
Constant	5.436**	6.536**
	(2.536)	(2.611)
Observations	57039	53409
R-squared	0.876	0.881
Within R-squared	0.031	0.029
Firm FE	Yes	Yes
Industry # Year FE	Yes	Yes

Table 1.9: Firm greenness levels
Models (1), (2) and (3) have different dependent variables. Based on LSEG Workspace's GRCS - Green Revenue tiering system, the green revenues are classified as: Tier 1 (greenest): significant and clear environmental benefits Tier 2 (greener): limited but net positive environmental benefits Tier 3 (green but net neutral/negative): some benefits but net neutral or negative impact. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively. Standard errors are clustered at firm level and reported in parentheses.

	(1)	(2)	(3)
	Tier 1 (greenest)	Tier 2 (greener)	Tier 3 (net neutral/negative)
PRI Top-20 Ownership (t-1)	0.00656**	-0.00127	-0.00329*
	(0.00324)	(0.00365)	(0.00171)
Non-PRI Top-20 Ownership (t-1)	0.00603**	-0.00134	-0.00209
	(0.00263)	(0.00301)	(0.00161)
Firm Size, Ln(Assets) (t-1)	0.226**	-0.0757	0.0885**
	(0.0964)	(0.0679)	(0.0400)
Market-to-Book, Ln (t-1)	0.333***	0.128***	0.0665***
	(0.0735)	(0.0435)	(0.0231)
Leverage (t-1)	1.299***	0.0621	0.156
	(0.310)	(0.242)	(0.105)
Return on Assets (t-1)	-0.00599	-0.00934**	0.00851***
	(0.00469)	(0.00392)	(0.00310)
Dividend Payout Ratio (t-1)	-0.00108	0.00174**	0.000495
	(0.000684)	(0.000814)	(0.000322)
Free Cash Flow/Assets (t-1)	-0.267	0.208	-0.0800
	(0.398)	(0.226)	(0.0938)
Constant	1.238*	2.318***	-0.341
	(0.751)	(0.490)	(0.307)
Observations	98187	98187	98187
R-squared	0.935	0.897	0.914
Within R-squared	0.002	0.001	0.001
Firm FE	Yes	Yes	Yes
Industry # Year FE	Yes	Yes	Yes

Table 1.10: Active versus passive investing
This test checks if pri ownership gets amplified or attenuated by the rest of top20 investor ownership. For this test, only top20 active ownership is considered because passive top20 is complement of this variable. All the 3 models are sample matched for non-missing active top 20 investor ownership. Model (1) – baseline for comparison, model (2) includes active top 20 at (t-1) and model (3) shows interaction. No separate active or passive pri ownership was constructed. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively. Standard errors are clustered at firm level and reported in parentheses.

	(1) Baseline	(2) +Active IO (t-1)	(3) PRI ## Active IO
	Green Revenue %	Green Revenue %	Green Revenue %
PRI Top-20 Ownership (t-1)	0.0247***	0.0252***	0.0214***
	(0.00768)	(0.00769)	(0.00749)
Non-PRI Top-20 Ownership (t-1)	-0.00638	-0.00557	-0.00294
	(0.00660)	(0.00669)	(0.00677)
Active Top-20 IO % (t-1), mean-centered		-0.00586	-0.00123
		(0.00586)	(0.00618)
PRI Top-20 Ownership (t-1) # Active Top-20 IO % (t-1), mean-centered			-0.000780*
			(0.000426)
Firm Size, Ln(Assets) (t-1)	0.164	0.156	0.161
	(0.174)	(0.175)	(0.175)
Market-to-Book, Ln (t-1)	0.456***	0.449***	0.443***
	(0.112)	(0.112)	(0.112)
Leverage (t-1)	1.892***	1.893***	1.878***
	(0.556)	(0.556)	(0.556)
Return on Assets (t-1)	0.0105	0.0108	0.0107
	(0.00878)	(0.00878)	(0.00878)
Dividend Payout Ratio (t-1)	0.00329**	0.00327**	0.00322**
	(0.00149)	(0.00149)	(0.00149)
10. Free Cash Flow/Assets (t-1)	-0.966*	-0.957*	-0.940*
	(0.549)	(0.549)	(0.549)
Constant	3.852***	3.895***	3.832***
	(1.316)	(1.320)	(1.319)
Observations	115872	115872	115872
R-squared	0.874	0.874	0.874
Within R-squared	0.002	0.002	0.002
Firm FE	Yes	Yes	Yes
Industry # Year FE	Yes	Yes	Yes

Table 1.11: Pension funds and SWFs versus Mutual funds
Sample-matched observations across all models. Model (1) is baseline comparison. Model (2) includes the pension funds and SWFs together in the top20 investor ownership. Model (3) includes mutual fund type investors only. Model (4) pri investor ownership amongst pension and SWFs. Model (5) pri investor ownership amongst mutual funds. Model (6) include both pri pension and SWF along with pri mutual funds. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively. Standard errors are clustered at firm level and reported in parentheses.

