Silencing the Green Engine: How Shareholder Voice Suppresses Innovation *

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Abstract

This paper sheds lights on the real effects of environmental shareholder proposals classified by large language model (LLM) approach. We find that environment-related shareholder proposals escalated to a public vote significantly suppresses corporate green innovation and impede firm value. Excessive support levels for such proposals weakens green patenting, while low support promotes that. We then analyze possible mechanisms for the decline, including dilution of environmental metrics in managerial incentives and heightened incidents following activism. Cross-sectional evidence suggests that the suppressive effect is concentrated among targets of disclosure-oriented proposals and firms with shorter innovation cycles, yet reverses for environmental laggards and during periods of heightened climate sentiment. This paper reveals that public ESG engagement can introduce critical frictions in the form of green underinvestment, highlighting the unintended consequences of interventions sourced from a multitasking agency problem.

Keywords: Environmental shareholder proposal, Green innovation, Large language model

JEL Classification: G34, M14, O31

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1 Introduction

When shareholders wield their democratic voice to demand environmental action, does corporate America listen and respond? And when it does, do firms genuinely move toward sustainability, or do they merely appease their constituencies? Under SEC Rule 14a-8, eligible shareholders can place a proposal in the firm's proxy materials unless the company obtains regulatory relief to exclude it from the ballot. [1] Environmental shareholder proposals have become a critical governance instrument through which investors exercise voice, monitor management, and coordinate collective action on climate change and other sustainability issues.

A priori, it is not obvious whether shareholder voice improve firms' long-run environmental investment, or if such public pressure distort managerial incentives in ways that undermine innovation. In agency research, shareholder pressure may correct managerial slack(Aguilera et al., 2008), shirking(Manso, 2011), or the pursuit of a quiet life(Bertrand and Mullainathan, 2003), thereby encouraging longer horizons and reducing underinvestment in socially valuable projects. Yet the opposing force is equally plausible as short-term pressures may induce managerial myopia and deter innovation. First, innovation is inherently long-horizon and does not always align with the scope of shareholder discontent. Because the benefits of intangible investments typically materialize only over extended horizons, these investments often conflict with near-term performance metrics such as earnings and stock prices (Edmans, 2009; He and Tian, 2013). Managers pressured to deliver immediate results may distort corporate innovation policies at the expense of long-term value creation (Brav et al., 2018). Second, radical innovation entails experimentation, a high probability of interim failure, and difficulty in measurement. As a result, when subjected to stronger external scrutiny and career concerns, managers may reduce their willingness to pursue uncertain projects, but rather respond to pressures with policies that can be easily decoupled (Bushee, 1998; Manso, 2011; Aghion et al., 2013; David et al., 2007). In addition to financial trade-offs, external interference can also trigger managerial "reactance," where executives perceive activism as a threat to their

1. See U.S. Securities and Exchange Commission, *Fact Sheet*, https://www.sec.gov/files/34-95267-fact-sheet.pdf.

strategic discretion and try to defend the status quo and neutralize the immediate challenges (David et al., 2007). Under these conditions, greater shareholder influence may paradoxically intensify managerial short-termism and thus exacerbate incentive misalignment.

This misalignment is arguably most severe in the context of environmental activism for three primary reasons. First, the scope and measurement of corporate environmental transitions lack clear consensus. The extent to which firms should internalize environmental externalities and how to evaluate their relevant performance remains subject to significant disagreement among stakeholders (Berg et al., 2022). Second, target firms may face severe attention and information-processing constraints. Overwhelmed by the high volume and complexity of competing shareholder demands, boards may default to heuristic-driven, suboptimal strategies rather than properly evaluating complex, long-horizon projects (Ocasio, 1997; Shapira et al., 2026). [2] Third, these agency frictions are compounded by a multitask incentive problem. When pressured by external accountability demands, managers find symbolic compliance strategically appealing while underinvesting in substantive green innovative projects that are risky, long-dated, and inherently difficult to contract upon ex ante (Hart, 2017). To appease external sentiment, managers may rationally prioritize immediate, highly observable actions, such as enhancing sustainability disclosures, at the expense of costly exploratory investments (Holmstrom and Milgrom, 1991; Meyer and Rowan, 1977; Westphal and Zajac, 1994, 1998).

Whether environmental shareholder pressure resolves managerial inertia or exacerbates defensive short-termism is therefore an open empirical question, and one with direct implications for the efficacy of ESG governance. This study aims to inform the debate by assessing how shareholder voice demanding environmental responsibility influences corporate innovation. We identify environmental (green) proposals from ISS shareholder proposal data using a large language model (LLM) built on ClimateBERT (Bingler et al., 2024). We fine-tune the model based on a human-labelled, stratified dataset drawn from its preliminary classifications. Because standard corporate proxy texts are

2. See Scarlett Brown, Conversation with Sir John Manzoni, *Board Intelligence*, https://www.boardintelligence.com/blog/in-conversation-with-sir-john-manzoni(last visited Feb. 22, 2026). "It's incredibly frustrating as a board member when you receive 1,200 pages to read over the weekend and, as a result, you can't see the wood for the trees. By the time you've got through all of that, you realise you're missing the big picture."

often brief, we augment the inputs with surrounding proposal- and firm-level contextual data to maximize classification accuracy. Consequently, our LLM-based approach captures 46.17% more environmental proposals relative to the traditional category-based taxonomy.

We specially focus on green proposals that advance to a shareholder vote for two reasons. First, a proposal reaching the ballot signals that private negotiation has failed to resolve the underlying disagreement, making the conflict between shareholders and management both public and adversarial. Second, the vote itself constitutes a credible, observable signal of shareholder discontent that carries reputational and governance consequences independent of the vote outcome.

To quantify the real effects of such adversarial agency friction, we focus on green innovation outcomes. This allows us to distinguish substantive technological progress from symbolic corporate actions or "cheap talk." While emission reductions can be achieved through static abatement activities, green innovation represents a forward-looking and risky commitment to addressing climate challenges and hedging against transition shocks.

Innovation entails long development horizons and a high tolerance for early failure, which often conflicts with the demands of investors possessing shorter investment horizons. If shareholder pressure induces managers to prioritize immediate compliance targets, such as emission reductions or ESG rating improvements, it may divert managerial attention and inadvertently crowd out the internal resources required for breakthrough technologies, such as skilled workforces and capital expenditures for long-term growth. Understanding the relationship between shareholder activism and green innovation is therefore essential to determine whether the public engagement strategies advance the green transition or merely encourage short-termism at the expense of long-term technological solutions.

We test our hypothesis on a panel of 7,530 firm-year observations, spanning 2,840 green proposals and 790 U.S. public firms during 2012–2023 period. Our baseline estimates indicate that green proposals advancing to a proxy vote are associated with a significant and persistent decline in subsequent green patenting. This contraction in patenting is economically meaningful: a one-standard-deviation increase in green proposals entering the voting stage is associated with a

decline in green patents of about 10% relative to the sample mean. The Wald tests confirm that this contraction in innovative activity is specifically driven by proposals that reach shareholder vote, rather than by settled or omitted proposals, which entail less public scrutiny and weaker adversarial pressure.

These findings are robust to a difference-in-differences framework with propensity matching, Heckman two-step selection models, and a battery of tests. Consistent with the innovation evidence, event study analyses reveal a negative stock market reaction to the voting of green proposals. This suggests that investors anticipate the costs associated with intensified governance conflict and environmental policy disputes, as well as the implications for firms' transition-related investment choices. This is consistent with the findings of iaz-RaineyDIAZ-RAINEY et al. (2024) that market responds negatively to ex-ante costlier proposals.

Beyond the *presence* of proposal voting, we examine whether the voting results redirect investments in innovative project. We document that patent value increase (decreases) as support levels fall into low (top) quartile of all green proposals. The points to a trade-off between engagement benefits and distortionary pressure, with excessive shareholder support undermining firms' capacity to undertake long-horizon green innovation. Besides, we find no evidence to support that the close-call passage of a green proposal affect innovation. These findings suggest that the intensity of shareholder discontent, rather than the formal governance outcome, serves as the primary signal through which excessive voting pressure suppresses corporate innovation.

We next provide evidence on two underlying mechanisms. First, we find that firms introduce fewer environment-linked metrics into executive compensation after green proposal voting. This pattern supports an incentive decoupling hypothesis: when environmental responsibility becomes politically contested, boards may weaken explicit environmental incentives to shield performance evaluation from managerial opportunism. Such misalignment can, in turn, dampen firms' innovation incentives. Second, we show that voted proposals serve as a leading indicator of negative environmental incidents. The resulting imminent reputational pressure and crisis-management demands increase the opportunity cost of managerial attention and effort devoted to long-horizon innovation.

Our cross-sectional analyses show that the suppressive effect is concentrated among firms with shorter innovation cycles and among targets of disclosure-oriented proposals, which are more likely to invite symbolic compliance. At the same time, green activism appears to stimulate innovation among environmental laggards and during periods of heightened climate concern. These patterns suggest that the effectiveness of shareholder intervention depends critically on both selection and timing: target firms may respond by innovating when they exhibit clear environmental deficiencies or face acute shifts in public sentiment. This echoes the findings of Dimson et al. (2015) and Barko et al. (2022) that ESG engagements are more likely to succeed or create value when the target firm retains larger headroom for improvement, possesses stronger implementation capacity, and exhibits greater reputational sensitivity. The moderating effect of ex ante environmental performance is also consistent with the view that environmental CSR is a resource with decreasing marginal returns Flammer (2013, 2015). We also examine the submission patterns and sponsoring shareholders behind green proposals. The results indicate that broad shareholder participation deters green innovation, whereas participation by professional institutional investors is associated with stronger innovation incentives.

Our findings inform the ongoing debate on the efficacy of ESG shareholder engagement, particularly through public mechanisms such as proxy proposals. As shareholder engagement is increasingly reckoned in addressing sustainability issues and outperform divestment strategies in eliciting meaningful real-world changes, a rich strand of literature highlights how private engagements redirect corporate sustainability policies (Dimson et al., 2015; Barko et al., 2022; Liang et al., 2025; Hoepner et al., 2024). However, behind-the-scenes negotiations suffer from limited observability and rely heavily on the salience of the engaged shareholders.

Besides pursuing private settlement, pro-environmental shareholder can publicly engage via initiating shareholder proposals. This provides a low-cost way for activists but risks generating ill-informed proposals to distract management time and energy Gantchev and Giannetti (2021). Moreover, shareholder proposals are commonly perceived advisory and symbolic by nature, and they are not legally binding for further implementation even when they garner majority support.

Thus, shareholder proposals are feasibly treated as the indicator of investor sentiment or demands of articulating discontent that management may address, but less likely to influence firm behaviors.

Even so, more research document that environmental shareholder proposals yield positive outcomes in terms of voluntary disclosure and environmental performance ratings (Chen et al., 2020; Flammer et al., 2021; Diaz-Rainey et al., 2024). The voice appears to discipline management to align with shareholder value and purpose pertinent to environmental responsibility. Such "correction" outcomes may immediately and explicitly signal firm's resolves in adapting green transitions, whereas they may fall short in tackling technology bottlenecks and achieving actionable targets. Our study hence advances this literature on ESG activism by quantifying the influence of shareholder voice on technological solutions to alleviate externalities in the long run.

Crucially, the extant literature has largely overlooked the costs associated with environmental activism. As mentioned before, while traditional perspectives presume green proposals are benign interventions or leave firm behaviors unaffected, we document significant unintended consequences. We attribute this gap in the literature to the tendency to treat all shareholder interventions as homogeneous events, which masks the escalation from private dialogue to a formal proxy vote (Krueger et al., 2020). By explicitly isolating the adversarial public phase of these disputes, we highlight that excessive external pressure inadvertently introduce frictions in the form of socially underinvestment, which could deviate firms from green technology advancement and objectives of long-term value creation. [3]

We argue that this social underinvestment stems from an attention-induced an attention-induced multitasking agency problem agency problem (Holmstrom and Milgrom, 1991). The sudden external scrutiny and accountability imposed by environmental activists severely strains managerial

3. Our results contrast with Tindall et al. (2025), who document that climate-related proposals promote relevant innovation. This divergence stems from fundamental differences in our research design and scope. First, our conceptual focus centers on the voted proposals to capture unresolved and adversarial activism, and distinguishing them from those withdrawn or omitted. Second, regarding proposal classification, we employ an LLM-based framework that parses rich contextual and semantic information, in contrast to their explicit keyword searches ("climate change") within DEF 14A filings. Third, our scope covers a broader universe of environment-related proposals and patents, rather than strictly climate-dedicated ones. Additionally, to address truncation biases, we adopt year-technology adjustments specifically within the green patent, whereas they control for year fixed effects alone due to sample limits. Together, these choices allow us to more cleanly identify how adversarial shareholder pressure shapes firms' green innovation incentives.

cognitive resources and agenda-setting capacity, while boards simultaneously face information fatigue in triaging competing shareholder demands and sustaining effective monitoring (Shapira et al., 2026). Under such pressure, shortsighted strategies with immediate and observable effects become strategically compelling substitutes for substantive action, raising the opportunity cost of the long-term, exploratory technology investments required to address fundamental environmental externalities.

Our study also also delineates boundary conditions of shareholder voices. We show that target firms exposed to voting pressures exhibit stronger innovation incentives when they have poor ex ante environmental performance and when environmental sentiment unexpectedly spikes, which implies the importance of the selection and timing of intervention. Finally, the tension surrounding CSR engagements underscores the necessity for better-calibrated and more carefully coordinated shareholder interventions to ensure that external monitoring catalyzes, rather than crowds out, long-term sustainable growth.

The remainder of the paper proceeds as follows. Section 2 describes the data, the LLM-based classification procedure, and the sample construction. Section 3 presents the baseline results. Section 4 addresses endogeneity and conducts robustness tests. Sections 5 and 6 examine underlying mechanisms and cross-sectional heterogeneity. Section 7 draws conclusion remarks.

2 Data and sample

2.1 Activism Data and LLM-based Text Classification

2.1.1 LLM-based text classification with context augmentation

We measure environmental activism through shareholder proposals, an essential mechanism of corporate democracy that enables shareholders to communicate with management and demand public accountability. We source shareholder proposal data of Russell 3000 firms from Institutional Shareholder Services (ISS). For each resolution, ISS provides granular information, including the annual meeting date, a summary of the proposal, proponent identities, voting requirements, and detailed voting outcomes (i.e., votes cast for, against, and abstaining).

To classify environmental proposals, we utilize a Large Language Model (LLM) framework based on ClimateBERT, developed by Bingler et al. (2024). ClimateBERT is pre-trained on a domain-specific corpus comprising climate-related research abstracts, corporate disclosures, and environmental news. This specialized pre-training ensures that the model possesses a rigorous semantic understanding of environmental terminology and institutional nuances before fine-tuning for our classification task.

Beyond a general understanding of climate domains, the LLM offers a advantage over dictionary-based methods (e.g., bag-of-words) by capturing specialized technical vernacular without the need for exhaustive keyword lists. The model can identify proposals based on technical acronyms and industry-specific identifiers. For instance, it correctly flags resolutions referencing "CA100+" (Climate Action 100+) and "HFCs" (hydrofluorocarbons, potent short-lived climate pollutants). This capability ensures that technical environmental proposals are captured even when they lack generic descriptors such as "pollution," "emissions," or "climate change."

Standard LLM classification relies on raw text, which in the ISS context is often laconic and semantically ambiguous. For example, a proposal requesting a report on "water risk management" may pertain to environmental water stress (a environmental issue) or the human right to water access (a social issue). To mitigate measurement errors from semantic ambiguities that confound traditional keyword-based or zero-shot classifications, we augment the model's input with proposal- and firm-level metadata. Specifically, our augmented contextual bundle incorporates four elements: (i) the text of the shareholder proposal resolution, (ii) the identity of the sponsor (e.g., individual, fund, public pension, labor union, or special-interest organization), (iii) the target firm's two-digit SIC industry classification, and (iv) a high-level agenda code capturing the proposal's general topical domain. Providing this bundle at inference time enables the Transformer attention mechanism to condition its classification on more economically relevant priors than those latent or omitted in the summary text.

To prevent *pre-training bias*, we also mask target firm and proponent names. Because LLMs embed extensive background knowledge regarding prominent firms, retaining specific corporate

identifiers may cause predictions to reflect pre-existing reputational associations rather than resolution substance. For example, highly scrutinized firms like ExxonMobil appear disproportionately in broad ESG training corpora. Without masking, the model might mechanically overfit to the firm's identity rather than evaluating the proposal's semantic context. Masking entity names forces the model to condition its classification strictly on the semantic content of the proxy material.

Our strategy also improves out-of-sample generalizability by helping the model learn fundamental economic relationships, such as the association between methane-related vocabulary and the energy sector. For instance, a resolution requesting a "Report on Tobacco Portrayals in Movies" from a firm in the communications industry might be misclassified as an environmental mandate by dictionary methods focusing on generic "Sustainable Development Goal (SDG)" keywords. However, by conditioning on the industrial context and the semantic relationship between "tobacco" and "media," our model accurately identifies the latter as a public health issue (SDG 3) rather than a climate risk (SDG 13). This context-aware approach significantly enhances the precision and discriminant validity of our classification across diverse governance settings.

To fine-tune the LLM for the shareholder proposal context, we use a dataset generated from stratified sampling and human supervision. We sample based on model confidence to avoid an unbalanced training set dominated by obvious non-environmental proposals, which provides little information for the model to learn decision boundaries. Specifically, we partition an initial run of the full sample into score-based quartiles and randomly draw 750 observations from each of the first two quartiles. This results in a training set of 1,500 "hard-to-classify" samples concentrated in the lower half of the score distribution.

We manually verify and correct these labels to maximize marginal information gain and improve the model's ability to distinguish between environmental and social mandates. The fine-tuning performance of the LLM is reported in Appendix Table A1. [4]

4. The fine-tuned model weights and training dataset used in this paper are available upon Hugging Face (https://huggingface.co/Jidi1997/ClimateBERT_GPROP_Detector).