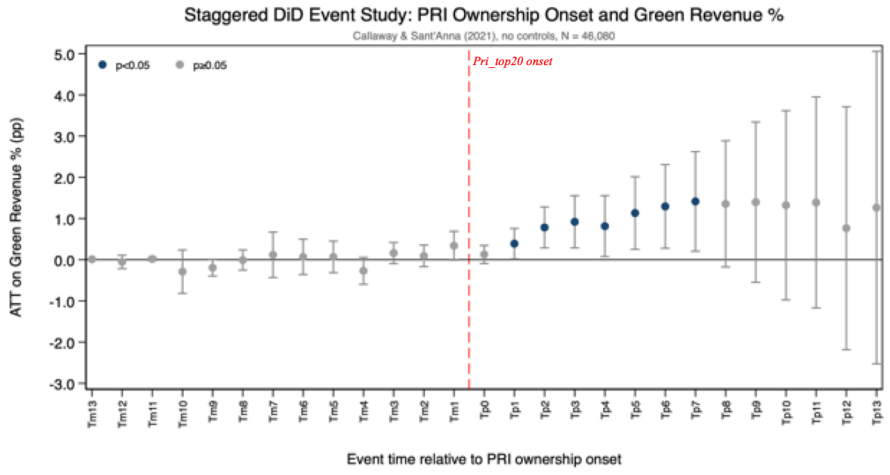
	(1) Baseline	(2) No split pension + SWF investor types	(3) No split Mutual fund	(4) PRI Pension+ SWF only	(5) PRI Mutual Fund only	(6) PRI Pension+ SWF+MF
	Green Revenue %	Green Revenue %	Green Revenue %	Green Revenue %	Green Revenue %	Green Revenue %
PRI Top-20 Ownership (t-1)	0.0254***					
	(0.00766)					
pension_swf_top20 (t-1)		0.0601**				
		(0.0263)				
mutualfund_top20 (t-1)			0.0212			
			(0.0134)			
PRI Ownership via Pension/SWF, Top-20 (t-1)				0.0457		0.0472
				(0.0553)		(0.0553)
PRI Ownership via Mutual Fund, Top-20 (t-1)					0.0559***	0.0560***
					(0.0130)	(0.0130)
Non-PRI Top-20 Ownership (t-1)	-0.00562	-0.0158**	-0.0140**	-0.0125**	-0.00585	-0.00575
	(0.00651)	(0.00631)	(0.00619)	(0.00618)	(0.00638)	(0.00638)
Firm Size, Ln(Assets) (t-1)	0.161	0.169	0.184	0.190	0.179	0.176
	(0.173)	(0.173)	(0.172)	(0.172)	(0.172)	(0.172)
Market-to-Book, Ln (t-1)	0.452***	0.493***	0.483***	0.498***	0.466***	0.465***
	(0.112)	(0.111)	(0.111)	(0.111)	(0.111)	(0.111)
Leverage (t-1)	1.883***	1.914***	1.890***	1.909***	1.845***	1.846***
	(0.551)	(0.552)	(0.552)	(0.552)	(0.551)	(0.551)
Return on Assets (t-1)	0.0114	0.0116	0.0116	0.0115	0.0123	0.0124
	(0.00875)	(0.00875)	(0.00875)	(0.00875)	(0.00875)	(0.00876)
Dividend Payout Ratio (t-1)	0.00343**	0.00354**	0.00352**	0.00356**	0.00346**	0.00345**
	(0.00150)	(0.00149)	(0.00149)	(0.00149)	(0.00149)	(0.00149)
Free Cash Flow/Assets (t-1)	-1.023*	-1.125**	-1.102**	-1.114**	-1.070*	-1.068*
	(0.545)	(0.547)	(0.547)	(0.547)	(0.546)	(0.546)
Constant	3.838***	4.081***	3.934***	3.965***	3.846***	3.854***
	(1.302)	(1.304)	(1.303)	(1.302)	(1.302)	(1.302)
Observations	116297	116297	116297	116297	116297	116297
R-squared	0.874	0.874	0.874	0.874	0.874	0.874
Within R-squared	0.002	0.002	0.001	0.001	0.002	0.002
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Industry # Year FE	Yes	Yes	Yes	Yes	Yes	Yes

Table 1.12: Green, Neutral, and Brown firms
Based on EU taxonomy, model (1) represents firm year observations for green firms, model (2) for neutral firms and model (3) for brown firms. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively. Standard errors are clustered at firm level and reported in parentheses.