2.1.2 Manual audit and revision

Despite their ability to capture semantic nuances beyond simple keyword matching, LLMs may still blur the boundaries between environmental, social, and governance (ESG) domains when terminology overlaps. Put different, encoder-only models are particularly prone to false positives when encountering such high-frequency "buzzwords" . For instance, the term "Neutrality" may refer to carbon neutrality in a climate context or net neutrality in a telecommunications governance context. Similarly, references to "Waste" may pertain to food waste (a social or humanitarian issue) or systemic environmental waste management.

Our fine-tuning process specifically aims to maximize discriminant validity by distinguishing strictly environmental mandates from social or governance interventions that utilize similar language. To ensure robustness, we perform targeted manual audits of proposals containing terms associated with systemic false positives. We specifically verify proposals containing terms prone to false positives, such as "Net neutrality," "Human right to water," "Food waste," and "Pig gestation."

We compare two supply chain proposals submitted to firms in the Food & Kindred Products industry to illustrate our model's discriminant validity.

Example 1 (Classified as Green): A proposal from an SRI fund requesting a report on "Supply Chain and Deforestation." The model correctly identifies this as an ecosystem and climate risk issue.

Example 2 (Classified as Non-Green): A proposal requesting a report on "Options to Minimize the Use of Neonics" (neonicotinoid insecticides).

Despite the scientific context, our framework recognizes the latter as a product safety and consumer health issue for a food supplier rather than a systemic climate risk. This approach prevents resolutions regarding public health or consumer safety from being misclassified as environmental category.

2.1.3 Classification results and stylized facts

The standard ISS taxonomy relies on a relatively broad categorization that lack the precision required to isolate environmental shareholder proposals. Relying strictly on the ISS "Environmental" tag

will capture only 1,943 proposals (10.16%), missing environmental resolutions filed under "E&S Blend". Conversely, including the entire E&S Blend" category inflates the count to 3,727 (19.49%), conflating environmental issues with broader social and governance content. Our LLM framework addresses these limitations by utilizing semantic nuances and augmented contextual inputs to identify 2,840 environmental proposals (14.85%), representing a 46.17% increase relative to the narrow ISS classification. Table A2 presents 10 validation examples from random sampling.

Figure 1 plots the evolution of green proposal volume and average voting support between 2012 and 2023. Green proposal frequency remained stable through 2020. The 2021 issuance of SEC Staff Legal Bulletin No. 14L (SLB 14L) narrowed the scope for such exclusions, particularly for resolutions addressing significant social policy matters. This regulatory shift prompted a surge in green proposals to approximately 200 in the 2022 and 2023 seasons, accompanied by a contraction in omissions and a rise in proposals reaching the ballot.

Despite the surge in volume, average shareholder support experienced a reversal. Voting support climbed to a peak of approximately 40% in 2021 before declining sharply to roughly 20% following the issuance of SLB 14L. Consistent with recent findings by Khoo and Tallarita (2024) and Matsusaka et al. (2025), proposals admitted under these relaxed standards are substantially more prescriptive. In the climate domain, resolutions have shifted from merely requesting risk disclosures to mandating specific emissions-reduction strategies and operational targets. In sum, while regulatory easing expands ballot access for green proposals, it also facilitates the entry of marginal ones that lack broad investor consensus and encroach on managerial discretion.

2.2 Innovation data and truncation bias adjustment

We proxy corporate green innovation using green patents, which provide a readily observable measure of innovation output. We obtain patent data from the extended database of Kogan et al. (2017) (hereafter KPSS). Following recent literature (Cohen et al., 2026; Sautner et al., 2023; Li et al., 2024), we identify green patents using their Cooperative Patent Classification (CPC) codes. This classification encompasses technologies related to pollution abatement, water adaptation,

renewable energy, energy storage, and carbon capture. Applying the OECD algorithm from Haščič and Migotto (2015) to the universe of KPSS patents, we identify 175,968 green patents, representing 5.32% of the 3,282,234 total patents in the sample.

However, patent data is subject to significant truncation bias stemming from the lag between application and grant dates. This issue is particularly severe for citation analysis, as citations generally occur only after the cited patent is granted, and the citing patents themselves undergo a similar application-to-grant delay Lerner and Seru (2022). A related concern is sample-end censoring, which induces a mechanical decline in observed patent and citation counts toward the end of the sample period due to these inherent processing lags. Besides, patent data exhibits systematic biases across time, technology domains, regions, industries, firm characteristics, and their complex interactions.

We adjust the patent data by employing the Enhanced Time-and-Technology Adjustment approach, following prior literature Hall et al. (2005); Seru (2014); Flammer and Kacperczyk (2016). Specifically, we scale the number of patents in different technology class assigned for each firm in application year by total number of patents applied in corresponding year and class. The same is true for citation adjustment. The adjustment procedure resembles computing the market share of each patent while controlling for time and technology class fixed effects, which effectively alleviates the mechanical tail-off in patent data. By applying such a normalization, one may control not just for truncation problems, but also adjust for the shifts engendered by changes in patent office policy and technological fluctuations.

The adjustment for patent counts and forward citations are shown in Equation 1a and 1b, respectively.

$$\text{Adj. Patent Counts}_{ft} = \sum_{k=1}^{M} \frac{n_{fkt}}{N_{kt}} \tag{1a}$$

$$\text{Adj. Patent Citations}_{ft} = \sum_{k=1}^{M} \frac{\sum_{i=1}^{n_{fkt}} \text{Citation}_i}{\sum_{j=1}^{N_{kt}} \text{Citation}_j / N_{kt}} \tag{1b}$$

where n_{fkt} denotes the total number of granted patents for firm f applied in year t in class k,

and N_{kt} denotes the total number of granted patents applied in year t in class k. According to the CPC classification (A, B, ..., H, and Y), $M = 9$, which represents the total number of technology classes in the patent data.

Throughout this paper, we measure green innovation by quantity and quality metrics. We proxy green innovation quantity as the total adjusted number of green patents of the firm per application year. We capture quality use: 1) the total adjusted forward citations received by these green patents; and 2) the economic value of these green patents patents, which is provided by Kogan et al. (2017). [5]

Figure 2 compares unadjusted and adjusted green patent data, including patent counts and forward citations. Both unadjusted measures exhibit a sharp decline over time, and become notably sparse toward the sample-end, which indicates patent applications are underrepresented and justifies our adjustment solution.

2.3 Other data

We supplement the ISS data with a hand-collected dataset of SEC no-action letters, which enables us to track early managerial resistance to activism. These letters document the regulatory process through which SEC staff mediate disputes between management and shareholders. They consist of the original proposal, the firm's exclusion request, and the SEC's final determination. We merge the no-action letter records with the ISS universe using a fuzzy matching algorithm based on proponent identities, firm identifiers, and meeting dates.

We obtain additional data from several sources. ESG data comes from S&P Global ESG Score. Environmental incidents data comes from RepRisk. Executive compensation metrics data comes from Executive Compensation Analytics (ECA) of ISS. Media climate change concern index comes from Ardia et al. (2022). Institutional shareholdings come from FactSet Ownership data. Accounting data of firms comes from Compustat, and stock price data comes from CRSP.

5. This measure represents the firm's abnormal stock return over the three-day window surrounding the patent approval date, multiplied by the firm's market capitalization and deflated to 1982 (million) dollars using the consumer price index. We exercise caution to adjust the economic value of patents since this measure is constructed from firm-specific market reactions to individual patent grants and scales with firm market capitalization, its economic representativeness and interpretation may be distorted when controlling for time and technology-class fixed effects.

2.4 Summary statistics

Our final sample comprises 7,530 firm-year observations across 790 unique U.S. public firms over the 2012–2023 period. We require each firm in the sample has received at least one shareholder proposal and has been granted at least one patent during the sample period. These restrictions effectively exclude firms with an inactive shareholder base or a lack of observable patenting activity. [6] Within this sample, 45.99% of firms have been targeted by at least one environmental shareholder proposal, and 54.75% have obtained at least one green patent by the end of the sample period.

Table 1 presents summary statistics for the primary variables used in our analysis, and Table 2 discloses variable definitions. All continuous variables (except count variables) are winsorized at the 1st and 99th percentiles to mitigate the influence of outliers. In the rightmost columns, we partition the sample into firm-years with no green proposals ($N = 4,086$) and those with at least one green proposal ($N = 3,465$), and report subsample means alongside univariate tests for differences in means.

Firms targeted by green proposals are significantly larger (mean log Assets of 9.76 vs. 7.78) and more mature (mean Age of 34.87 vs. 26.04 years) than their non-targeted counterparts. Targeted firms also exhibit higher profitability (EBIT of 0.09 vs. 0.05), higher leverage (Debt of 0.27 vs. 0.23), and greater asset tangibility (PP&E of 0.54 vs. 0.36). Conversely, non-targeted firms hold significantly larger cash reserves (0.22 vs. 0.12), invest more heavily in R&D (0.06 vs. 0.02), and display higher idiosyncratic volatility (0.11 vs. 0.09).

Univariate comparisons further reveal that firms targeted by green proposals demonstrate significantly stronger green innovation performance across multiple dimensions. Specifically, the targeted group generates more green patents (mean adjusted patents of 0.40 vs. 0.17) with higher impact (mean adjusted citations of 0.25 vs. 0.11) and greater economic worth (mean log economic value of 1.08 vs. 0.54). All these differences are statistically significant at the 1% level.

6. In principle, we could further expand the sample by including firms never experience shareholder activism. However, such firms are unlikely to serve as suitable comparison group, as shareholder activism is not well defined in the absence of activists who publicly voice dissent.

3 Baseline results

3.1 Firm value implications of voted green proposals

We conduct an event study on shareholder-voted green proposals to examine their influence on firm value. The event day is defined as the shareholder meeting date rather than the proxy mailing date, as the meeting represents the moment at which proposals become most observable to public and the shareholder vote upon resolutions is finally cast. We adopt a 250-trading-day estimation window that ends 25 days prior to the event of interest and require at least 100 days with returns. Then, cumulative abnormal return (CARs) are calculated through Fama-French 3 (FF3) and 5 factor models (FF5), with the results reported in Table 3.

Across the 3-, 5-, and 7-day event windows centered around the meeting date, we document a consistently negative market reaction to the voting of environmental proposals. The estimated CARs are statistically significant across all specifications, with the sole exception of the 3-day window under the FF5 model. To ensure our inferences are not driven by extreme outliers or distributional assumptions, we further conduct non-parametric Wilcoxon signed-rank and generalized sign tests. For both the 5- and 7-day windows, these tests reject the null hypotheses that the median CAR is zero and that the proportion of positive to negative CARs is evenly split.

These findings suggest that investors perceive the voting on green proposals as a signal of impending transition costs. Compliance with such environmental mandates necessitates structural adjustments that may divert managerial attention and resources away from shareholder value maximization. Alternatively, the very presence of an environmental resolution on the proxy ballot may indicate a breakdown in private, behind-the-scenes negotiations, thereby signaling managerial reluctance to proactively take environmental responsibility or undertake forward-looking investment (David et al., 2007).

3.2 Green shareholder proposals and innovation

3.2.1 Voting of green proposals

We begin our empirical analysis by examining the relationship between environmental shareholder activism and subsequent green innovation. Specifically, we estimate the following firm-level panel regression:

$$GInno_{i,t+1} = \alpha_0 + \beta_1 Activism_{i,t} + \gamma \mathbf{Z}_{i,t-1} + \delta_i + \delta_t + \epsilon_{i,t} \tag{2}$$

where i and t index the firm and year, respectively. The dependent variable, $Green\ Innovation_{i,t+1}$, represents one of the green innovation metrics detailed in Section 2. The primary independent variable, $Activism_{i,t}$, captures environmental shareholder activism, initially measured by the total number of environmental proposals submitting to a firm in a given year. We characterize environmental activism with more specific measures in following sections.

We first focus on the *depth* of environmental shareholder activism and investigate whether proposals that proceed to a shareholder vote elicit changes in innovation policies. To determine the importance of a proposal's final status, we decompose the aggregate $Activism_{i,t}$ measure into voted and unvoted green proposals. The unvoted category is further partitioned into withdrawn and omitted proposals. Shareholder proposals reaching a vote indicate the escalating shareholder sentiment, resolution complexity, and the failure of behind-the-scenes negotiations (Krueger et al., 2020). In contrast, withdrawn proposals typically indicate behind-the-scenes settlements between shareholders and management, whereas omitted proposals represent resolutions that management successfully excluded from the proxy via SEC no-action relief. We estimate the following regression:

$$\text{GInno}_{i,t+1} = \alpha_0 + \beta_1 \text{GVoted}_{i,t} + \sum_{s \in w,o} \beta_{2,s} \text{GUnvoted}^s_{i,t} + \gamma \mathbf{Z}_{i,t-1} + \delta_i + \delta_t + \epsilon_{i,t} \tag{3}$$

Table 4 reports the estimation results. In Column (1), where the dependent variable is the truncation-adjusted count of green patents, the coefficient on the aggregate number of green proposals (#GPROP) is negative but statistically indistinguishable from zero. However, distinguishing proposals

by their terminal status reveals significant heterogeneity. In Column (2), we decompose the proposals into voted, withdrawn, and omitted categories. The results indicate that the negative relationship is driven primarily by proposals that proceed to a vote. The coefficient on #GVoted is −0.092 and is statistically significant at the 5% level. This contraction in patenting is economically meaningful. A one-standard-deviation increase (0.303) in green proposals entering the public voting stage is associated with a 0.028 reduction in next-year adjusted green patents, equivalent to 10.14% of the sample mean (0.275). In contrast, the coefficients on both withdrawn and omitted proposals are economically negligible and statistically insignificant.

Column (3) aggregates unvoted categories into a single component (#GUnvoted), which allows us to directly compare their effect against voted proposals. The results confirm that the decline in green patenting is specific to voted proposals, where the coefficient on #GVoted remains negative and highly significant, while that on #GUnvoted is positive and insignificant. A Wald test of the equality of coefficients ($\beta_1 = \beta_2$) rejects the null hypothesis (p-value = 0.005), suggesting that the voting status of green proposals is a primary determinant of their subsequent innovation impact.

In Columns (4) and (5), we investigate whether this reduction in patenting quantity is accompanied by a deterioration in patent quality. Using aggregate forward citations and the natural logarithm of estimated patent value as the dependent variables, we find no evidence that environmental proposals (regardless of voting status) adversely affect the quality or economic value of green innovation. The coefficients on #GVoted are statistically insignificant across both specifications. Moreover, Wald tests fail to reject the equality of the coefficients for voted and unvoted proposals. Collectively, these results imply that while environmental activism that reaches a proxy vote may reduce the volume of green patents, it does not appear to compromise the average quality or economic value of the innovations produced.

Panel B of Table 4 conducts tests using different outcome scopes and subsamples. Columns (1) and (2) extend the measurement window for adjusted patent counts to two- and three-year horizons, respectively. The coefficients on #GVoted remain negative and statistically significant, indicating a persistent decline in green innovation following a proxy vote. Columns (3) and (4) test on the

subsamples. Column (3) restricts the sample to firms targeted by at least one green proposal during the sample period, and Column (4) focuses on observations subsequent to a firm's initial green proposal. Across all alternative specifications, the effect of voted proposals (#GVoted) remains significantly negative, whereas the effect of unvoted proposals (#GUnvoted) remains statistically indistinguishable from zero. Crucially, the Wald tests consistently reject the null hypothesis of coefficient equality between voted and unvoted proposals across all columns (p-values ranging from 0.001 to 0.057), confirming that the contraction in innovation is specific to resolutions that reach the ballot.

3.2.2 Support level of green proposals

Shareholder proposals serve not only as a mechanism to communicate discontent to management, but also a public channel to reveal the aggregate preference of broad shareholder base. While initial submissions may reflect the agenda-setting of small coalitions of active shareholders, voting outcomes aggregate the views of the wider investor groups, including passive institutional investors who may otherwise remain reticent to engage (Kastiel and Nili, 2020; Nili and Kastiel, 2016).

Following the empirical setting of He et al. (2023), we condition on green proposals that reach a shareholder vote to examine whether the degree of voting consensus conveys information regarding subsequent green innovation policies. This focus on support levels mitigates sample-selection concerns, ensuring that our findings are not driven by firm-specific propensities to receive green proposals.

Table 5 presents the regression results. In Panel A, the key independent variable is the interaction term of $GPROP\ voting$ (an indicator variable equal to one if the firm faces a voted green proposal) and $Support\ for$ (the percentage of shares voted in favor). This design allows us to measure the marginal effect of increasing shareholder approval. For the quantity measure in Column (1), the interaction coefficient is negative but insignificant ($t = 1.23, -0.366/0.298$). The coefficient on the standalone $GPROP\ voting$ indicator is positive and statistically significant for innovation quality measures (Columns 2 and 3), suggesting that the mere occurrence of a proposal prompts green

patent quality. However, their coefficient on the interaction terms ($GPROP\ voting \times Support\ for$) are significantly negative for patent citations and value at the 5% level. The results are similar when we re-run the regressions using innovation outputs over longer window and using the subsample, as shown in Table A7. The results hence imply that green patent quality decreases in shareholder support for green proposals.

In Panel B, we interact $GPROP\ voting$ with two indicator variables, where $Low\ support$ identify proposals with valid voting support in the bottom quartile of the sample distribution, and $High\ support$ for those in the top quartile. The results uncover an asymmetry in the innovation response. Columns (3) and (5) indicate that the interaction term with $Low\ support$ yields positive and significant coefficients for green patent citations and economic value, both of which are significant at the 5% level. In contrast, Columns (2) and (6) show that the interaction term with $High\ support$ is significantly negative for the adjusted volume of green patents (10% level) and their economic value (1% level).

Collectively, these results document a non-linear relationship between shareholder support and subsequent green innovation. While low-to-moderate support levels for green proposals are associated with improvements in patent quality, high shareholder consensus is linked to a contraction in both patent volume and value. These patterns are consistent with firms prioritizing defensive, short-term compliance measures over long-term exploratory innovation when faced with excessive shareholder pressures.

Next, we focus on the formal governance effects of proposal passage, and examine whether the passage of green proposals influences subsequent innovation. Unlike non-environmental proposals, the vast majority of environmental shareholder proposals fail to obtain majority support. To address potential endogeneity, we follow previous studies and employ a Regression Discontinuity Design (RDD) approach focusing on close-call proposals, which pass or fail by a small margin (Cuñat et al., 2012; Flammer and Bansal, 2017; Gantchev and Giannetti, 2021; Berkman et al., 2024; Couvert, 2025). The key intuition is that for green proposals falling within a narrow bandwidth of the majority threshold, the outcome is locally exogenous. There should be no systematic differences between

firms where a proposal marginally passes (e.g., 51%) and those where it marginally fails (e.g., 49%). So, the passage of these proposals approximates a random assignment of shareholder pressure, providing a quasi-experimental setting to identify the causal effect of green activism.

As reported in Figure A1, we validate the RDD design using the McCrary (2008) density test. The results show that there is no jumps around the passing threshold (with p-value = 0.711), and hence strategic manipulation of vote shares is improbable.

Table 6 reports the RDD estimates. Columns (1) employs the non-parametric local linear regression method proposed by Calonico et al. (2020). In Columns (2) through (4), we examine the sensitivity of estimates to bandwidth selection, progressively narrowing the window around the approval threshold from 15% to 5%. Column (5) restricts the sample to non-close calls lying far from the passing threshold. We observe that the estimates remain are generally statistically indistinguishable from zero, except for non-close proposals.

In sum, the RDD estimates provide no evidence that the decline in green innovation is driven by the formal passage of shareholder resolutions. Instead, the innovation contraction is more consistent with a preemptive response to escalating shareholder sentiment and the credible threat of public engagement, suggesting that firms react to the pressure of activism itself rather than to its direct governance consequences.

3.2.3 Test on innovation-lagged samples

One question naturally arises: do environmental activists have the ability to pick up targets who are already under-investing in green technologies? If so, our findings above could reflect confounding results of shareholders' stock-picking on laggards who are about to fail clean-tech research or relevant patent filings. Inspired by (Brav et al., 2018), we focus on the subset of chemical, healthcare, medical equipment, and drug industries (CHMD) to test such stock-picking prediction, since those industries have beyond one-year lags between the inputs and the realization of innovation. [7] We explore CHMD subsample and its complement to distinguish the impact of proposal intervention

7. In our regression sample, 18.61% of the firms operate in the CHMD industry, while the remaining 81.39% are classified as non-CHMD firms.

from activists' ability to select firms with failing innovation pipelines. If the decline in green patents were mainly driven by a "selection effect" (i.e., activists selecting firms whose long-term innovative activities were already destined to fail), we should observe an persistent drop in patenting regardless of whether a proposal goes to a vote.

Table 7 reports subsample analyses partitioned by industry innovation lags. Columns (1)–(2) restrict the sample to CHMD industries, while Columns (3)–(4) correspond to the non-CHMD. Within each group, the first Column employs the adjusted green patent counts as the dependent variable at $t + 1$, and the second uses cumulative counts over a three-year window spanning $t + 1$ to $t + 3$.

For the CHMD subsample in Column (1), while the coefficient on *#GVoted* is significantly negative, the coefficient on non-voted proposals is similar, and the Wald test indicates that the two are statistically indistinguishable ($p = 0.426$). The negative association with voted proposals dissipates when the patent output is measured in a longer horizon in Column (2), while the coefficients on non-voted proposals remain significantly negative. The Wald test suggests that the two parts of green proposals are different from each other ($p = 0.030$). Such pattern indicates that for long-lag firms, the decline in green patents is insensitive to whether a green shareholder proposal proceeds to a proxy vote. This can be explained by either that long-lag firms yet have time to change innovation pipeline post activism pressures, or that CHMD industries adapt their strategies through behind-the-scenes negotiations.

In contrast, for the non-CHMD subsample in Columns (3) and (4), the coefficient on voted green proposals remains significantly negative across 1- or 3-year innovation windows, while the coefficient on non-voted proposals is positive and indistinguishable from zero. Wald tests reject coefficient equality between the two (p-values = 0.004 and 0.009, respectively). [8] The evidence in short-lag industries support that pushing green proposals to a formal vote exerts a distinct intervention effect that suppresses corporate green innovation.

8. Results using two- and four-year cumulative patent counts as the dependent variable are quantitatively similar and are omitted for brevity.

4 Causality and robustness

The consistency of our results across specifications and empirical settings provides strong support for the "distraction" hypothesis, suggesting that the observed decline in green innovation is driven by environmental shareholder proposals and subsequent voting outcomes. A primary concern for this interpretation is reverse causality. One might argue that a firm's strong (or weak) performance in clean technology patenting could alleviate (or intensify) shareholder concerns about long-term environmental risks, thereby influencing their incentives to submit or support environmental proposals and mechanically generating a negative relation between proposal intensity and innovation outcomes. However, such a channel is less likely to be a first-order concern in our setting.

Specifically, patenting outcomes are subject to substantial application-to-grant lags and considerable uncertainty, which limits their ability to drive contemporaneous shareholder activism. Throughout the analysis, we rely on patent application years to capture the timing of innovation investment, rendering green innovation outputs largely unobservable to external shareholders at the time of engagement or voting. Even if insiders observe the exact timing of patent filings, the granting decision remains outside the control of both firms and activists. Moreover, shareholders—including large institutional investors—are unlikely to systematically possess superior information that allows them to accurately predict patent approval outcomes. Taken together, these features suggest that shareholders are unlikely to systematically condition their activism or voting decisions on contemporaneous innovation activities, thereby alleviating concerns that green innovation outcomes drive environmental activism.

Another important concern relates to omitted variable bias, as environmental shareholder activism is not randomly assigned across firms. First, proposal sponsors may be motivated by conflicts of interest rather than purely by the objective of improving corporate environmental performance. For example, corporate gadflies may seek nonpecuniary benefits such as public visibility or the intrinsic satisfaction of advancing particular agendas (Kastiel and Nili, 2020), while other sponsors, such as labor unions, may use proposals opportunistically to extract private benefits, including wage concessions (Matsusaka et al., 2019). Second, prior literature shows that large and

underperforming firms are more likely to be targeted by activist, thus shareholder proposals can be complementary mechanism to correct inefficiencies (Dimson et al., 2015; Gantchev and Giannetti, 2021; Couvert, 2025; Aggarwal et al., 2024). In addition, firms with greater environmental risks or more severe negative externalities are more likely to receive environmental proposals and to attract stronger voting support (Berkman et al., 2024; Diaz-Rainey et al., 2024; Fich and Xu, 2025). These considerations imply that green proposals and voting outcomes may be correlated with unobservable firm characteristics that also shape green innovation policies.

While our baseline analyses incorporate a rich set of control variables, multiple dimensions of fixed effects, and extensive subsample tests to mitigate these concerns, we further implement additional identification strategies to address potential endogeneity. The details of these approaches are presented in the following sections.

4.1 PSM-DID

To mitigate endogeneity concerns, we complement our baseline OLS regressions with a difference-in-differences analysis on a propensity score matched sample. Following the methodology of Brav et al. (2018) and Flammer (2021), we design a counterfactual to estimate how target firms would have performed had they not experienced a voted green proposal. We construct the control pool by selecting firms with active shareholder base, that is those experienced at least one shareholder proposal but were never targeted by a voted green proposal during the sample period. We further require control candidates to operate in the same Fama-French 12 industry as the target firms. This strict selection criterion isolates the specific impact of environmental concerns while controlling for the general effects of shareholder activism.

Within the pool of candidates, we then select the nearest neighbor based on covariates including log firm size, market-to-book ratio, and return on assets, all measured at the year preceding the event year ($t-1$). For firms targeted by multiple environmental proposals, we retain only the earliest event. The event year of the target firm is assigned as the "pseudo-event" year for its matched counterpart.

Table 8 reports summary statistics comparing the characteristics of the target firms with those of

the matched firms in the year before the event. All continuous variables are winsorized at the 1% extremes. Table 8 includes the mean, standard deviation, and median of target and controls firms, and reports differences and the t-statistics testing the equality of means of the two groups. Prior to the green activism, the target and matched firms are indistinguishable along size, market-to-book ratio, and return on assets. Notably, matched firms have very similar green innovation level as target firms before the event, which is evident from the raw and adjusted number of green patents, adjusted citations, and economic value. Overall, these statistics confirm that control firms are very similar to treated firms and hence likely provide a reliable counterfactual of how treated firms would behave absent green proposal voting.

We construct the sample for DID estimates by expanding the matched firm pairs to observations beginning five years prior to the event year (pseudo-event year) through five years afterwards. Then, we estimate the effects of voted green proposals by using the DID with the two-way fixed effect form:

$$Green\ Innovation_{i,t+1} = \alpha_0 + \beta_1 Treat_i \times Post_{i,t} + \gamma \mathbf{Z}_{i,t-1} + \delta_i + \delta_t + \epsilon_{i,t} \tag{4}$$

where i and t index firm and year, respectively. The dependent variable denotes one of the green innovation outputs described in Section 2 measured in the next year of the event year ($t + 1$). The variable of interest is $Target \times Post$, where $Target$ is an indicator equal to one for firms with voted environmental shareholder proposals and $Post$ equals one for the post-event years. β_1 thus measures the change in innovation outcomes following the green proposal voting accounting for contemporaneous changes in outcomes at otherwise comparable firms that do not experience green activism. $\mathbf{Z}_{i,t}$ denotes the vector of control variables, δ_i and δ_t represent firm and year fixed effects, respectively, and $\epsilon_{i,t}$ is the error term.

Table 9 presents the difference-in-differences estimation results. Consistent with our expectations, the coefficients on the interaction term $Target \times Post$ are uniformly negative across all specifications. Specifically, the estimates are statistically significant at the 5% and 10% levels for the truncation-adjusted number of green patents and their economic value, respectively. These results remain robust regardless of whether we include the full set of baseline control variables or restrict the controls to

the covariates used in the propensity score matching. Overall, the evidence suggests that the voting of environmental shareholder proposals exerts a dampening effect on subsequent green innovation.

We supplement the dynamics in green innovation by estimates the following specification:

$$Green\ Innovation_{i,t} = \alpha + \sum_{k=-5, k\neq -1}^{5} \beta_k \times (Target_i \times \mathbb{I}[RelativeYear_{i,t} = k]) + \gamma \mathbf{Z}_{i,t-1} + \delta_i + \delta_t + \epsilon_{i,t} \tag{5}$$

where $\mathbb{I}[RelativeYear_{i,t} = k]$ is an indicator variable equal to one if the observation year t is k years relative to the event year. We exclude the year prior to the event ($k = -1$) as the benchmark period. The coefficients β_k thus capture the dynamic trajectory of innovation outcomes for target firms relative to control firms compared to the pre-event baseline. All other variables ($\mathbf{Z}_{i,t-1}$, δ_i, δ_t) are defined as in Equation (4).

Figure 3 shown the dynamic effects in green innovation after the green proposal voting. The results tell two key patterns. First, the coefficients on the relative time indicators prior to the event ($t - 5$ to $t - 2$) are small in magnitude and statistically indistinguishable from zero. This lack of differential pre-trends provides strong support for the parallel trends assumption, alleviating concerns that the observed decline in innovation is driven by pre-existing deteriorating trends or reverse causality (i.e., activists targeting firms that were already reducing green innovation).

Second, the treatment effect begins to materialize shortly after the intervention. We observe a distinct structural break in the trend following the event year. The coefficients turn negative in $t = 0$ and exhibit a persistent downward trend in the post-event years ($t = 1$ to $t = 5$). This dynamic pattern corroborates DID findings, suggesting that the suppression of green innovation is not merely a transitory shock but reflects a sustained shift in corporate strategy following environmental activism.

4.2 Heckman 2-stage model

This study aims to identify the effect of green proposal voting on subsequent corporate innovation. However, the submission of and votes on green proposals are not randomly assigned. Unobservable firm characteristics may simultaneously drive the likelihood of being targeted by environmental

shareholder activism. To correct for this endogenous treatment assignment, we employ a Heckman 2-stage model accommodating high-dimensional fixed effects (Heckman, 1978; Wooldridge, 2015).

In the first stage, we estimate the conditional probability of a firm-year experiencing green proposal vote using a Probit model, specified as follows:

$$\Pr(\text{GVoted}_{it} = 1) = \Phi\left(\gamma IV_{it} + \beta X_{it} + \theta \bar{X}_i + \mu_j + \tau_t\right) \tag{6}$$

where GVoted_{it} is a selection dummy equaling one if firm i experiences a voted green proposal in year t; IV_{it} represents a set of instrumental variables serving as the exclusion restriction, meaning they only affect the firm's green innovation level through their impact on the voting of green proposals; X_{it} is a vector of time-varying firm-level control variables; $\bar{X}_i$ denotes the Mundlak time-series mean, used to approximately absorb unobserved firm heterogeneity; and μ_j and τ_t are SIC-2 industry and year fixed effects, respectively.

We construct instrumental variables based on the "waves" of proposals submitted by shareholders, as documented in recent activism literature (Flammer and Bansal, 2017; Flammer et al., 2021). Specifically, shareholders often establish a targeted agenda and simultaneously submit identical proposals to numerous firms within their investment portfolio. For instance, when the California Public Employees' Retirement System (CalPERS) mandates its portfolio firms to disclose biodiversity risks, it typically submits a batch of such proposals concurrently during the proxy voting season once the agenda is set. In such instances, the targeting decision is driven by the investor's pro-environment mandate rather than unobservable firm-specific characteristics, making the submission plausibly exogenous. We employ the following instrumental variables:

(1) Number of Wave Proposals Ex-Target (*#Wave Other*): This is defined as the total number of identical green proposals initiated by the same sponsor in the same year against all other firms, excluding the target firm. When a sponsor submits identical green proposals to different firms simultaneously, it reflects an exogenous intent to drive industry transition through standardized intervention strategies.

(2) Number of Wave Proposals Ex-Industry (*#Wave Other Ind*): This is defined as the total number of identical green proposals initiated by the same sponsor against other firms strictly outside the target firm's SIC-2 industry. This strictly purges common industry-level shocks that might simultaneously drive sponsor behavior and corporate innovation.

To address the incidental parameters problem inherent in incorporating panel fixed effects directly into non-linear models, we apply the correlated random effects approach in the first stage (Mundlak, 1978; Wooldridge, 2010), and extend it to accommodate unbalanced panel data structures (Wooldridge, 2019). By including the time-series means of the firm-level covariates, $\bar{X}_i$, we allow unobservables to be correlated with the independent variables, thereby approximately absorbing firm fixed effects within a non-linear framework. Based on the Probit estimates, we construct the two-sided Inverse Mills Ratio (IMR), λ_{it}:

$$\lambda_{it} = \begin{cases} \frac{\phi(xb_{it})}{\Phi(xb_{it})}, & \text{if GVoted}_{it} = 1 \\ -\frac{\phi(xb_{it})}{1-\Phi(xb_{it})}, & \text{otherwise} \end{cases} \tag{7}$$

where xb_{it} is the linear prediction from the first stage, and $\phi(\cdot)$ and $\Phi(\cdot)$ are the probability density and cumulative distribution functions of the standard normal distribution, respectively. To prevent numerical divergence and excessive sensitivity caused by predicted probabilities approaching extreme values, we dynamically winsorize λ_{it} at the 1st and 99th percentiles.

In the second stage, we control the two-sided IMR in the baseline regression, which accounts for the correlation between the unobserved confounders in the treatment assignment and the innovation outcome. Because the inclusion of a generated regressor (λ_{it}) causes traditional standard errors to understate the true sampling variance (Murphy and Topel, 2002), we employ a non-parametric bootstrap resampling procedure with 500 replications in the estimation (Cameron and Miller, 2015). This approach yields consistent standard errors that account for the two-stage estimation process and correct for potential serial correlation within the panel structure.

Table 10 reports the results of Heckman 2-step model. In the first-stage selection model, Panels A and B utilize *#Wave Other* and *#Wave Other Ind* as the respective instrumental variables Column

(1) present the first-stage results, the coefficients on the instrumental variables in both panels are positive and statistically significant at the 1% level. This indicates that the "wave" submission pattern of green activists significantly increases the probability of a firm becoming a target of green proposal voting. The F-statistics for Panels A and B are 80.56 and 50.59, respectively, both well above the empirical threshold of 10 (Staiger and Stock, 1997; Stock and Yogo, 2005). This confirms that our selected instruments satisfy the relevance condition and are free from weak instrument problems.

Columns (2) through (4) display the second-stage results after controlling for the IMR. Across both panels, the coefficients on the number of voted green proposals remain negative and statistically significant for both the volume and economic value of green patents. In contrast, the coefficients on unvoted green proposals are uniformly insignificant across all specifications. The IMR itself is also statistically insignificant in both sets of estimations. Overall, the Heckman 2-step results suggest that our baseline inferences remain robust to potential selection bias, lending further credibility to the main findings.

4.3 Robustness check

We evaluate the robustness of our baseline estimates through several additional tests:

(1) Alternative model specifications. We add industry-year fixed effects to the OLS specification to account for unobservable, time-varying characteristics at the industry level; employ Poisson models to accommodate the count nature of patent data (Cohn et al., 2022; Silva and Tenreyro, 2006; Chen and Roth, 2024); and additionally include industry-year fixed effects in the Poisson model. The relevant results are presented in Tables A4.

(2) Alternative dependent variable. We replace the adjusted number of green patent counts with its natural logarithm; restrict it to climate-change-specific patents; and apply a log transformation to climate patents. The results are shown in Tables A5.

(3) Other considerations. We use alternative measures of the independent variable, including winsorized measure, indicator variables for green proposal voting, two index-normalized ratios,

decomposition by support levels. We also incorporate the target firm's environmental scores as additional controls, following Flammer et al. (2021). We report those results in Tables A6.

Across all these tests, our baseline findings remain qualitatively unchanged and statistically significant. Details of the robustness tests are reported in the Appendix.

5 How green activism influence innovation?

5.1 Underlying channels

5.1.1 Internal managerial incentives

Executive compensation serves as a primary governance mechanism to mitigate agency costs arising from the separation of ownership and control (Jensen and Meckling, 1976). Within the principal-agent framework, boards design performance-contingent pay to ensure incentive compatibility, aligning managerial effort with the wealth-maximization objectives of shareholders.