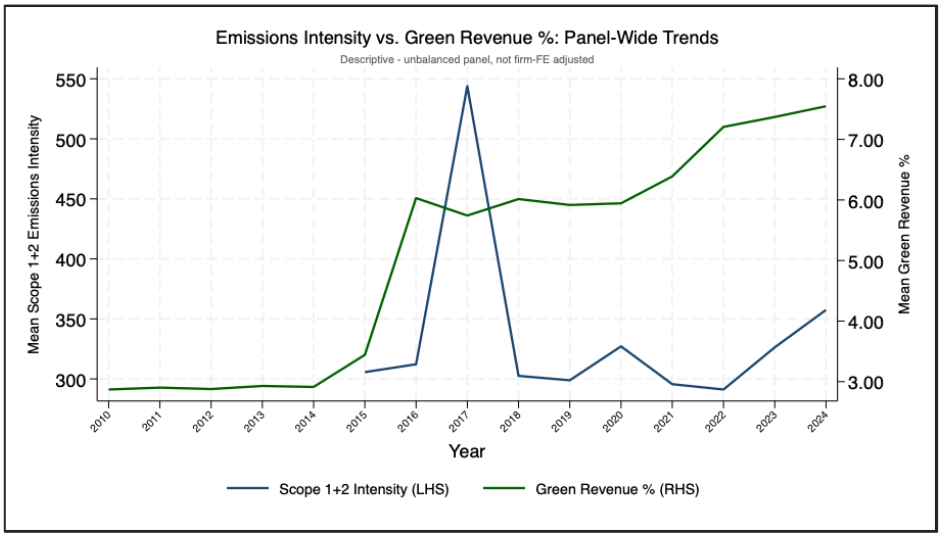
	(1) Green	(2) Neutral	(3) Brown
	Green Revenue %	Green Revenue %	Green Revenue %
PRI Top-20 Ownership (t-1)	0.0242* (0.0145)	0.0109** (0.00453)	0.0424** (0.0187)
Non-PRI Top-20 Ownership (t-1)	0.00778 (0.0114)	0.00187 (0.00434)	-0.0251 (0.0156)
Firm Size, Ln(Assets) (t-1)	-0.000670 (0.279)	-0.0847 (0.146)	0.531 (0.404)
Market-to-Book, Ln (t-1)	0.513** (0.252)	0.117* (0.0698)	0.710*** (0.232)
Leverage (t-1)	1.841* (1.097)	0.276 (0.377)	3.205*** (1.182)
Return on Assets (t-1)	-0.0246 (0.0177)	0.0115* (0.00635)	0.0388** (0.0197)
9. Dividend Payout Ratio (t-1)	0.00651* (0.00338)	0.00204* (0.00114)	0.00249 (0.00286)
Free Cash Flow/Assets (t-1)	0.647 (0.988)	0.235 (0.400)	-3.205*** (1.152)
Constant	6.187*** (2.101)	1.664 (1.124)	4.187 (2.975)
Observations	30397	42047	43794
R-squared	0.893	0.884	0.849
Within R-squared	0.002	0.001	0.004
Firm FE	Yes	Yes	Yes
Industry # Year FE	Yes	Yes	Yes

Graphs

Graph 1.1: First time onset of PRI equity ownership and its effect on GR% Panel period: 2010-2024. Not all firms receive treatment in a specific year; hence the onset year is considered as tp0 – given any year it would have received the ownership. Once received, it is considered as treated firm throughout the panel. Tm1 (T-minus 1) definition: for a firm whose pri_top20 (Tp0: T-plus 0) has an onset in 2015, tm1(T-minus 1) is 2014, tm2 (T-minus 2) is 2013, tm3 (t-minus 3) is 2012 and so on until 2010. That is why the pre-trends time period spans up to tm13 (t-minus 13). Tp1 (T-plus 1) definition: for the same firm with tp0 in 2015, tp1 (T-plus 1) is 2016, tp2 (T-plus 2) is 2017 and so on until 2024 (T-plus 9). Control firms are firms that have not yet received the treatment (pri ownership) inclusive of the never-treated firms.



Graph 1.2: Firm's GR% and emissions trajectory based on the data from LSEG Workspace for this panel between 2010-2024.The CY2017 shows a spike in LSEG Workspace which could be an outlier.



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Appendices

Appendix A: Variable Definitions

Variable	Label	Definition / Construction	Data source
company_gr_pct	Green Revenue %	Company green revenue percentage Reported or estimated green revenue as a proportion of total revenue. 0 - 100%	LSEG Workspace
pri_top20	PRI Top-20 Ownership	Equity ownership of responsible investors Cumulative equity ownership percent of PRI signatories in the top 20 institutional investors. 0-100%	FACTSET, UNPRI Signatory Directory
non_pri_top20	Non-PRI Top-20 Ownership	Equity ownership of conventional investors total_top20 - pri_top20	FACTSET
ln_assets	Firm Size	Firm Size Logarithm of total assets	FACTSET, LSEG Workspace
ln_mtb	Market-to-Book	Market-to-Book Logarithm of market to book ratio	LSEG Workspace
w_leverage	Leverage	Leverage calculated as total debt / total assets; winsorized 1,99%.	LSEG Workspace
w_roa	Return on Assets	roa Return on assets; winsorized 1,99%.	LSEG Workspace
w_dpr5	Dividend Payout Ratio	dpr dividend payout ratio; winsorized 5,95%.	LSEG Workspace
w_fcf_assets	Free Cash Flow/Assets	Free cash flow available for re-investments scaled to assets; winsorized 1,99%	LSEG Workspace
total_io	Total Institutional Ownership	Total Investor Ownership Total IO for a firm winsorizing by 1,99%	FACTSET
active_iopct	Active Investor Ownership	FactSet defines Active ownership based on the investors' holding styles "Growth", "Aggressive Growth", "Deep Value", "Value", "GARP", "Yield".	FACTSET
passive_iopct	Passive Investor Ownership	FactSet defines Passive ownership from the investors whose holding style is "index"	FACTSET

Appendix B: EU taxonomy-based industry (TRBC) classification

Classification procedure:
A step-by-step approach is taken to classify TRBC industries into green, neutral and brown.
Step 1 – Based on EU Taxonomy and NACE alternate classification[10] (*EU Taxonomy for Sustainable Activities - European Commission*, n.d.; *EU Taxonomy Navigator*, n.d.), the activity codes that are referenced to 10-digit TRBC activity codes are mapped to different levels of greenness suggested in the document and excel file shared on their portal (for example: TRBC code 5330101011 maps to *Hotels & Entertainment Services* industry group in TRBC maps to the NACE activity *Hotels, holiday, camping grounds and similar accommodation* is left blank[11], which indicates *standard green* as per the EU taxonomy compass matrix.) The standard green, enabling green and transitional green are captured from this document first at the TRBC 10-digit activity level. EU extended taxonomy is also referenced for further clarity.
Step 2 – Residual codes: Remainder of 10-digit TRBC codes in the panel were then searched on AI (Gemini) at a six-digit level with a further 10-digit level TRBC codes. The prompts used were *"Based on EU taxonomy and EU extended taxonomy, could you provide the classification for TRBC industry group code 503010 and its relevant 10-digit activity codes based on the divergent scale of +3- standard green, +2 – Enabling, +1 – Transitional, 0 – Neutral, -1 – Light brown, -2 - Dark brown"*. The results produced were accordingly verified with reasoning and references provided to classify them into 0-Neutral, -1-Light brown, and -2 – Dark brown. This was done one by one at the industry group code level and further down to activity level.
Step 3 – Light Brown and Dark Brown firms were combined to "Brown" category; Standard green, enabling green and transitional green were combined to "Green" category; Neutral firms were kept as "Neutral" for main tests.