Extending this alignment mechanism to corporate social responsibility (CSR), Flammer et al. (2019) show that integrating CSR criteria into executive pay lengthens managerial horizons and incentivizes green innovation. This shift toward a broader stakeholder orientation increases failure tolerance within the firm, which encourages the experimentation necessary for innovative productivity (Flammer and Kacperczyk, 2016). Thus, CSR-linked contracting likely shapes corporate patenting that inherently requires long-term investment horizons and sustained environmental commitment.

However, the effectiveness of such alignment is challenged when environmental objectives are publicly scrutinized and disputed. The transition from private engagement to a publicly voted proposal typically signifies a breakdown in the "behind-the-scenes" negotiations between shareholders and management.

These contested resolutions transform environmental metrics from alignment tools into highly visible, politicized signals. Such public scrutiny is frequently driven by external actors whose preferences may diverge from the firm's optimal strategy, introducing substantial noise into the performance evaluation (Cohen et al., 2023; Jensen and Murphy, 1990).

Moreover, under this heightened scrutiny from public voting, boards must also account for

distortions in performance measures. Executives anticipating scrutiny may "game" the incentive system when measurement is imperfect, particularly regarding ESG issues (Chaigneau and Sahuguet, 2025). Furthermore, the multitasking problem and the general lack of consensus in ESG metrics allow self-interested executives to exploit opaque goals for rent extraction without delivering actual social or environmental outcomes (Bebchuk and Tallarita, 2022).

We argue that green proposal voting induces a rational adjustment of corporate contracting that crowds out long-horizon innovative investments. To shield managers from short-term activist pressures and to curtail their opportunistic "gaming" of highly scrutinized metrics, boards may optimally reduce the sensitivity of executive pay to explicit environmental targets. While this reduction in pay-performance sensitivity serves as a defensive response to a noisy informational environment, it yields unintended real consequences. By decoupling compensation from environmental performance metrics, the board inadvertently weakens the incentives necessary for long-term research and development, as well as risk tolerance for exploratory projects. Absent explicit contracting, risk-averse executives are more likely to pursue myopic goals and adopt symbolic compliance in respond to shareholder pressures.

We test the "incentive decoupling hypothesis", which posits that green activism drives the attenuation of environmental metrics in executive contracts. In the ISS ECA dataset, we classify a compensation metric into environmental category if it is explicitly designated as "Climate change and energy use," "Environmental protection," "Resource use," or simply "Environment." Then, we construct count variables for firm-years and merge the compensation data with shareholder proposals data for firm-level regression.

Table 12 presents the results assessing how green proposal voting affects executive incentive structures. In Column (1), the coefficient on the total count of green proposals (#GPROP) is negative but statistically insignificant, suggesting that the mere submission of green proposals does not necessarily trigger a re-calibration of executive compensation. However, when decomposing the proposals in Column (2), the coefficient on voted green proposals (#GVoted) is -0.172 and highly significant at the 1% level, while the coefficient on unvoted proposals (#GUnvoted) remains

statistically insignificant. The Wald test rejects the null hypothesis that the two coefficients are equal (p-value = 0.002), indicating that voted proposal are the primary drivers of the reduction in environmental performance metrics, rather than those settled or omitted.

Columns (3) through (6) further explore the heterogeneity across different types of incentive metrics. The results reveal that the negative impact of voted proposals is most pronounced for quantitative and short-term metrics. Specifically, the coefficient for voted proposals is -0.088 for quantitative metrics (Column 3, $p < 0.05$) and -0.138 for short-term metrics (Column 5, $p < 0.01$). In contrast, the effects on future-oriented (Column 4) and long-term metrics (Column 6) are smaller in magnitude and exhibit lower levels of significance. The Wald tests across these sub-categories consistently confirm the statistical difference between voted and unvoted proposals.

Overall, these findings support the "incentive decoupling hypothesis". Faced with elevated shareholder pressure and associated noise, boards are prone to de-emphasize quantifiable and short-term environmental targets to insulate performance evaluation from market sentiment and curb managerial opportunism. Nonetheless, such defensive contracting undermines the managerial incentives required for innovation growth in green transition.

5.1.2 External reputational risk

When latent ESG vulnerabilities materialize into salient negative incidents, they heighten reputational accountability and reveal critical information regarding a firm's hidden weaknesses (Liang et al., 2025). Such realization of environmental risks imposes urgent operational and financial imperatives, as negative ESG coverage frequently induces analysts to downgrade earnings forecasts and adversely affects firm value (Derrien et al., 2025), and usually trigger institutional engagement (McCahery et al., 2016).

We posit that the inclusion of green proposals on the ballot acts as a leading indicator of reputational shocks. While He et al. (2023) suggest that support levels in environmental and social votes aggregate private information about future risks of target firms, we argue that the mere *presence* of such a vote signals a breakdown in internal governance. Because shareholders and management

typically resolve disputes through private negotiations, a public proxy contest reveals deep-seated managerial resistance and unresolved environmental weakness. This public exposure subjects the firm to intense media scrutiny and agenda-setting, which amplifies the perceived severity of ESG deficiencies (Dyck et al., 2008).

This ensuing reputational crisis stifles green innovation through three ways. First, the diversion of managerial attention. Since executive cognitive resources are finite, concentrated negative coverage forces management to prioritize immediate crisis communication and short-term regulatory compliance over uncertain, long-term green technology development (Ocasio, 1997). The "agenda overload" from broader societal concerns further impairs the board's monitoring capacity and its ability to triage strategic business priorities (Shapira et al., 2026).

Second, the increasing financing frictions. Negative media coverage erodes reputational capital and increases the risk premiums demanded by investors (Vasi and King, 2012). Faced with a higher cost of capital, managers often adopt a precautionary motive, favoring conservative liquidity management and short-term compliance expenditures. This defensive allocation of financial resources directly crowds out the capital required for riskier, long-horizon green investments. Third, heightened risk aversion. External scrutiny creates an asymmetric payoff structure where the career risks of project failure outweigh the potential gains from innovation (Stein, 1989). Consequently, managers may eschew exploratory R&D in favor of low-risk, symbolic compliance to appease external stakeholders.

In sum, the reputational pressure triggered by green proposal votes necessitates a defensive reallocation of attention and capital, ultimately impeding the firm's green innovative capacity. We test this hypothesis using RepRisk data, which captures substantive ESG controversies and norm violations independently of voluntary corporate disclosures. Table 13 presents the results testing this external reputation channel.

In Column (1), we observe a statistically insignificant relationship between the total number of green proposals and the total count of future negative environmental incidents. However, when decomposing the proposals in Column (2), we find that voted green proposals (#GVoted) become a

significant leading indicator of future media scrutiny, with a positive coefficient significant at the 10% level. In contrast, the coefficient for unvoted proposals (#GUnvoted) is much smaller and lacks statistical significance.

Columns (3) through (6) further explore the changes of sub-category environmental incidents. The results reveal that the effect of voted proposals is concentrated in high-impact negative coverage. Specifically, voted green proposals significantly predict an increase in incidents characterized by medium-to-high severity (Column 4, $p < 0.05$), medium-to-high media reach (Column 5, $p < 0.05$), and recurrent issues (Column 6, $p < 0.1$). The Wald test at the bottom of Column (4) formally confirms that the predictive power of voted proposals for severe environmental incidents is statistically distinct from that of unvoted proposals ($p < 0.05$).

Taken together, these findings support the external reputation channel. When shareholder interventions escalate to a formal proxy vote, they place the target firm under a public spotlight. Target firms thus expose to increasing media visibility and stakeholder scrutiny, which precipitates severe negative environmental coverage. The ensuing reputational crisis compels management to redirect scarce strategic attention and financial resources toward short-term crisis management and precautionary savings, ultimately crowding out the firm's capacity and willingness to undertake high-risk, long-term green innovative projects.

5.2 Cross-Sectional heterogeneity

5.2.1 Disclosure-oriented proposal

In this section, we test whether shareholder proposals of more symbolic nature are more likely to induce underinvestment in green innovation. Rule 14a-8 introduces tension between management functions and relevance on shareholder proposals. If the sponsoring shareholder want her proposal to survive the Rule 14a-8 screening, she must trade-off to maker sure that the proposal carry important implications to the company but are not too specific to micromanage on ordinary business. [9] Such

9. When requesting no-action relief from SEC staff, a company may rely on specific bases to exclude a shareholder proposal. For example, Rule 14a-8(i)(5) *(Relevance)*: "A proposal may be excluded if it concerns operations that account for less than 5 percent of the company's total assets at the end of its most recent fiscal year, and less than 5 percent of its net earnings and gross sales for that year, and is not otherwise significantly related to the company's business"; and Rule

structural limitations on shareholder proposals cause most resolution become symbolic and advisory in nature, which affords managers considerable discretion to appease activist interventions with immediate response. We thus expect disclosure-oriented proposals are more likely to attract short-termism response and hence increase the opportunity cost of deprioritizing long-term innovative projects.

In Table 11, we partition the count of voted proposals into disclosure-oriented proposals ($\#GVoted_Disc$) and those targeting operational practices or internal governance ($\#GVoted_Nondisc$). [10]

As shown in Columns (1) and (3), disclosure-oriented green proposals are significantly and negatively associated with subsequent green patent counts and their economic value, at the 1% and 5% significant levels, respectively. In contrast, non-disclosure (operational) proposals positively relate to patent citations and economic value at the 5% level (Columns 2 and 3). The Wald tests reported confirm that the estimated effects of disclosure and non-disclosure proposals are statistically distinct, across all three specifications.

Taken together, these findings indicate that the contraction of green innovation is primarily driven by the voting of disclosure-oriented proposals, whereas operational proposals stimulate innovation. This evidence lends support to the notion that proposals demanding enhanced reporting may compel managers to prioritize immediate, symbolic compliance at the expense of long-term investments in green technologies.

5.2.2 Prior environmental performance of target firms

To investigate whether the effect of green activism is conditional on firms' environmental profiles, we examine cross-sectional heterogeneity based on S&P Global ESG Scores. We construct indicator variables, *Low ESG* (*High ESG*), which equal one for firms in the bottom (top) quartile of the score distribution in the given year. Table 14 reports the results.

14a-8(i)(7) *(Management functions)*: "A proposal may be excluded if it relates to matters concerning the company's ordinary business operations".

10. At the proposal level, 67.51% of the voted green proposals are disclosure-oriented, with the remainder addressing non-disclosure or operational issues.

Columns (1) and (2) classify firms based on the contemporaneous Environmental (E) Score in the meeting year. In Column (1), the coefficient on the interaction between the number of voted green proposals (*#GVoted*) and the *Low ESG* indicator is positive and statistically significant ($p < 0.05$). In Column (2), the interaction term with the *High ESG* indicator is negative but not statistically significant.

Columns (3) and (4) employ the *ex ante* E Score, measured one year prior to the meeting to capture the firm's initial environmental standing. Consistent with the contemporaneous measure, Column (3) documents a significant positive interaction for low-ESG firms ($p < 0.05$). Conversely, Column (4) reveals a negative and statistically significant interaction for high-ESG firms ($p < 0.10$). The coefficient on *#GVoted* is statistically indistinguishable from zero, indicating that heightened shareholder pressure is associated with a reduction in green technology investment for firms with already strong environmental performance.

Finally, Columns (5) and (6) verify these dynamics using the aggregate ESG Score, which incorporates broader social and governance dimensions. The core mechanism remains robust. The interaction for *Low ESG* in Column (5) continues to be positive and significant ($p < 0.10$). For *High ESG* in Column (6), the interaction term remains negative, though statistically insignificant.

Collectively, these findings demonstrate that the efficacy of environmental activism is highly dependent on a firm's initial ESG standing. For ESG laggards, activism exerts a disciplining effect that catalyzes improvements in green corporate innovation, which encourages target firms to correct environmental irresponsibility through technological investment. However, for more environmentally responsible firms, additional pressures may act as distraction role and compliance burden that deprioritize long-term technology development, and hence crowd out resources otherwise allocated to long-term green investments.

A related concern is that the findings pertinent to environmental laggards might be confounded by the underestimated innovation capability of energy sector. The recent literature suggests that ESG metrics may underrepresent the innovative efforts of firms in carbon-intensive industries, hence this disconnect leads to a systematic misperception of such firms (Cohen et al., 2026). If so, energy

firms will be more likely to applying for more green patents regardless of whether activist engage through green proposal voting. To address this concern, we partition the sample into energy and non-energy sectors [11] and re-estimate the model.

Table 15 reports the subsample analysis pertinent to energy sector. Column (1) presents the results for the energy sector. The interaction term between *#GVoted* and the *Low Env.* indicator is omitted because activist proposals in this industry almost exclusively target low-ESG firms, resulting in perfect collinearity. The coefficient on *#GVoted* ($p < 0.01$) captures the marginal impact on these targeted low-ESG energy firms. This suggest that green proposal voting significantly stifle green innovation in the energy sector, consistent with a distraction effect observed in baseline results.

Column (2) reports the results for the non-energy sector. The interaction term between *#GVoted* and *Low Env.* is significantly positive ($p < 0.10$). In contrast to distraction hypothesis, this finding indicates that low-E firms outside the energy sector increase their investments on green technologies after the activist intervention through public votes. These findings together rule out the possibility that the underrated innovation ability of energy sector drives the positive baseline results. Instead, the disciplinary effect of shareholder proposals on less environmentally responsible firms is mainly sourced from the non-energy sectors.

5.2.3 Shocks to climate sentiment

This section examines how exogenous shock in aggregate climate change concern moderates the corporate responses to shareholder pressure, thereby shedding light on the underlying mechanism through which green governance operates. We start from the Media Climate Change Concerns (MCCC) index developed by Ardia et al. (2022) and extract its unanticipated component, the Unexpected Media Climate Change Concerns (UMC), to isolate exogenous informational shocks.

Specifically, we estimate an Augmented Autoregressive (ARX) model. The specification incorporates a first-order autoregressive structure augmented with a vector of macroeconomic

11. Following Cohen et al. (2026), we define energy firms as those with two-digit SIC codes of 10, 12, 13, 14, 29, or 49, with all remaining firms classified as non-energy. In our sample, 79 distinct firms (10.00%) are categorized as belonging to the energy sector.

conditioning variables to filter out the predictable variation in the index:

$$C_t = \alpha + \phi\, C_{t-1} + \boldsymbol{\delta}'\mathbf{z}_{t-1} + \epsilon_t \tag{8}$$

where C_t is the MCCC index in month t; α is the intercept; ϕ is the autoregressive coefficient capturing the temporal persistence of the series; $\mathbf{z}_{t-1}$ is a vector of lagged conditioning variables; and $\boldsymbol{\delta}'$ is the associated coefficient vector. The UMC is then defined as the one-step-ahead forecast error of this model:

$$UMC_t \equiv C_t - \mathbb{E}[C_t \mid \mathcal{I}_{t-1}] \tag{9}$$

where $\mathcal{I}_{t-1}$ denotes the information set available as of period $t-1$. The residual UMC_t therefore represents the component of media climate attention that is orthogonal to all information available at $t-1$.

To accommodate the monthly data frequency and to absorb the influence of prevailing macroeconomic and financial market conditions, the vector $\mathbf{z}_{t-1}$ comprises seven variables spanning five dimensions. [12] By conditioning on this set of variables, the model purges climate media coverage that is predictably driven by macroeconomic fundamentals and market fluctuations, thereby more precisely isolating the exogenous, unexpected component of climate change concern.

The ARX model is estimated using a 60-month rolling window to allow the parameter estimates to adapt to time-varying market dynamics. For each month t, the parameters μ, ρ, and g are estimated using the preceding 60 monthly observations, and the conditional expectation is computed accordingly. The UMC for that month is then defined as the deviation of the realized $MCCC_t$ from this conditional expectation. This recursive estimation strategy ensures that the model respond to structural shifts in the relationship between media attention and macroeconomic conditions over time, and effectively purges climate media coverage attributable to known economic fundamentals,

12. The conditioning variables are similar to (Ardia et al., 2022) but more concise: the monthly market return (NASDAQ Composite Index); the monthly return on WTI crude oil spot prices; the Economic Policy Uncertainty index (EPU) of Baker et al. (2016); the CBOE Volatility Index (VIX); the TED spread; the option-adjusted spread on BBB-rated corporate bonds (DFLT); and the term spread (TERM), defined as the yield differential between 10-year and 2-year U.S. Treasury securities. All series are retrieved from the FRED database (https://fred.stlouisfed.org).

prevailing macroeconomic trends, and major scheduled events. Figure 4 presents the trends of both the MCCC and the estimated UMC over the sample period, with vertical dashed lines marking major climate-related policy events.

Further, we construct a binary indicator, *UMC Spike*, to proxy salient shocks to climate change attention. The construction proceeds in two steps based on the UMC series. First, for each sample month t, we employ a rolling-window approach to assess whether the realized UMC constitutes an anomalously large realization relative to recent history. Specifically, we establish a rolling threshold by computing the 95th percentile of the UMC index over the trailing 36-month window. We then define $UMC\ Spike_t$ as an indicator variable equal to one if the contemporaneous index exceeds this threshold ($UMC_t > P95_{[t-36,\,t-1]}$), and zero otherwise. Such rolling benchmark ensures that a shock is identified only when climate attention rises abruptly relative to the recent media environment, and guards against endogenous spikes in coverage around major scheduled events inflating the shock classification.

Second, to map these macro-level shocks to firm-level decision-making, we define the relevant decision window for each firm-year observation. Drawing on AGM dates recorded in the ISS database and SEC regulations governing the submission deadlines for annual shareholder proposals, we backdate each firm's AGM by six months to define the window during which shareholder proposals are filed and management formulates its response strategy. [13] The monthly *UMC Spike* indicator is then matched to each firm-year observation based on this decision window. Accordingly, $UMC\ Spike = 1$ indicates that, during the submission window of a green shareholder proposal, a rare and unexpected media climate-change attention shock occurred relative to the firm's prior three-year history.