Table below provides the panel specific TRBC industry group code level classification observations. One observation belongs to only one specific industry and activity code as per LSEG TRBC database captured for this panel.

trbc_industry_group_code	trbc_industry_group_name	std_green_n	transition_green_n	enabling_green_n	neutral_n	light_brown_n	dark_brown_n	row_total
		0	0	0	973	0	0	973
501010	Coal	0	0	0	0	0	978	978
501020	Oil & Gas	0	0	0	0	0	4313	4313
501030	Oil & Gas Related Equipment and Services	0	0	0	0	0	2100	2100
502010	Renewable Energy	140	0	1032	50	0	0	1222
503010	Uranium	0	0	0	0	231	0	231
511010	Chemicals	0	0	0	0	7657	0	7657
512010	Metals & Mining	0	0	0	0	8935	0	8935
512020	Construction Materials	0	0	0	0	1965	0	1965
513010	Paper & Forest Products	0	0	0	0	992	0	992
513020	Containers & Packaging	0	0	0	0	1188	0	1188
521010	Aerospace & Defense	0	0	0	0	1521	0	1521
521020	Machinery, Tools, Heavy Vehicles, Trains & Ships	0	0	0	0	11766	0	11766
522010	Construction & Engineering	0	0	0	0	4524	0	4524

[10] NACE alternate classification, prepared by platform of sustainable finance and listed on the EU taxonomy portal, represents only an indicative mapping of select industry groups. This is not an official EU Commission document.
[11] The matrix is coded as "standard green" for blank, "enabling" for "enabling" and "transitional" for "transitional" entries in the source document table.

522020	Diversified Industrial Goods Wholesale	0	0	0	442	0	0	442
522030	Professional & Commercial Services	1394	349	656	2953	0	0	5352
524050	Freight & Logistics Services	0	0	0	0	2577	0	2577
524060	Passenger Transportation Services	0	0	0	0	1363	0	1363
524070	Transport Infrastructure	0	0	0	0	1400	0	1400
531010	Automobiles & Auto Parts	0	0	0	0	4993	0	4993
532020	Textiles & Apparel	0	0	0	0	3221	0	3221
532030	Homebuilding & Construction Supplies	0	0	0	0	2351	0	2351
532040	Household Goods	0	0	840	714	0	0	1554
532050	Leisure Products	0	0	331	536	0	0	867
533010	Hotels & Entertainment Services	715	81	338	3291	0	0	4425
533020	Media & Publishing	0	0	1839	2091	0	0	3930
534020	Diversified Retail	0	0	0	1565	0	0	1565
534030	Specialty Retailers	703	0	263	2595	0	0	3561
541010	Beverages	0	0	0	1583	0	0	1583
541020	Food & Tobacco	7	0	29	6350	0	0	6386
542010	Personal & Household Products & Services	102	0	46	1335	0	0	1483
543010	Food & Drug Retailing	0	0	0	2153	0	0	2153
544010	Consumer Goods Conglomerates	0	0	0	789	0	0	789
551010	Banking Services	428	153	0	11269	0	0	11850
551020	Investment Banking & Investment Services	0	0	0	5231	0	0	5231
553010	Insurance	0	0	1499	2007	0	0	3506
555010	Collective Investments	0	0	0	2419	0	0	2419
556010	Investment Holding Companies	0	0	0	849	0	0	849
561010	Healthcare Equipment & Supplies	0	0	0	4427	0	0	4427
561020	Healthcare Providers & Services	115	0	0	1924	0	0	2039
562010	Pharmaceuticals	6668	0	0	658	0	0	7326
562020	Biotechnology & Medical Research	2882	0	0	2550	0	0	5432
571010	Semiconductors & Semiconductor Equipment	0	0	4452	1219	0	0	5671
571020	Communications & Networking	0	0	237	1815	0	0	2052
571040	Electronic Equipment & Parts	0	0	2793	622	0	0	3415
571050	Office Equipment	30	0	0	462	0	0	492
571060	Computers, Phones & Household Electronics	0	50	0	2034	0	0	2084
571070	Integrated Hardware & Software	0	0	0	252	0	0	252
572010	Software & IT Services	0	8862	780	1393	0	0	11035

573010	Financial Technology (Fintech) & Infrastructure	0	34	0	869	0	0	903
574010	Telecommunications Services	0	0	1820	630	0	0	2450
591010	Electric Utilities & IPPs	0	0	0	0	0	3787	3787
591020	Natural Gas Utilities	0	0	0	0	0	882	882
591030	Water & Related Utilities	93	33	542	0	0	0	668
591040	Multiline Utilities	0	0	0	0	0	601	601
601010	Real Estate Operations	7238	0	0	0	0	0	7238
601020	Residential & Commercial REITs	4815	0	0	41	0	0	4856
631010	Miscellaneous Educational Service Providers	0	0	433	0	0	0	433
631020	Schools, Colleges & Universities	0	0	188	0	0	0	188
631030	Professional & Business Education	0	0	0	178	0	0	178

Appendix C: Additional tables

Table C.1: 6 categories of firms based on EU taxonomy
Model (1) is for the full sample – baseline regression. The Std. green (model (2)) firms indicate a positive insignificant effect of pri_top20 on Green Revenue %. The neutral and light brown firms indicate significant and positive effect of pri_top20 on Green Revenue %. (models (5) and (6)). The transition green (model (3)) and dark brown (model (7)) firms indicate a negative effect of pri_top20 on Green Revenue %, but the firm-year observations are low in both these categories. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively. Standard errors are clustered at firm level and reported in parentheses.

	(1) Full sample	(2) Std. green	(3) Transition	(4) Enabling	(5) Neutral	(6) Light brown	(7) Dark brown
	GR%	GR%	GR%	GR%	GR%	GR%	GR%
PRI Top-20 Ownership (t-1)	0.0254***	0.0313	-0.00320	0.0299	0.0109**	0.0600***	-0.0601
	(0.00766)	(0.0269)	(0.0103)	(0.0224)	(0.00453)	(0.0209)	(0.0403)
Non-PRI Top-20 Ownership (t-1)	-0.00562	0.00389	-0.00449	0.0183	0.00187	-0.0321*	0.0171
	(0.00651)	(0.0193)	(0.0108)	(0.0199)	(0.00434)	(0.0181)	(0.0276)
Firm Size, Ln(Assets) (t-1)	0.161	-0.528	0.113	0.631	-0.0847	0.256	1.739
	(0.173)	(0.378)	(0.365)	(0.590)	(0.146)	(0.424)	(1.135)
Market-to-Book, Ln(t-1)	0.452***	0.479*	-0.146	0.815	0.117*	0.562**	1.496**
	(0.112)	(0.277)	(0.274)	(0.573)	(0.0698)	(0.242)	(0.685)
Leverage (t-1)	1.883***	1.083	-0.291	3.581	0.276	4.039***	0.164
	(0.551)	(1.348)	(0.954)	(2.364)	(0.377)	(1.258)	(3.180)
Return on Assets (t-1)	0.0114	-0.0381	0.00588	-0.0226	0.0115*	0.0545**	-0.0246
	(0.00875)	(0.0261)	(0.0264)	(0.0339)	(0.00635)	(0.0221)	(0.0418)
Dividend Payout Ratio (t-1)	0.00343**	0.0131**	0.00695	-0.00280	0.00204*	0.00307	-0.000909
	(0.00150)	(0.00559)	(0.00512)	(0.00420)	(0.00114)	(0.00310)	(0.00725)
Free Cash Flow/Assets (t-1)	-1.023*	-0.351	0.381	2.167	0.235	-3.239***	-2.635
	(0.545)	(1.319)	(0.884)	(1.976)	(0.400)	(1.162)	(3.697)
Constant	3.838***	8.433***	1.699	5.465	1.664	5.135*	-0.528
	(1.302)	(2.818)	(2.705)	(4.401)	(1.124)	(3.062)	(9.152)
Observations	116297	14722	4353	11285	42047	36221	7573
R-squared	0.874	0.820	0.894	0.929	0.884	0.831	0.895
Within R-squared	0.002	0.003	0.002	0.004	0.001	0.005	0.007
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry # Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Table C.2: Exclusionary sensitivity analysis
Brown firms with GR% > 30%, GR%>50%, and GR%> 70%. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively. Standard errors are clustered at firm level and reported in parentheses.