Table 16 examines whether the impact of green shareholder proposals on corporate green innovation is conditional on exogenous shocks to climate-change concerns. In Column (1), the

13. We employ a six-month lag to reflect the statutory timeline of U.S. proxy regulations. SEC Rule 14a-8 requires proposals be submitted 120 days prior to the previous year's proxy mailing anniversary, while Rule 14a-16 mandates material distribution roughly 40 days before the meeting. We adopt a conservative six-month window to accommodate firm-level timing variations and the proposal formulation process. For firm-year observations with missing AGM dates, we impute May 15 of the corresponding calendar year as the default AGM date.

coefficient on *#GVoted* is negative and significant at the 1% level. This indicates that, in the absence of acute external environmental pressure, shareholder activism may inadvertently impede innovation, potentially due to managerial entrenchment or the crowding-out of long-term investment under immediate intervention pressure. Notably, the interaction between *#GVoted* and the *UMC Spike* is positive and significant at the 5% level, indicating that high climate attention shocks reverse short-termism on corporate innovation strategies.

The estimates on innovation quality reveal similar pattern. While the standalone coefficients on *#GVoted* in Columns (2) and (3) are statistically insignificant, the interaction terms are positive and significant at the 5% and 1% levels, respectively. These findings suggest that external shocks act as a necessary catalyst for activism to improve innovation quality, likely by reducing the cost of capital for green projects and enhancing the valuation premiums associated with environmental performance.

To ensure the results are driven by unanticipated information rather than routine media coverage, Columns (4) through (6) present a placebo test using the *MCCC Spike*, which contains expected components of climate-change concerns. The interaction terms involving the *MCCC Spike* are uniformly insignificant across all models. This contrast confirms that our baseline findings are driven by unanticipated shocks that update investor beliefs and alter corporate financing environments, rather than predictable media cycles.

Overall, our findings indicate that external climate shocks align corporate innovation policies with long-term value creation. Episodes of acute climate attention amplify reputational concerns and ease financing constraints for green projects. Within this altered environment, an escalated shareholder voice ceases to be a managerial distraction. The resonance between internal shareholder pressure and external market discipline instead shifts corporate responses from short-term defensive compliance toward value-enhancing green investment. This synchronization of governance and market incentives resolves the underinvestment problem stemming from frictions between shareholder demands and the corporate green transition.

6 Sponsor heterogeneity and green shareholder proposals

6.1 Sponsor type measures

In this section, we focus on sponsoring shareholders to better elucidate how shareholder voice evolves and influences corporate innovation. We distinguish between sponsor types because they may serve as credibility signals for other shareholders casting votes and as critical factors for management when evaluating and responding to activism. Specifically, we classify proposal sponsors along two distinct dimensions: (1) *Sponsor experience*, which reflects the shareholder's track record in the proxy process; and (2) *Sponsor identity*, which captures their organizational nature and underlying motives.

To characterize *Sponsor experience*, we evaluate submission frequency and historical engagement patterns. We designate *Top Activists* as sponsors whose volume of (co-)filed green proposals ranks in the top quartile during a given proxy season. We then partition sponsors into *Newcomers* (those without any green proposal filings over the preceding three years) and *Persisters* (those possessing at least one prior filing during the same window). Drawing on the ownership breadth literature (Chen et al., 2002; Lehavy and Sloan, 2008), newcomer intervention constitutes a costly, independent signal of recent environmental scrutiny by a relatively inexperienced monitor, whereas persister engagement reflects recurrent, experienced activism driven by persistent environmental concerns and unresolved managerial disagreements.

Sponsor identity provides complementary insights into the nature of activism. Consistent with stakeholder salience theory, managers are likely to be more responsive to proposals from highly salient shareholder groups (Mitchell et al., 1997; David et al., 2007). We retrieve sponsor identity classifications from ISS. While ISS provides identities for most proposals, classifications are often aggregated for co-filed submissions, which can obscure the identity of individual co-sponsors. To address this, we adopt the ISS classification for solo-sponsored proposals and manually verify affiliations for co-filed proposals using proxy statements and open-source records. Our finally identify 1,531 distinct sponsors with correct names and categorize them into individuals, institutions,

and others. [14] Table A3 lists the top-10 activists of each category of identity.

We partition institutional sponsors into public pension funds, labor unions, and investment firms (e.g., mutual funds, SRI funds, and other asset managers) bound by fiduciary duties to maximize shareholder value. In contrast, special interest groups—the *Other* category comprising advocacy organizations like As You Sow—depart from this value-maximization paradigm to pursue alternative agendas. Unlike resource-constrained individual proponents, these highly professionalized entities leverage dedicated legal counsel, sophisticated media strategies, and deep expertise in SEC Rule 14a-8 to execute their campaigns. These nonprofit organizations lack the direct stock holdings and cash-flow exposure that align traditional institutions with shareholder value. Instead, they submit proposals on behalf of beneficial owners and rely on public agenda-setting and reputational pressure to exert influence.

6.2 Pre-vote and vote results

A formal vote on a green proposal is the residual outcome of a sequential bargaining game rather than an random event (Couvert, 2025; Gantchev, 2013). As a result, analyzing voting results in isolation may produce biases by neglecting the strategic selection process that determines which proposals will be included into the ballot. Typically, a proposal proceeds to a vote only when management fails to exclude it via SEC Rule 14a-8 or cannot reach a private settlement with the sponsor. These pre-vote outcomes can be sensitive to sponsor motives. For instance, non-pecuniary advocates often face higher negotiation friction than those seeking financial risk mitigation. To address these selection effects and provide a comprehensive view of the activism process, we first examine how green proposal and sponsor characteristics influence two pre-vote outcomes, the probability of a managerial challenge and voluntary withdrawal.

Table 17 shows the pre-vote outcomes [15] for filed environmental proposals. Panel A reports the results of SEC no-action challenges, while Panel B focuses on negotiated withdrawals. The

14. Mostly are special interest groups, religious group, and NGOs, who usually hold non-pecuniary purpose.
15. We hand-collect the data on SEC no-action challenges by parsing records of no-action letter from SEC website. If there is a record can be matched to the ISS shareholder proposal, we define such a proposal is challenged by management. Withdrawn proposals is retrieved from ISS.

positive and significant coefficient on the standalone *Green* indicator suggests that environmental proposals generally encounter greater managerial resistance and necessitate more extensive pre-vote negotiation. However, interaction terms reveal significant heterogeneity in management's response across sponsor categories. Specifically, green proposals from *Newcomers* and individual activists are significantly less likely to be challenged ($p < 0.05$), whereas those from *Persisters* and special interest groups are significantly more likely to face a challenge ($p < 0.01$).

In Panel B, green proposals sponsored by *Activists* and *Newcomers* are significantly more likely to be withdrawn ($p < 0.01$). These results suggest that management is more inclined to reach a private settlement with these groups, likely to avoid a public vote. By contrast, negotiated withdrawals are significantly less frequent for green proposals from *Persisters* ($p < 0.05$) and special interest groups ($p < 0.01$). Taken together, these patterns indicate that private settlements occur less frequently with sponsors who may be more focused on agenda-setting. In these instances, management is more likely to utilize legal mechanisms in an attempt to exclude the proposals from the proxy statement.

Table 18 reports the voting results for proposals that proceed to a formal shareholder vote. In our analysis of voting support, we additionally control for the recommendations issued by management and institutional proxy advisors, specifically ISS, for each shareholder proposal. ISS recommendation data are sourced from (Zytnick, 2025).[16]

Favorable recommendations from management and ISS are important determinants of shareholder support ($p < 0.01$). Notably, green proposals sponsored by *Persisters* and special interest group receive significantly higher voting support ($p < 0.01$), whereas those from *Newcomers* and institutional investors receive significantly lower support ($p < 0.01$ and $p < 0.05$, respectively). These findings suggest that management strategically respond to green activism by utilizing no-action challenges to exclude proposals from *Persisters* and advocacy groups (*Other*), which otherwise would have garnered higher support had they reached the ballot. However, management prioritize private negotiation for *Newcomers* proposals with lower expected support.

16. We also utilize alternative measures, including Glass Lewis recommendations imputed by (Zytnick, 2025) and those provided by Shu (2024), and find that the results remain qualitatively similar.

6.3 Sponsor influence on green innovation

To evaluate the aggregate impact of sponsors on corporate green innovation, we construct firm-level measures of sponsor characteristics by counting the number of environmental sponsoring shareholders and the their specific types. This help us capture the intensity of shareholder activism along the *breadth* dimension. We expect that broader coalitions indicate shareholder consensus on environment accountability and intensify external pressure, thereby exacerbating managerial short-termism in innovation, and that management differentiates its response across sponsor types.

Table 19 presents the results of these tests, utilizing adjusted patent counts, adjusted citations, and the economic value of green patents as primary dependent variables, the same as Section 3. We first test if *there is safety in numbers*, that is, whether a larger numbers of environmental sponsors prompts management to alter innovation policies. We posit that coordinated activism may be more likely to divert managerial attention and elicit short-termism and underinvestment in environmental technologies. In Panel A, we document a significantly negative relationship between the total number of green proposal sponsors (*#All GPROP sponsors*) and the subsequent adjusted number of green patents ($p < 0.10$) and their economic value ($p < 0.01$). This suggests that coordinated shareholder pressure may shift managerial focus away from high-value, breakthrough environmental innovation.

To unpack this aggregate effect, Panels B and C decompose the sponsor base into distinct categories based on their activism profile and persistence. In Panel B, we partition the sponsors into *Activists* and *Non-Activists*. While the estimates for both groups are negative, the statistical significance for the decline in patent value is concentrated in the non-activist subsample ($\beta = -0.073$, $p < 0.01$).

Similarly, Panel C categorizes proponents based on their historical engagement, splitting them into *Newcomers* versus *Non-Newcomers* (Columns 1-3), and *Persisters* versus *Non-Persisters* (Columns 4-6). Consistent with the prior panel, we find that the dampening effect on green patent value is driven by proposals originating from *Newcomers* ($\beta = -0.073$, $p < 0.01$) and *Non-Persisters* ($\beta = -0.079$, $p < 0.01$).

Taken together, these results suggest that broader shareholder sponsorship in environmental proposals is associated with lower-value green innovation, with the effect primarily driven by transient and less experienced activists. Crucially, however, we must interpret these subsample significances with caution. Across both Panel B and Panel C, Wald tests of coefficient equality consistently fail to reject the null hypothesis that the effects of the distinct sponsor types are statistically different from one another ($p > 0.10$ for all specifications).

Panel D decomposes sponsors by investor identity to determine which classes of shareholders drive the aggregate negative effect on green innovation. Individual investors and the *Other* category (including special interest groups, religious organizations, and NGOs) are the primary sources of this adverse effect. Specifically, proposals from individual sponsors are negatively and significantly associated with adjusted green patent counts ($p < 0.05$). Meanwhile, sponsors in the *Other* category exhibit a broader suppressing effect spanning all three innovation metrics ($p < 0.05$ for counts and citations; $p < 0.01$ for patent value). Because these advocacy groups are typically motivated by non-pecuniary objectives and operate without equity-based governance channels, their proposals likely generate diffuse reputational pressure and agenda-setting friction rather than targeted strategic guidance for management.

In contrast, investment firm sponsorship is positively associated with all three green innovation metrics ($p < 0.10$). This suggests that, relative to other sponsors, professional investors are more effective in using green shareholder proposals to exert disciplinary pressure and curb managerial short-termism, which is consistent with stakeholder salience theory.

In sum, the above cross-sectional results reveal that individual activist and non-pecuniary advocacy groups are likely to depress green innovation, whereas professional investing firms promote it. The real effects of environmental activism therefore are affected by the sponsor's identity and underlying economic motives.

7 Conclusions

This paper utilizes a LLM approach to identify environmental shareholder proposals and investigates whether adversarial green activism, as signaled by proposal voting, influences corporate green innovation. Our empirical analysis demonstrates that green proposal voting inadvertently suppresses firm-level green patenting. These findings are robust to various econometric specifications, including a PSM-DID counterfactual framework and Heckman two-step models designed to mitigate selection bias.

Further results indicate that high support on green proposals is negatively associated with green innovation, whereas low support encourages it, which implies excessive shareholder pressures may drive unintended environmental underinvestment.

We then analyze several plausible mechanisms for the decline in innovation, including decoupling managerial incentives on environmental metrics and heightened reputational pressure from negative environmental coverage. Cross-sectional analyses show that the suppressing effect of shareholder intervention is stronger among firms have shorter innovation cycles and those targeted by proposals of a more symbolic nature. Conversely, voting pressure of green proposals promotes green innovation only among firms with substantial room for environmental improvement or during periods of high environmental sentiment. We also document how sponsor features are associated with pre-vote and support levels of green proposals and subsequent changes in firm-level green innovation.

Collectively, our findings is consistent with a distraction theory that escalating shareholder voice on environmental responsibility may induce managerial short-termism and underinvestment in green innovation. However, shareholder interventions stimulate patenting conditional on the level of support, the target firm's environment performance, prevailing environmental sentiment, and sponsoring shareholders.

This study is subject to several limitations that offer avenues for future research. First, our measure of innovation captures "relative innovation intensity," analogous to a firm's market share in green technology (Lerner and Seru, 2022). Second, we cannot exclude the possibility of a substitution effect, wherein firms respond to green activism by acquiring external patents rather

than developing indigenous technologies. Third, our analysis utilizes a conditional sample of firms targeted by activists, the findings hence should be generalized to the broader population of firms with caution.

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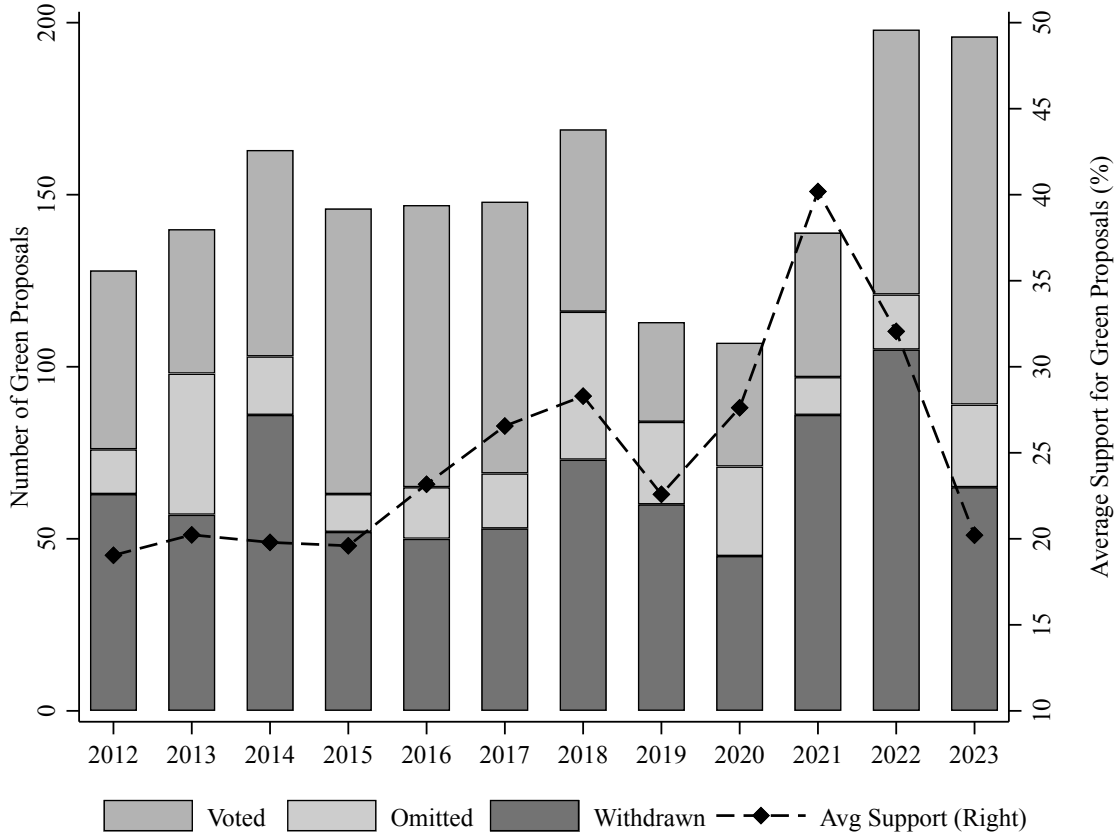
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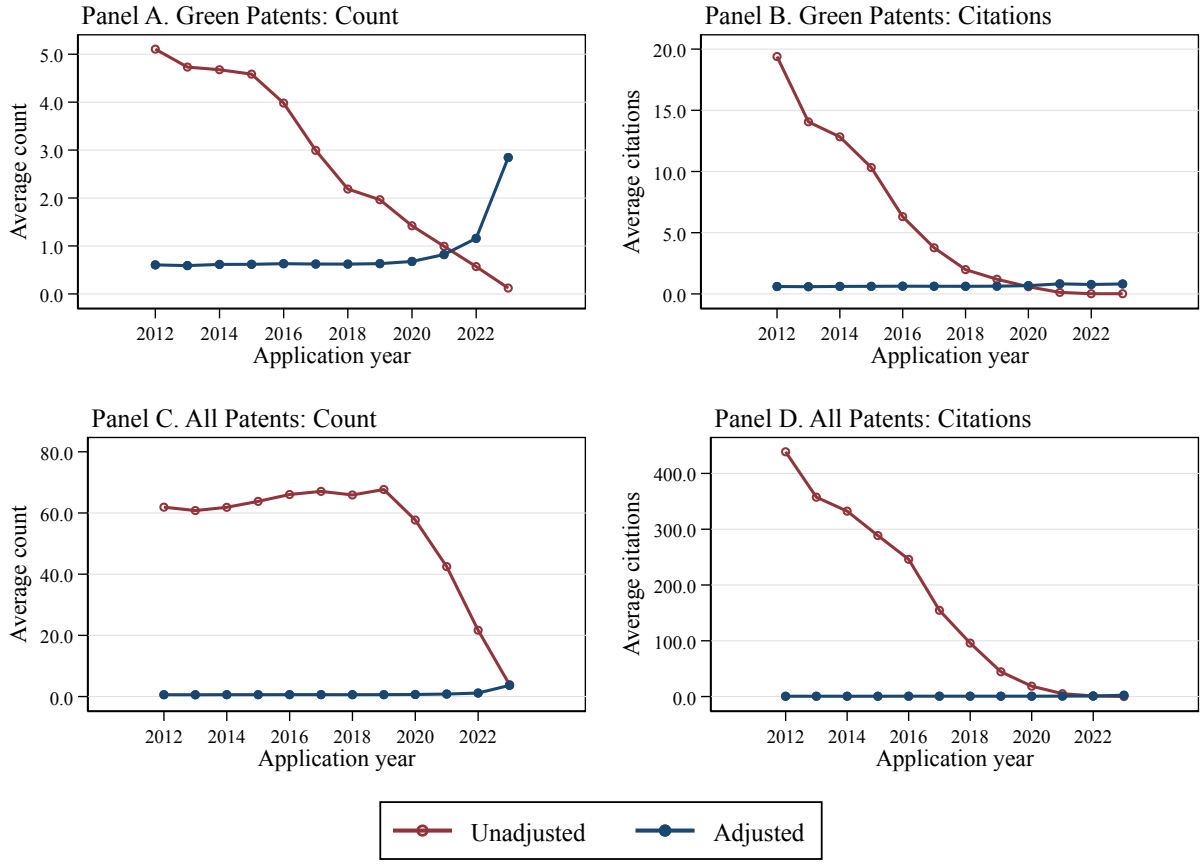
Figures and tables

Figure 1. Volume and support rate of green shareholder proposals



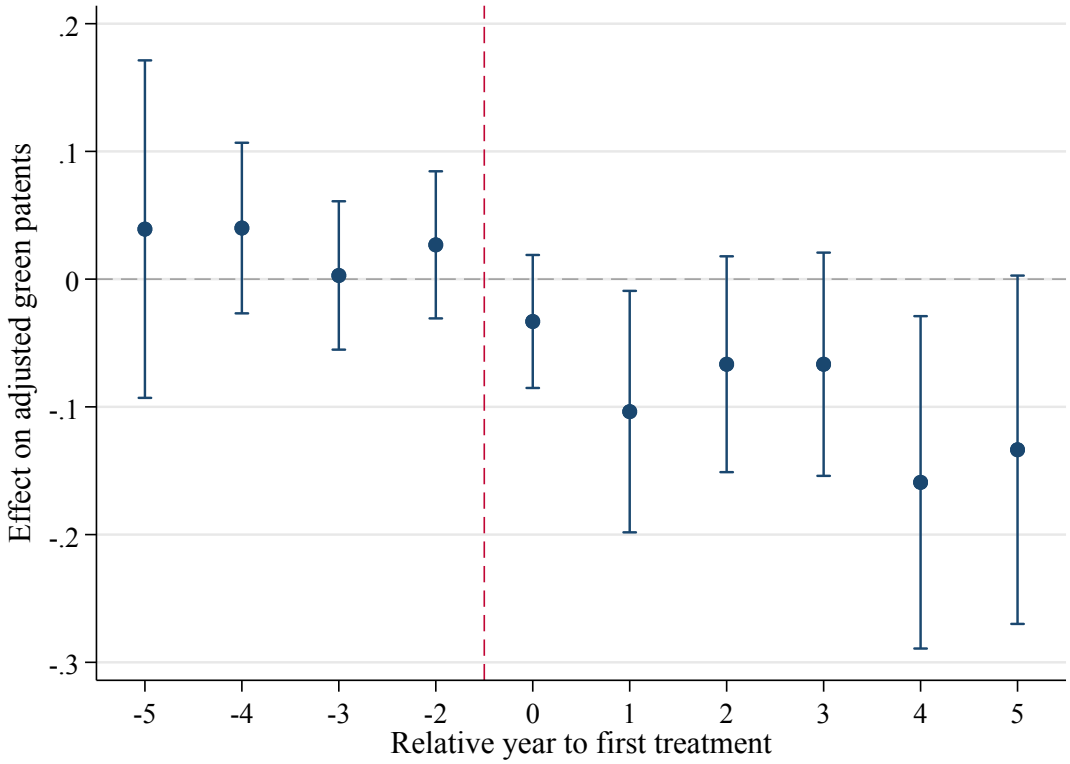
This figure illustrates the volume of green shareholder proposals and the associated level of shareholder support over the sample period. The left y-axis reports the annual total number of green proposals by final status, while the right y-axis indicates the annual support rate for proposals that reach a shareholder vote. Among green shareholder proposals, "Voted" denotes proposals that reach a shareholder vote, "Omitted" refers to proposals excluded from the proxy statement following firms' receipt of SEC no-action relief, and "Withdrawn" indicates proposals withdrawn by proponents. A total of 15 green proposals with unknown final status are not displayed in this figure.

Figure 2. Trend in unadjusted and adjusted patent data



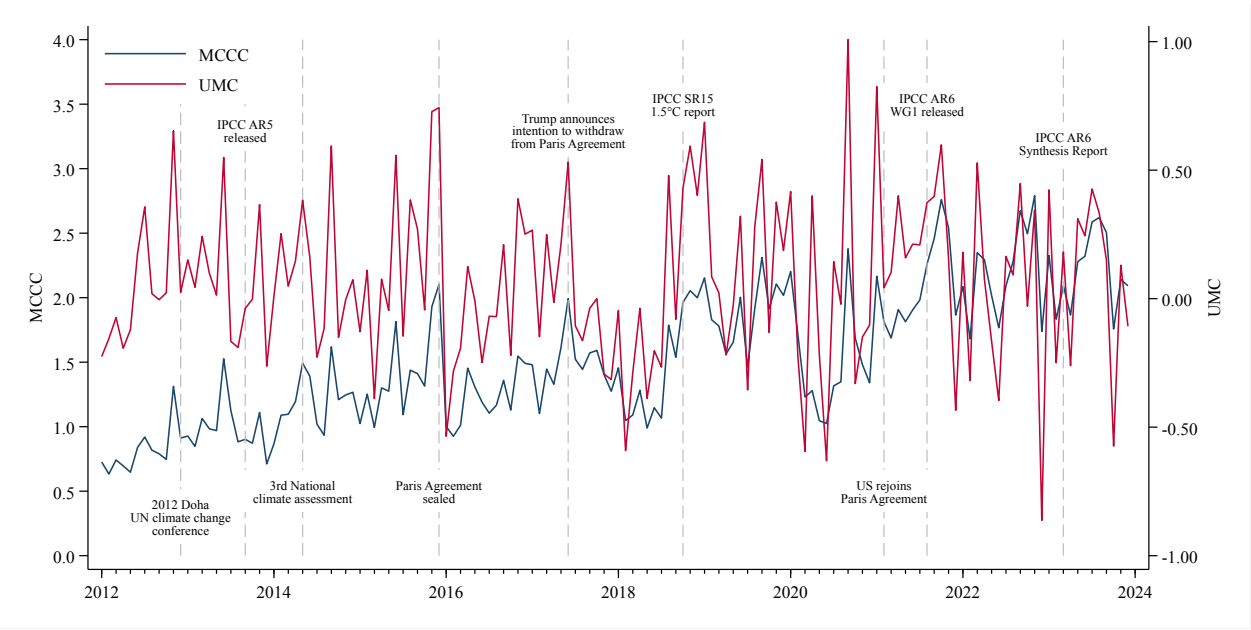
This figure compares trends in unadjusted and adjusted average patent data by application year. The upper panels focus on green patents, while the lower panels focus on all patents. The left panels compare unadjusted and adjusted patent counts, and the right panels compare forward patent citations.

Figure 3. Parallel trends and dynamic treatment effects of voted green proposals



This figure plots the dynamics in corporate green innovation in the years around the arrival of environmental proposal voting. The coefficient estimates (β_k) and 95% confidence intervals obtained from the specification in Equation 5. The coefficients represent the dynamic differences in green innovation between target and control firms relative to the year prior to the event ($t = -1$). The dependent variable is the adjusted number of green patents. The horizontal axis represents the years relative to the first voted green proposal ($t = 0$). The coefficient for the year prior to the treatment ($t = -1$) is normalized to zero. Control variables and fixed effects follow the specification in Equation (4).

Figure 4. Media Climate Change Concerns Index and Unexpected Component



This figure plots the monthly time series of the Media Climate Change Concerns (MCCC) index of Ardia et al. (2022) and the Unexpected Media Climate Change Concerns (UMC) index estimated over the sample period. The UMC series is the residual from a 60-month rolling-window ARX model as defined in Section 5.2.3. Vertical dashed lines denote major climate-related policy events.

Table 1. Alternative measures on the number of green patents

	Full sample (N=7551, 790 firms)			By GPROP Status		
	Mean	Median	SD	#GPROP = 0 (N=4086, 450 firms)	#GPROP ≥ 1 (N=3465, 340 firms)	Diff. in Means
Adj. Counts	0.28	0.00	0.72	0.17	0.40	-0.22***
Adj. Cites	0.17	0.00	0.54	0.11	0.25	-0.15***
Log(1+Value)	0.79	0.00	1.63	0.54	1.08	-0.54***
#GPROP	0.13	0.00	0.58	0.00	0.29	-0.29***
#GVoted	0.05	0.00	0.30	0.00	0.12	-0.12***
#GUnvoted	0.08	0.00	0.42	0.00	0.17	-0.17***
Asset	8.69	8.75	1.99	7.78	9.76	-1.98***
CAPEX	0.04	0.03	0.04	0.03	0.04	-0.01***
Cash	0.18	0.12	0.18	0.22	0.12	0.10***
Debt	0.25	0.23	0.19	0.23	0.27	-0.04***
EBIT	0.07	0.08	0.12	0.05	0.09	-0.04***
PP&E	0.44	0.31	0.39	0.36	0.54	-0.18***
R&D	0.04	0.01	0.07	0.06	0.02	0.04***
ILLIQ	0.03	0.01	0.07	0.05	0.02	0.04***
Dividend yield	0.01	0.01	0.02	0.01	0.02	-0.01***
IVOL	0.10	0.09	0.04	0.11	0.09	0.03***
Past return	0.14	0.10	0.43	0.15	0.12	0.03***
Inst. ownership	4.08	4.44	1.05	4.07	4.09	-0.02
Age	30.09	26.45	17.07	26.04	34.87	-8.83***

This table reports the summary statistics for the full sample and univariate difference-in-means tests partitioned by the incidence of green proposals. The full sample consists of 7,551 firm-year observations. The first three columns report the mean, median, and standard deviation for the full sample. The subsequent columns present means for firm-years with no green proposals (No GPROP, $N = 4,086$) and those with at least one green proposal (At least one GPROP, $N = 3,465$). The final column reports the difference in means between the two subgroups. Variable definitions are provided in the Appendix. Statistical significance at the 10%, 5%, and 1% levels is denoted by *, **, and ***, respectively.

Table 2. Variable definitions

Variable	Definition
Panel A: Dependent variables	
Adj. Counts	Total number of green patents awarded to the firm in a given year, adjusted for truncation bias.
Adj. Cites	Total number of citations received by the firm's green patents awarded in a given year, adjusted for truncation bias.
Log(1+Value)	Natural logarithm of the inflation-adjusted total economic value of the firm's green patents awarded in a given year, estimated following Kogan et al. (2017).
Panel B: Independent variables	
#GPROP	Total number of environmental-related shareholder proposals received by the firm in a given year, identified via fine-tuned large language models.
#GVoted	Number of environmental-related shareholder proposals that proceeded to the final voting stage at the shareholder meeting.
#GUnvoted	Number of environmental-related shareholder proposals that did not proceed to the voting stage, including those withdrawn or omitted via SEC no-action letters.
#GWithdrawn	Number of environmental-related shareholder proposals proactively withdrawn by the sponsor.
#GOmitted	Number of environmental-related shareholder proposals excluded by the firm upon receiving an SEC no-action letter.
GPROP voting	An indicator equal to one if the firm has at least one environmental proposal that proceeds to a vote with a recorded support rate, and zero otherwise.
Support for	The average support rate of all environmental proposals received by the firm in a given year, following He et al. (2023).
High support	An indicator equal to one if an environmental proposal received by the firm achieves a support rate in the top quartile of the sample, and zero otherwise.
Low support	An indicator equal to one if an environmental proposal received by the firm achieves a support rate in the bottom quartile of the sample, and zero otherwise.

(Continued)

Table 2. Variable definitions (Continued)

Variable	Definition
Panel C: Control variables	
Asset	Natural logarithm of the firm's total assets at year-end.
CAPEX	Ratio of capital expenditures to total assets.
Cash	Ratio of cash and cash equivalents to total assets.
Debt	Ratio of the sum of long-term and short-term debt to total assets.
EBIT	Ratio of earnings before interest and taxes to total assets.
PP&E	Ratio of net property, plant, and equipment to total assets.
R&D	Ratio of research and development expenses to total assets, with missing values imputed as zero, following literature conventions.
ILLIQ	Square root of the average daily illiquidity ratio (absolute daily return divided by trading volume), multiplied by 1,000, following He et al. (2023).
Dividend yield	Sum of common and preferred equity dividends, scaled by the sum of the market value of common equity and the book value of preferred equity.
IVOL	Average monthly idiosyncratic volatility over the past 12 months, estimated as the standard deviation of residuals from a Fama–French three-factor plus momentum regression.
Past return	The 12-month buy-and-hold raw stock return.
Inst. ownership	Percentage of shares held by 13F institutions at year-end, winsorized at 100% and log-transformed, following Kim (2025).
Age	Number of years since the firm's initial public offering.

(Continued)

Table 2. Variable definitions (Continued)

Variable	Definition
Panel D: Mediating and moderating variables	
#EPay	Total number of environmental-related executive compensation metrics, identified when themes such as climate change, energy consumption, or resource utilization are explicitly addressed.
#EPay quant	Number of environmental compensation metrics with quantitative performance targets (threshold, target, and maximum values).
#EPay future	Number of environmental compensation metrics with a future performance evaluation period.
#EPay short	Number of environmental compensation metrics with a short-term evaluation period.
#EPay long	Number of environmental compensation metrics with a long-term evaluation period.
Log(1+#EIncident)	Natural logarithm of one plus the total number of negative environmental incidents.
Log(1+#UNENV)	Natural logarithm of one plus the number of incidents violating the environmental principles of the UN Global Compact.
Log(1+#EServ)	Natural logarithm of one plus the number of negative environmental incidents with intermediate or high severity (Severity $\geq$ 2 in RepRisk).
Log(1+#EReach)	Natural logarithm of one plus the number of negative environmental incidents with medium to high reach (Reach $\geq$ 2 in RepRisk).
Log(1+#ERecurr)	Natural logarithm of one plus the number of recurring negative environmental incidents (Novelty = 1 in RepRisk).
Low E (High E)	An indicator equal to one if the firm's environmental score is in the bottom (top) quartile of the annual sample distribution, and zero otherwise.
Low ESG (High ESG)	An indicator equal to one if the firm's ESG score is in the bottom (top) quartile of the annual sample distribution, and zero otherwise.
MCCC Spike	An indicator equal to one if an rare shock in media climate change concern (relative to the 3-year historical level) occurs during the proposal submission window (six months prior to the annual meeting). The index comes from Ardia et al. (2022).
UMC Spike	An indicator equal to one if an unanticipated, rare shock in media climate change concern occurs during the proposal submission window. UMC is computed using a 60-month rolling-window augmented autoregressive model.

(Continued)

Table 2. Variable definitions (Continued)

Variable	Definition
Panel E: Sponsor-related variables	
#All GPROP sponsors	Total number of sponsors (including co-filers) for all green shareholder proposals received by the firm in a given year.
#Co-filed	Number of green proposals jointly submitted by multiple shareholders.
Co-filed	An indicator equal to one if the firm receives a jointly submitted green proposal, and zero otherwise.
#Activist(annual)	Number of green proposal sponsors classified as active shareholders in a given year.
#Activist(throughout)	Number of green proposal sponsors classified as active shareholders across the entire sample period.
#Newcomer	Number of green proposal sponsors constituting newcomers in a given year.
#Persister	Number of green proposal sponsors identified as persistent participants in a given year.
#NonActivist	Number of green proposal sponsors who are not active shareholders in a given year.
#NonActivist(throughout)	Number of green proposal sponsors who are not active shareholders across the entire sample period.
#NonNewcomer	Number of green proposal sponsors who are not newcomers in a given year.
#NonPersister	Number of green proposal sponsors who are not persistent participants in a given year.
#Individual	Number of individual investors acting as green proposal sponsors.
#Institution	Number of institutional investors (including investment firms, pension funds, and labor unions) acting as green proposal sponsors.
#Pension	Number of public pension funds acting as green proposal sponsors.
#Union	Number of labor unions acting as green proposal sponsors.
#Invest. firm	Number of investment firms or asset management institutions acting as green proposal sponsors.
#Other	Number of other organizations (e.g., non-profits, religious groups) acting as green proposal sponsors.

Table 3. Cumulative abnormal returns of green proposal voting

	Fama-French 3-Factor			Fama-French 5-Factor		
	(1) CAR(-1, 1)	(2) CAR(-1, 3)	(3) CAR(-3, 3)	(4) CAR(-1, 1)	(5) CAR(-1, 3)	(6) CAR(-3, 3)
Mean CAR	-0.0025*	-0.0030*	-0.0043**	-0.0023*	-0.0033*	-0.0048**
	(0.001)	(0.002)	(0.002)	(0.001)	(0.002)	(0.002)
Median CAR	-0.0016	-0.0029**	-0.0037***	-0.0014	-0.0027**	-0.0044***
	(-1.58)	(-2.53)	(-2.94)	(-1.28)	(-2.56)	(-3.14)
Negative %	52.92%	54.93%**	56.75%***	52.74%	55.84%***	58.03%***
	(1.37)	(2.31)	(3.16)	(1.28)	(2.73)	(3.76)
Observations	548	548	548	548	548	548

This table reports the event-study results for shareholder-voted green proposals. Columns 1–3 present cumulative abnormal returns (CARs) over 3-, 5-, and 7-day event windows centered on the event day, with CARs estimated using the Fama–French 3-factor model. Columns 4–6 report CARs over the same windows based on the Fama–French 5-factor model. The mean returns are assessed by the cross-sectional t-test with robust standard errors. To assess the distributional properties, median values of CARs and the proportion of negative CARs are reported, with statistical significance evaluated using the Wilcoxon signed-rank test and the sign test. Standard errors are reported in brackets. Statistical significance at the 10%, 5%, and 1% levels is denoted by *, **, and ***, respectively.