	(1) Brown firms sample	(2) Excl. >30% cutoff	(3) Excl. >50% cutoff	(4) Excl. >70% cutoff
	GR%	GR%	GR%	GR%
PRI Top-20 Ownership (t-1)	0.0424**	0.0339***	0.0382**	0.0470**
	(0.0187)	(0.0120)	(0.0151)	(0.0188)
Non-PRI Top-20 Ownership (t-1)	-0.0251	-0.00569	-0.0126	-0.0231
	(0.0156)	(0.00911)	(0.0125)	(0.0158)
Firm Size, Ln(Assets) (t-1)	0.531	0.0354	0.510	0.685*
	(0.404)	(0.277)	(0.360)	(0.411)
Market-to-Book, Ln (t-1)	0.710***	0.636***	0.688***	0.730***
	(0.232)	(0.193)	(0.225)	(0.235)
Leverage (t-1)	3.205***	2.511***	2.911***	3.233***
	(1.182)	(0.844)	(1.077)	(1.191)
Return on Assets (t-1)	0.0388**	-0.00562	0.0246	0.0391**
	(0.0197)	(0.0120)	(0.0170)	(0.0197)
Dividend Payout Ratio (t-1)	0.00249	-0.000227	0.00173	0.00273
	(0.00286)	(0.00192)	(0.00233)	(0.00284)
Free Cash Flow/Assets (t-1)	-3.205***	-2.107***	-3.067***	-3.359***
	(1.152)	(0.691)	(1.071)	(1.170)
Constant	4.187	2.970	0.842	0.726
	(2.975)	(2.081)	(2.686)	(3.030)
Observations	43794	39587	41573	42594
R-squared	0.849	0.647	0.712	0.759
Within R-squared	0.004	0.004	0.004	0.004
Firm FE	Yes	Yes	Yes	Yes
Industry # Year FE	Yes	Yes	Yes	Yes

Table C.3: Emissions intensity based classification
Brown, neutral and green firms. The Green, Neutral and Brown classification in this table is based on emissions intensity – Scope 1 and Scope 2 intensity. The data, especially for models (2) – (5) are from 2015-2024 due to the emissions data availability starting from 2015 onwards. Model (1) panel (full sample) is based on the years 2010-2024. The firms are classified as Green, Neutral or Brown terciles based on their scope 1 and 2 intensities. The dummies are time invariant for firms through the panel. Models 2-4 are samples specific to the respective green, neutral and brown firms. Model 5 tests the interaction model. In which it can be observed that neutral firms' pri effect is 0.0241 percent points lower than the green firm's pri effect (0.00537-0.0241 = -0.0187). While the brown firms' pri effect is 0.028 pp higher than that of green firms. (0.00537 + 0.0280 = 0.0334). *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively. Standard errors are clustered at firm level and reported in parentheses.

	(1) Full sample	(2) Green	(3) Neutral	(4) Brown	(5) Interaction model
	GR%	GR%	GR%	GR%	GR%
PRI Top-20 Ownership (t-1)	0.0254***	0.00306	-0.00786	0.0215	0.00537
	(0.00766)	(0.00991)	(0.0163)	(0.0224)	(0.0101)
Non-PRI Top-20 Ownership (t-1)	-0.00562	0.00214	-0.00836	-0.00666	0.000459
	(0.00651)	(0.00766)	(0.0159)	(0.0181)	(0.00863)
Firm Size, Ln(Assets) (t-1)	0.161	-0.102	-0.364	0.886*	0.172
	(0.173)	(0.219)	(0.326)	(0.512)	(0.222)
Market-to-Book, Ln (t-1)	0.452***	0.0815	0.308	0.856***	0.417***
	(0.112)	(0.138)	(0.229)	(0.329)	(0.142)
Leverage (t-1)	1.883***	-1.321	2.012*	4.690***	1.936***
	(0.551)	(0.820)	(1.156)	(1.477)	(0.689)
Return on Assets (t-1)	0.0114	-0.00431	-0.0256	0.0573**	0.0167
	(0.00875)	(0.0187)	(0.0165)	(0.0227)	(0.0118)
Dividend Payout Ratio (t-1)	0.00343**	0.00293	0.00560*	0.00631	0.00494**
	(0.00150)	(0.00216)	(0.00331)	(0.00405)	(0.00197)
Free Cash Flow/Assets (t-1)	-1.023*	-0.114	-0.498	-2.631*	-1.003
	(0.545)	(1.211)	(1.338)	(1.425)	(0.829)
Green					0
					(.)
Neutral					0
					(.)
Brown					0
					(.)
Green # PRI Top-20 Ownership (t-1)					0
					(.)
Neutral # PRI Top-20 Ownership (t-1)					-0.0241
					(0.0176)
Brown # PRI Top-20 Ownership (t-1)					0.0280
					(0.0234)
Green # Non-PRI Top-20 Ownership (t-1)					0
					(.)
Neutral # Non-PRI Top-20 Ownership (t-1)					-0.00699
					(0.0176)
Brown # Non-PRI Top-20 Ownership (t-1)					-0.00521
					(0.0198)

Constant	3.838*** (1.302)	3.709** (1.888)	8.689*** (2.543)	1.644 (4.028)	4.418** (1.796)
Observations	116297	27363	25682	27701	81369
R-squared	0.874	0.875	0.865	0.887	0.879
Within R-squared	0.002	0.001	0.001	0.005	0.001
Firm FE	Yes	Yes	Yes	Yes	Yes
Industry # Year FE	Yes	Yes	Yes	Yes	Yes

Table C.4: First differential test pri ownership & GR%

Rate of change of pri ownership and its influence on rate of change of GR%, which is positive and significant as specified in models (1) and in model (2), where the change in non-pri ownership is included. However, this is not observed in the case of ESG scores (models (3) and (4)). *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively. Standard errors are clustered at firm level and reported in parentheses.