Table 4. Voted green proposals and innovation outcomes

Panel A. Green shareholder proposals and decomposition

	(1)	(2)	(3)	(4)	(5)
Dep't var =	Adj. Counts	Adj. Counts	Adj. Counts	Adj. Cites	Log(1 + Value)
#GPROP	-0.014				
	[0.016]				
#GVoted		-0.092**	-0.094**	0.006	-0.095
		[0.036]	[0.036]	[0.028]	[0.092]
#GUnvoted			0.014	0.012	-0.033
			[0.014]	[0.014]	[0.035]
#GWithdrawn		0.043			
		[0.032]			
#GOmitted		-0.005			
		[0.011]			
Asset	0.069***	0.069***	0.069***	0.018	0.091
	[0.024]	[0.024]	[0.024]	[0.025]	[0.066]
CAPEX	0.129	0.140	0.137	-0.186	-0.058
	[0.302]	[0.303]	[0.303]	[0.326]	[0.821]
Cash	0.117	0.120	0.119	0.028	0.416**
	[0.075]	[0.076]	[0.075]	[0.073]	[0.207]
Debt	0.027	0.028	0.027	0.079	0.024
	[0.067]	[0.067]	[0.067]	[0.069]	[0.151]
EBIT	-0.073	-0.077	-0.076	-0.105	-0.460**
	[0.084]	[0.084]	[0.084]	[0.087]	[0.226]
PP&E	0.035	0.032	0.032	-0.063	0.058
	[0.084]	[0.084]	[0.084]	[0.090]	[0.215]
R&D	-0.170	-0.175	-0.175	0.291	0.637
	[0.195]	[0.195]	[0.195]	[0.258]	[0.609]
ILLIQ	-0.048	-0.049	-0.049	-0.153*	-0.587***
	[0.090]	[0.091]	[0.090]	[0.083]	[0.217]
Dividend yield	-0.795*	-0.773*	-0.792*	-0.592	-1.176
	[0.421]	[0.414]	[0.422]	[0.416]	[1.143]
IVOL	1.081	1.069	1.075	1.586***	4.280***
	[0.662]	[0.663]	[0.663]	[0.602]	[1.365]
Past return	-0.013	-0.013	-0.013	-0.008	-0.031
	[0.012]	[0.012]	[0.012]	[0.012]	[0.027]
Inst. ownership	0.004	0.004	0.004	0.018	0.038
	[0.008]	[0.008]	[0.008]	[0.011]	[0.027]
Age	0.008	0.008	0.007	0.008	0.003
	[0.008]	[0.008]	[0.008]	[0.013]	[0.015]
Observations	7,530	7,530	7,530	7,530	7,530
R-squared	0.703	0.703	0.703	0.566	0.668
Year FE	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes
Wald test ($\beta_1 = \beta_2$)			-2.823	-0.215	-0.647
p-val of Wald test			0.005	0.830	0.518

(Continued)

Table 4. (Continued)

Panel B. Test on other time periods and subsamples

	(1)	(2)	(3)	(4)
Dep't var = Adj. Counts	2 year	3 year	Ever GPROP	Post GPROP
#GVoted	-0.113*	-0.190**	-0.087**	-0.100*
	[0.063]	[0.086]	[0.036]	[0.056]
#GUnvoted	0.005	-0.012	0.019	0.073
	[0.024]	[0.035]	[0.015]	[0.048]
Observations	7,530	7,530	3,459	460
R-squared	0.751	0.774	0.724	0.750
Control variables	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes
Wald test ($\beta_1 = \beta_2$)	-1.907	-2.021	-2.747	-3.408
p-val of Wald test	0.057	0.044	0.006	0.001

This table reports the results of firm-level panel regressions examining the relationship between environmental shareholder proposals and green innovation outcomes. In Panel A, the dependent variables comprise measures of green innovation output, specifically truncation-adjusted patent counts, forward citations, and the estimated economic value of these patents. Column (1) of Panel A utilizes the aggregate number of environmental proposals as the independent variable. Column (2) decomposes this aggregate measure into proposals that are voted on, withdrawn, and omitted, while Columns (3) through (5) partition the proposals into voted and unvoted categories. Panel B retains the voted and unvoted specification but restricts the dependent variable exclusively to the truncation-adjusted count of green patents. Specifically, Columns (1) and (2) employ the cumulative adjusted patent counts over two- and three-year forward-looking windows, respectively. Column (3) restricts the sample to firms that are targeted by at least one environmental proposal during the sample period, and Column (4) further limits the estimation to firm-year observations subsequent to the receipt of the initial proposal. The last two rows report t-statistics and p-values from Wald tests of coefficient equality between voted and unvoted proposal counts. All regressions include firm and year fixed effects. Standard errors, clustered at the firm level, are reported in brackets. Statistical significance at the 10%, 5%, and 1% levels is denoted by *, **, and ***, respectively.

Table 5. Support level of green proposals and innovation

Panel A. Support for green proposals

	(1)	(2)	(3)
Dep't var =	Adj. Counts	Adj. Cites	Log(1+Value)
GPROP voting	0.012	0.138*	0.365**
	[0.077]	[0.074]	[0.178]
GPROP voting × Support for	-0.366	-0.607**	-1.454**
	[0.298]	[0.283]	[0.595]
Observations	7,530	7,530	7,530
R-squared	0.703	0.567	0.669
Control variables	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes

Panel B. Effects of low versus high part of green proposal support level

	(1)	(2)	(3)	(4)	(5)	(6)
Dep't var =	Adj. Counts		Adj. Cites		Log(1+Value)	
GPROP voting	-0.108**	-0.031	-0.063	0.029	-0.109	0.180
	[0.048]	[0.043]	[0.044]	[0.038]	[0.112]	[0.126]
GPROP voting ×	0.125		0.220**		0.487**	
Low support	[0.110]		[0.111]		[0.206]	
GPROP voting ×		-0.141*		-0.119		-0.511***
High support		[0.077]		[0.081]		[0.197]
Observations	7,530	7,530	7,530	7,530	7,530	7,530
R-squared	0.703	0.703	0.567	0.566	0.668	0.669
Control variables	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes

This table reports the relationship between the level of shareholder voting support for environmental proposals and subsequent green innovation outcomes. The dependent variables capture three dimensions of patenting activity: *Adj. Counts* (citation-adjusted patent counts), *Adj. Cites* (aggregate forward citation counts), and *Log(1+Value)* (the natural logarithm of one plus the estimated patent value), which are specified in Columns (1)–(2), (3)–(4), and (5)–(6), respectively. Panel A presents estimation results utilizing a continuous measure of voting support. The independent variables are the indicator *GPROP voting* and its interaction with *Support for*, a continuous variable denoting the percentage of votes cast in favor of the environmental proposal. Panel B investigates the heterogeneous effects across discrete thresholds of voting support. The main variables of interest are the interaction terms between *GPROP voting* and two indicator variables, *Low support* and *High support*, which equal one if the voting support percentage falls into the designated lower or upper tiers, respectively. All regressions include firm and year fixed effects. Standard errors, clustered at the firm level, are reported in brackets. Statistical significance at the 10%, 5%, and 1% levels is denoted by *, **, and ***, respectively.

Table 6. Passage of green proposals and innovation

Dep't var = Adj. Counts	(1) Robust	(2) ± 15%	(3) ± 10%	(4) ± 5%	(5) Non-Close
Pass	0.085	-0.168	0.266	0.075	-1.281*
	(0.600)	(0.420)	(0.496)	(0.752)	(0.696)
Observations	673	121	74	34	486
R-squared		0.003	0.029	0.038	0.012

This table presents proposal-level regression discontinuity design (RDD) examining the relation between passing environmental shareholder proposals and adjusted green patent counts. The sample is limited to green shareholder proposals with voting results. Column (1) uses optimal bandwidth selector for the treatment effect estimator, following Calonico et al. (2020). Columns (2)-(4) progressively narrower passing margins, and Column (5) includes non-close-call green proposals. Statistical significance at the 10%, 5%, and 1% levels is denoted by *, **, and ***, respectively.

Table 7. Results in CHMD and non-CHMD industries

	CHMD		Non-CHMD	
	(1) Adj. Counts	(2) 3 years	(3) Adj. Counts	(4) 3 years
#GVoted	-0.296**	0.009	-0.091**	-0.203**
	[0.139]	[0.121]	[0.037]	[0.086]
#GUnvoted	-0.213**	-0.685**	0.026	0.025
	[0.086]	[0.281]	[0.017]	[0.035]
Observations	1,371	1,371	6,159	6,159
R-squared	0.620	0.739	0.723	0.784
Control variables	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes
Wald test ($\beta_1 = \beta_2$)	-0.799	2.196	-2.903	-2.617
p-val of Wald test	0.426	0.030	0.004	0.009

This table presents firm-level regressions for chemical, healthcare, medical equipment, and drug (CHMD) and non-CHMD industries. Columns (1)–(2) restrict the sample to CHMD industries with long innovating lags between R&D investment and new patents, and Columns (3)–(4) analyze the complement set of non-CHMD industries. Odd-numbered columns use adjusted green patent counts as the dependent variable, while even-numbered columns use their three-year totals. The last two rows report t-statistics and p-values from Wald tests of coefficient equality between voted and unvoted proposal counts. All regressions include firm and year fixed effects. Standard errors, clustered at the firm level, are reported in brackets. Statistical significance at the 10%, 5%, and 1% levels is denoted by *, **, and ***, respectively.

Table 8. Balance test of target and matched groups

	Target (N=95)			Control (N=95)			Difference	
Variable	Mean	S.D.	Median	Mean	S.D.	Median	Diff.	t-stat
Log(1 + Assets)	9.352	1.487	9.435	9.173	1.228	9.158	0.179	(-0.91)
Market-to-Book	3.080	3.086	2.055	2.590	3.848	1.729	0.490	(-0.97)
Return on assets	0.029	0.081	0.030	0.027	0.101	0.031	0.002	(-0.18)
Green Patents	0.600	2.285	0.000	0.747	2.798	0.000	-0.147	(0.40)
Adj. Green Patents	0.128	0.513	0.000	0.132	0.514	0.000	-0.004	(0.06)
Adj. Green Cites	0.088	0.389	0.000	0.046	0.274	0.000	0.042	(-0.85)
Log(1 + Green Value)	0.459	1.363	0.000	0.344	1.155	0.000	0.115	(-0.63)

This table compares the characteristics of treated firms and their matched controls with active shareholder base. The treated sample consists of firms subject to shareholder voting on green proposals. Each treated firm is matched to a never-treated control firm within the same year and Fama-French 12 industry, using a nearest-neighbor propensity score matching (PSM) procedure. Propensity scores are estimated using the natural logarithm of total assets, market-to-book ratio, and return on assets, all measured at the fiscal year-end prior to the green activism event ($t-1$). Innovation outcomes include the raw and adjusted count of green patents, their forward citations, and economic value. We report the mean, standard deviation, and median for each variable. The final two columns present the t-statistics for the differences in means between the treatment and control groups. Significance at the 10%, 5%, and 1% levels is indicated by *, **, and ***, respectively.

Table 9. DID results on the propensity-matched sample

	Baseline controls			Matching covariates		
	(1)	(2)	(3)	(4)	(5)	(6)
Dep't var =	Adj. Counts	Adj. Cites	Log(1 + Value)	Adj. Counts	Adj. Cites	Log(1 + Value)
Target × Post	-0.098**	-0.047	-0.166*	-0.119**	-0.053	-0.173*
	[0.047]	[0.032]	[0.091]	[0.057]	[0.034]	[0.098]
Observations	1683	1683	1683	1568	1568	1568
R-squared	0.808	0.705	0.794	0.806	0.714	0.794
Control variables	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes

This table reports difference-in-differences estimates for the propensity score matched sample. Dependent variables include the truncation-adjusted number and citations of green patents, and the logarithm of one plus their economic value. The variable of interest is $Target \times Post$, where $Target$ is an indicator equal to one for firms with voted environmental shareholder proposals and $Post$ equals one for the post-event years. Columns (1)–(3) use the controls variables in baseline analysis, while Columns (4)–(6) only control the matching covariates used in calculating propensity scores. Statistical significance at the 10%, 5%, and 1% levels is denoted by *, **, and ***, respectively.

Table 10. Two-stage Heckman selection model

Panel A. Ex-Target wave

	(1) First Stage	(2) Adj. Counts	(3) Adj. Cites	(4) Log(1+Value)
#Wave Other	0.426***			
	[0.030]			
#GVoted		-0.140**	0.046	-0.249*
		[0.058]	[0.053]	[0.141]
#GUnvoted		0.016	0.012	-0.028
		[0.019]	[0.017]	[0.045]
IMR		0.046	-0.040	0.153
		[0.036]	[0.037]	[0.098]
Observations	13919	7117	7117	7117
F-stat	80.56			
Pseudo/R-squared	0.324	0.711	0.573	0.673
Firm FE		Yes	Yes	Yes
Year FE		Yes	Yes	Yes

Panel B. Ex-Industry wave

	(1) First Stage	(2) Adj. Counts	(3) Adj. Cites	(4) Log(1+Value)
#Wave Other Ind	0.417***			
	[0.037]			
#GVoted		-0.138**	0.058	-0.254*
		[0.064]	[0.056]	[0.148]
#GUnvoted		0.015	0.012	-0.030
		[0.019]	[0.017]	[0.045]
IMR		0.043	-0.050	0.153
		[0.039]	[0.039]	[0.099]
Observations	13919	7117	7117	7117
F-stat	50.59			
Pseudo/R-squared	0.300	0.711	0.573	0.673
Firm FE		Yes	Yes	Yes
Year FE		Yes	Yes	Yes

This table presents Heckman two-stage selection model estimates of the effect of voted green proposals on firm green innovation. The instrumental variable is the number of "wave" proposals excluding the focal firm (Panel A) or excluding its 2-digit SIC industry (Panel B). Column 1 reports the first-stage Probit model over the full at-risk panel, including Mundlak means for unobserved heterogeneity. Columns 2–4 report second-stage OLS estimates where the dependent variables are truncation-adjusted number of green patents and citations, and the natural log of one plus green patent economic value, respectively. The main independent variable, *#GVoted*, is the number of voted green proposals. The Inverse Mills Ratio (*IMR*) from the first stage is winsorized at the 1st and 99th percentiles and included in the second stage to control for selection bias. Second-stage regressions include firm and year fixed effects. Standard errors in brackets are clustered at the firm level and, in the second stage, bootstrapped (500 replications) to correct for generated regressor bias. Statistical significance at the 10%, 5%, and 1% levels is denoted by *, **, and ***, respectively.

Table 11. Disclosure-oriented proposals

	(1)	(2)	(3)
Dep't var =	Adj. Counts	Adj. Cites	Log(1 + Value)
#GVoted_Disc	-0.166***	-0.062	-0.287**
	[0.055]	[0.042]	[0.134]
#GVoted_Nondisc	0.043	0.134**	0.269**
	[0.076]	[0.065]	[0.124]
#GUnvoted	0.014	0.012	-0.035
	[0.014]	[0.013]	[0.035]
Observations	7,530	7,530	7,530
R-squared	0.704	0.567	0.669
Controls	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes
Wald test ($\beta_1 = \beta_2$)	-1.939	-2.180	-2.815
p-val of Wald test	0.053	0.030	0.005

This table presents firm-level regressions examining the heterogeneity of green shareholder proposals based on management resistance (Panel A) and proposal content (Panel B). Dependent variables are green patent outputs, including truncation-adjusted counts and forward citations, and the economic value of new patents. Columns (1)–(3) partition voted green proposals into disclosure-oriented proposals and other proposals based on the reporting- or disclosure-related keywords (e.g., 'Sustainability report', 'Report', 'Publish', and derivatives of 'disclos-'), distinguishing them from those concerning operational practices or internal governance. The last two rows report t-statistics and p-values from Wald tests of coefficient equality between the two sub-categories of voted proposal counts ($\beta_1 = \beta_2$). All regressions include a vector of control variables as well as firm and year fixed effects. Standard errors are clustered at the firm level and reported in brackets. Statistical significance at the 10%, 5%, and 1% levels is denoted by *, **, and ***, respectively.

Table 12. Voted green proposals and executive compensation

	(1)	(2)	(3)	(4)	(5)	(6)
Dep't var =	All E-pay		Quant.	Future	Short	Long
#GPROP	-0.028					
	[0.026]					
#GVoted		-0.172***	-0.088**	-0.057**	-0.138***	-0.034*
		[0.058]	[0.039]	[0.024]	[0.053]	[0.019]
#GUnvoted		0.024	0.011	0.001	0.015	0.009
		[0.026]	[0.022]	[0.010]	[0.023]	[0.009]
Observations	7530	7530	7530	7530	7530	7530
R-squared	0.391	0.394	0.346	0.285	0.393	0.256
Control variables	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Wald test ($\beta_1 = \beta_2$)		-3.05	-2.17	-2.04	-2.76	-1.81
p-val of Wald test		0.002	0.030	0.042	0.006	0.071

This table analyze the changes on executive environmental compensation metrics after green proposal voting. The dependent variables are counts of environmental incentives metrics, including the total (Columns 1–2) and its sub-categories: quantitative (Column 3), future-oriented (Column 4), short-term (Column 5), and long-term (Column 6). The independent variables are the number of green proposals and its partition into voted and unvoted proposals. The last two rows report t-statistics and p-values from Wald tests of coefficient equality between voted and unvoted proposal counts. All regressions include a vector of control variables as well as firm and year fixed effects. Standard errors are clustered at the firm level and reported in brackets. Statistical significance at the 10%, 5%, and 1% levels is denoted by *, **, and ***, respectively.