	(1)	(2)	(3)	(4)
	ΔGR%	**Δ**GR%	**Δ**ESG	**Δ**ESG
Δ PRI Top-20 Ownership (t-1)	0.0117*** (0.00395)	0.0116*** (0.00424)	0.00268 (0.00640)	-0.000333 (0.00695)
Firm Size, Ln(Assets) (t-1)	-0.0176 (0.0677)	-0.0178 (0.0677)	0.128 (0.134)	0.129 (0.134)
Market-to-Book, Ln (t-1)	0.118** (0.0486)	0.118** (0.0485)	0.305*** (0.104)	0.308*** (0.104)
Leverage (t-1)	0.562** (0.258)	0.562** (0.258)	0.138 (0.504)	0.143 (0.504)
Return on Assets (t-1)	-0.00495 (0.00493)	-0.00495 (0.00493)	0.0115 (0.00952)	0.0115 (0.00951)
Dividend Payout Ratio (t-1)	-0.000598 (0.000727)	-0.000598 (0.000727)	0.000239 (0.00147)	0.000262 (0.00148)
Free Cash Flow/Assets (t-1)	-0.645 (0.422)	-0.645 (0.422)	0.568 (0.821)	0.540 (0.822)
Δ Non-PRI Top-20 Ownership (t-1)		-0.000102 (0.00349)		-0.00762 (0.00651)
Constant	0.453 (0.507)	0.454 (0.507)	0.843 (1.164)	0.832 (1.164)
Observations	105361	105360	49458	49458
R-squared	0.187	0.187	0.209	0.209
Within R-squared	0.000	0.000	0.000	0.000
Firm FE	Yes	Yes	Yes	Yes
Industry # Year FE	Yes	Yes	Yes	Yes

Table C.5: Emissions trajectory Vs. GR%

Model (1) - Given the number of observations, the effect of pri on the emissions intensity is not significant and inconclusive. The negative effect may differ depending on the sample. Model (2) Dependent variable: GR%, Emissions intensity has an almost 0 effect on Green Revenues %. They may not be directly associated with each other. Model 3: Dependent variable is Change in GR% year -on -year. Change in emissions intensity has a slightly significant negative effect (~0) to the change in GR%, The observations are inconclusive. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively. Standard errors are clustered at firm level and reported in parentheses.

	(1)	(2)	(3)
	scope12_intensity	Green Revenue %	**Δ**Green Revenue %
PRI Top-20 Ownership (t-1)	-0.688 (1.135)	0.00102 (0.00839)	
Non-PRI Top-20 Ownership (t-1)	-0.335 (1.151)	-0.00234 (0.00885)	
Firm Size, Ln(Assets) (t-1)	-73.02 (46.89)	-0.182 (0.280)	-0.0106 (0.115)
Market-to-Book, Ln (t-1)	39.58 (79.74)	0.236 (0.146)	0.161** (0.0771)
Leverage (t-1)	341.1 (406.1)	0.535 (0.638)	0.642* (0.360)
Return on Assets (t-1)	-3.265 (3.039)	-0.00221 (0.0105)	-0.00507 (0.00644)
Dividend Payout Ratio (t-1)	0.399 (0.519)	0.00141 (0.00186)	-0.0000955 (0.00130)
Free Cash Flow/Assets (t-1)	-166.2 (236.1)	-0.347 (0.845)	0.347 (0.541)
Scope 1+2 Combined Emissions Intensity (t-1)		0.00000244 (0.00000177)	
Change in Scope 1+2 Emissions Intensity (t-1), first-differenced			-0.00000148* (0.000000835)
Constant	892.0** (359.4)	9.622*** (2.431)	0.218 (1.011)
Observations	47485	45140	37537
R-squared	0.212	0.955	0.290
Within R-squared	0.000	0.000	0.000
Firm FE	Yes	Yes	Yes
Industry # Year FE	Yes	Yes	Yes