Table 13. Voted green proposals and environmental incidents

Dep't var =	(1) All E-incidents	(2)	(3) UN Env.	(4) Med/High Sev.	(5) Med/High Reach	(6) Recurrence
#GPROP	0.027					
	[0.018]					
#GVoted		0.047*	0.039	0.060**	0.052**	0.052*
		[0.028]	[0.029]	[0.027]	[0.026]	[0.031]
#GUnvoted		0.021	0.016	0.003	0.015	0.015
		[0.017]	[0.016]	[0.013]	[0.016]	[0.015]
Observations	7530	7530	7530	7530	7530	7530
R-squared	0.836	0.836	0.838	0.771	0.786	0.819
Control variables	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Wald test ($\beta_1 = \beta_2$)		0.91	0.83	2.13	1.39	1.27
p-val of Wald test		0.363	0.405	0.033	0.164	0.204

This table analyze the negative environmental incidents after green proposal voting. The dependent variables are various measures of negative environmental incidents in year $t + 1$, all in the form of natural logarithm. Columns (1) and (2) use the total count of E-incidents. Columns (3) to (6) examine specific incident sub-categories: violations of UN Environmental principles, incidents with medium to high severity, incidents with medium to high reach, and recurrent incidents. The independent variables are the number of green proposals and its partition into voted and unvoted proposals. The last two rows report t-statistics and p-values from Wald tests of coefficient equality between voted and unvoted proposal counts. All regressions include a vector of control variables as well as firm and year fixed effects. Standard errors are clustered at the firm level and reported in brackets. Statistical significance at the 10%, 5%, and 1% levels is denoted by *, **, and ***, respectively.

Table 14. Prior environmental performance, voted green proposals, and innovation

	E Score		Ex ante E Score		Total ESG Score	
	(1)	(2)	(3)	(4)	(5)	(6)
Dep't var = Adj. Counts	Low	High	Low	High	Low	High
#GVoted	-0.108***	-0.065	-0.099**	-0.019	-0.081**	-0.047
	[0.039]	[0.050]	[0.041]	[0.054]	[0.041]	[0.049]
Low (High) ESG	-0.084***	0.095***	-0.090***	0.099***	-0.033	0.103***
	[0.024]	[0.029]	[0.027]	[0.034]	[0.028]	[0.027]
#GVoted ×	0.224**	-0.046	0.169**	-0.130*	0.184*	-0.033
Low (High) ESG	[0.098]	[0.087]	[0.084]	[0.070]	[0.101]	[0.062]
Observations	4469	4469	3845	3845	4442	4442
R-squared	0.725	0.725	0.722	0.723	0.735	0.736
Control variables	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes

This table reports firm-level regression results examining the heterogeneous effects of shareholder activism on green innovation across different ESG profiles. The dependent variable is the adjusted green patent counts. *Low (High) ESG* is an indicator variable equal to one if the firm falls into the bottom (top) quartile of the respective score distribution in the given year, and zero otherwise. Columns (1) and (2) classify firms based on the Environmental (E) Score in the meeting year of green proposal voting. Columns (3) and (4) rely on the ex ante E Score, measured at one year prior to the meeting year, while Columns (5) and (6) employ the aggregate ESG Score in the meeting year. Fluctuations in the observations across specifications are driven by the varying availability of ESG data. All regressions include a vector of control variables as well as firm and year fixed effects. Standard errors, clustered at the firm level, are reported in brackets. Statistical significance at the 10%, 5%, and 1% levels is denoted by *, **, and ***, respectively.

Table 15. Test on energy sector

	(1)	(2)
Dep't var = Adj. Counts	Energy	Non-energy
#GVoted	-0.156***	-0.073
	[0.041]	[0.060]
Low Env.	-0.129	-0.082***
	[0.090]	[0.026]
#GVoted × Low Env.		0.194*
		[0.106]
Observations	527	3,942
R-squared	0.643	0.736
Year FE	Yes	Yes
Firm FE	Yes	Yes

This table reports subsample regression results examining whether the heterogeneous effects of green shareholder activism are driven by the energy sector. The sample is partitioned into energy firms (Column 1) and non-energy firms (Column 2). The dependent variable is the adjusted green patent counts. The independent variable is the number of voted green proposals. *Low Env.* is an indicator variable for firms falling into the bottom quartile of the environmental score distribution in the given year. In Column (1), the interaction term between *#GVoted* and *Low Env.* indicator is omitted due to collinearity, as activist proposals in the energy sector almost exclusively target environmental laggards. All regressions include a vector of control variables as well as firm and year fixed effects. Standard errors, clustered at the firm level, are reported in brackets. Statistical significance at the 10%, 5%, and 1% levels is denoted by *, **, and ***, respectively.

Table 16. Climate coverage shocks, voted green proposals, and innovation

	Shock of UMC			Shock of MCCC		
Dep't var =	(1) Adj. Counts	(2) Adj. Cites	(3) Log(1+Value)	(4) Adj. Counts	(5) Adj. Cites	(6) Log(1+Value)
#GVoted	-0.122***	-0.018	-0.152	-0.090***	0.005	-0.058
	[0.040]	[0.028]	[0.105]	[0.034]	[0.027]	[0.109]
UMC Spike	-0.005	-0.020	-0.030			
	[0.019]	[0.019]	[0.053]			
#GVoted ×	0.159**	0.134**	0.342***			
UMC Spike	[0.068]	[0.062]	[0.111]			
MCCC Spike				-0.045**	-0.016	-0.070
				[0.018]	[0.016]	[0.044]
#GVoted ×				-0.014	-0.001	-0.127
MCCC Spike				[0.047]	[0.045]	[0.117]
Observations	7,530	7,530	7,530	7,530	7,530	7,530
R-squared	0.704	0.566	0.669	0.704	0.566	0.668
Control variables	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes

This table reports regression results examining the moderating role of climate change concern shocks on the relationship between green shareholder activism and corporate green innovation. The dependent variables are the adjusted green patent counts, adjusted citations, and the natural logarithm of one plus the economic value of green patents. The independent variable is the number of voted green proposals. *UMC Spike* is an indicator variable equal to one if the UMC index reaches a 36-month high during the six months preceding the shareholder meeting, and zero otherwise. Columns (4) through (6) present a placebo test using *MCCC Spike*, an indicator based on the raw MCCC index which includes expected components, constructed using the same rolling window and threshold methodology. All regressions include a vector of control variables as well as firm and year fixed effects. Standard errors, clustered at the firm level, are reported in brackets. Statistical significance at the 10%, 5%, and 1% levels is denoted by *, **, and ***, respectively.

Table 17. Pre-vote shareholder proposals outcomes and sponsor features

Panel A. Proposal challenged and sponsor features

	(1)	(2)	(3)	(4)	(5)	(6)
Dep't var = Challenged	Activist	Newcomer	Persister	Indiv.	Instit.	Other
Green	0.394***	0.458***	0.327***	0.445***	0.373***	0.328***
	[0.065]	[0.080]	[0.066]	[0.081]	[0.062]	[0.069]
Sponsor Type	0.032	-0.000	-0.019	0.142***	-0.133***	-0.087**
	[0.059]	[0.029]	[0.029]	[0.034]	[0.043]	[0.038]
Green × Sponsor Type	-0.017	-0.107**	0.134***	-0.107**	0.026	0.127***
	[0.074]	[0.039]	[0.031]	[0.049]	[0.046]	[0.039]
Observations	2193	2193	2193	2193	2193	2193
R-squared	0.303	0.304	0.304	0.311	0.311	0.305
Control variables	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Prop Type FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes

Panel B. Proposal withdrawn and sponsor features

	(1)	(2)	(3)	(4)	(5)	(6)
Dep't var = Withdrawn	Activist	Newcomer	Persister	Indiv.	Instit.	Other
Green	0.135***	0.083**	0.170***	0.140***	0.123***	0.203***
	[0.030]	[0.035]	[0.033]	[0.031]	[0.035]	[0.034]
Sponsor Type	-0.010	0.065***	-0.059***	-0.142***	0.084***	0.044**
	[0.036]	[0.008]	[0.007]	[0.019]	[0.029]	[0.016]
Green × Sponsor Type	0.153***	0.081***	-0.064**	-0.019	0.022	-0.086***
	[0.041]	[0.023]	[0.024]	[0.022]	[0.028]	[0.016]
Observations	10204	10204	10204	10204	10204	10204
R-squared	0.298	0.303	0.302	0.309	0.302	0.297
Control variables	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Prop Type FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes

This table reports proposal-level regression examining the pre-vote outcomes of green shareholder proposals, specifically focusing on how sponsor features moderates the likelihood of a proposal being challenged by management or withdrawn prior to a vote. Panel A presents the linear probability model estimates where the dependent variable is *Challenged*, an indicator equal to one if the firm submitted a no-action request to the SEC. Panel B reports the estimates where the dependent variable is *Withdrawn*, an indicator equal to one if the proposal was withdrawn by the sponsor, which typically reflects a negotiated settlement with management. The primary independent variables are *Green*, an indicator for environmental proposals, *Sponsor Type* (evaluated across Columns 1 through 6), and their interaction term. All regressions include a vector of control variables, as well as proposal firm, year, and proposal type fixed effects. Standard errors, clustered at the proposal type level, are reported in brackets. Statistical significance at the 10%, 5%, and 1% levels is denoted by *, **, and ***, respectively.

Table 18. Support level and sponsor features

	(1)	(2)	(3)	(4)	(5)	(6)
Dep't var = Sup. lev.	Activist	Newcomer	Persister	Indiv.	Instit.	Other
Green	3.163**	3.601**	1.826	2.540*	4.173**	1.935
	[1.471]	[1.486]	[1.401]	[1.285]	[1.828]	[1.546]
Sponsor Type	-0.045	2.833***	-2.248***	-2.042	3.011**	-0.657*
	[0.364]	[0.717]	[0.717]	[1.379]	[1.271]	[0.332]
Green × Sponsor Type	-0.216	-1.721***	2.239***	1.506	-3.290**	2.294***
	[0.532]	[0.598]	[0.648]	[1.827]	[1.369]	[0.423]
Mgmt Rec.	49.587***	49.480***	49.458***	49.249***	49.517***	49.647***
	[3.387]	[3.339]	[3.375]	[3.380]	[3.379]	[3.385]
ISS Rec.	23.216***	23.215***	23.247***	23.214***	23.103***	23.183***
	[1.065]	[1.062]	[1.077]	[1.109]	[1.097]	[1.051]
Observations	5406	5406	5406	5406	5406	5406
R-squared	0.749	0.752	0.751	0.750	0.752	0.749
Control variables	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Prop Type FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes

This table reports the proposal-level regression examining how sponsor features moderates the shareholder support for green proposals that proceed to a proxy vote. The dependent variable is *Sup. lev.*, defined as the percentage of votes cast in favor of the proposal. The independent variables mirror those in Table 17, with the addition controls of *Mgmt Rec.* and *ISS Rec.*, which are indicator variables for favorable recommendations from management and Institutional Shareholder Services, respectively. All regressions include a vector of control variables, as well as proposal firm, year, and proposal type fixed effects. Standard errors, clustered at the proposal type level, are reported in brackets. Statistical significance at the 10%, 5%, and 1% levels is denoted by *, **, and ***, respectively.

Table 19. Green shareholder proposal sponsors and innovation

Panel A. Number of all sponsors

	(1)	(2)	(3)
Dep't var =	Adj. Counts	Adj. Cites	Log(1 + Value)
#All GPROP sponsors	-0.030*	-0.008	-0.073***
	[0.016]	[0.011]	[0.023]
Observations	7,530	7,530	7,530
R-squared	0.703	0.566	0.669
Control variables	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes

Panel B. Number of activists and non-activists

	(1)	(2)	(3)
Dep't var =	Adj. Counts	Adj. Cites	Log(1 + Value)
#Activist(annual)	-0.015	-0.049	-0.081
	[0.070]	[0.049]	[0.141]
#NonActivist(annual)	-0.030*	-0.006	-0.073***
	[0.016]	[0.011]	[0.022]
Observations	7,530	7,530	7,530
R-squared	0.703	0.566	0.669
Control variables	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes
Wald test ($\beta_1 = \beta_2$)	0.232	-0.893	-0.059
p-val of Wald test	0.817	0.372	0.953

Panel C. Number of newcomers and persisters

	(1)	(2)	(3)	(4)	(5)	(6)
	Newcomers vs. The rest			Persisters vs. The rest		
Dep't var =	Adj. Counts	Adj. Cites	Log(1+Value)	Adj. Counts	Adj. Cites	Log(1 + Value)
#Newcomer	-0.027	-0.010	-0.073***			
	[0.018]	[0.012]	[0.023]			
#NonNewcomer	-0.050	0.007	-0.077			
	[0.041]	[0.031]	[0.073]			
#Persister				-0.048	0.018	-0.033
				[0.040]	[0.026]	[0.069]
#NonPersister				-0.027	-0.012	-0.079***
				[0.019]	[0.013]	[0.024]
Observations	7,530	7,530	7,530	7,530	7,530	7,530
R-squared	0.703	0.566	0.669	0.703	0.566	0.669
Control variables	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Wald test ($\beta_1 = \beta_2$)	0.520	-0.482	0.059	-0.445	0.948	0.647
p-val of Wald test	0.603	0.630	0.953	0.656	0.344	0.518

(Continued)

Table 19. (Continued)

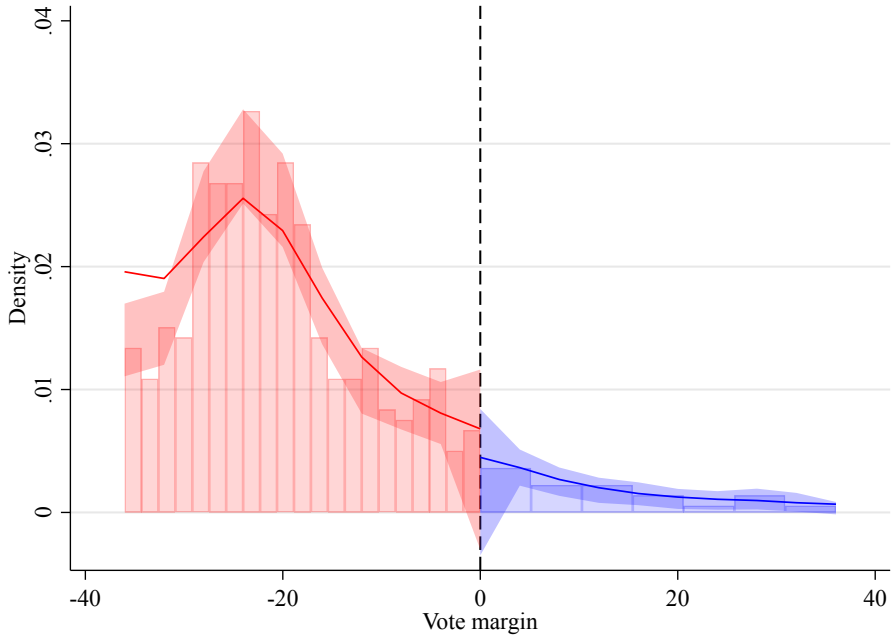
Panel D. Sponsor identity

	(1)	(2)	(3)
Dep't var =	Adj. Counts	Adj. Cites	Log(1 + Value)
#Individual	-0.072**	-0.020	-0.111
	[0.028]	[0.035]	[0.101]
#Other	-0.059**	-0.031**	-0.163***
	[0.026]	[0.016]	[0.039]
#Investment firm	0.070*	0.062*	0.124*
	[0.037]	[0.036]	[0.071]
#Pension	-0.009	0.003	0.003
	[0.012]	[0.010]	[0.035]
#Union	0.132	0.099	0.719**
	[0.220]	[0.188]	[0.347]
Observations	7,530	7,530	7,530
R-squared	0.704	0.567	0.670
Control variables	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes

This table presents firm-level regressions examining the relationship between the breadth of green shareholder activism and corporate green innovation. Dependent variables are defined the same as in Table 4, including truncation-adjusted patent counts, adjusted forward citations, and the economic value of green patents. Panel A utilizes the aggregate number of all green proposal sponsors as the independent variable. Panel B decomposes the sponsors into activists and non-activists. Panel C categorizes sponsors by their submission patterns, comparing newcomers versus non-newcomers (Columns 1–3) and persisters versus non-persisters (Columns 4–6). Panel D classifies sponsors based on their identity, including individuals, investment firms, pensions, unions, and other entities. For Panels B and C, the last two rows report t-statistics and p-values from Wald tests of coefficient equality between the respective decomposed sponsor groups. All regressions include a vector of control variables the same as Table 4, as well as firm and year fixed effects. Standard errors, clustered at the firm level, are reported in brackets. Statistical significance at the 10%, 5%, and 1% levels is denoted by *, **, and ***, respectively.

Appendix

Figure A1. McCrary density test on vote results manipulation



This figure displays the McCrary (2008) density test to assess the continuity of vote distribution around the 50% cutoff point. Margin indicates the difference between support level of a proposal and the 50% approval threshold. The p-value associated with the test is 0.711.

Table A1. Fine-tuning performance

Epoch	Training Loss	Validation Loss	Accuracy	F1
1	0.3060	0.0968	0.9667	0.9675
2	0.0954	0.0898	0.9733	0.9740
3	0.0956	0.1808	0.9600	0.9623
4	0.0029	0.0783	0.9800	0.9805
5	0.0395	0.1026	0.9800	0.9803
6	0.0350	0.1308	0.9733	0.9744
7	0.0094	0.1108	0.9767	0.9772
8	0.0003	0.1182	0.9800	0.9806
9	0.0004	0.1154	0.9767	0.9773
10	0.0002	0.1229	0.9767	0.9773

This table presents training loss, validation loss, classification accuracy, and $F1$ score across ten fine-tuning epochs.

Table A2. Sample of green and non-green LLM-classified shareholder proposal text

Order	Shareholder proposal text for LLM	Type	Score
1	A Special Interest-type sponsor has filed a shareholder proposal to a(an) Food & Kindred Products-sector company. This proposal requests: Assess Environmental Impact of Non-Recyclable Packaging. It falls under a broader agenda class that may include items not directly relevant to this specific proposal: Typically requests that the company report on, or establish, policies on product and packaging recycling, and/or extended producer responsibility (EPR). These resolutions may also ask the company to assess the environmental impact of its current packaging.	Green	0.99996
2	A NULL-type sponsor has filed a shareholder proposal to a(an) Electric, Gas, & Sanitary Services-sector company. This proposal requests: Report on Financial and Physical Risks of Climate Change. It falls under a broader agenda class that may include items not directly relevant to this specific proposal: Typically requests that the company report on the financial and physical risks of climate change on the company's operations, and/or its response to rising regulatory, competitive, and public pressure to significantly reduce greenhouse gas emissions.	Green	0.99996
3	A fund-type sponsor has filed a shareholder proposal to a(an) Oil & Gas Extraction-sector company. This proposal requests: Report on the Result of Efforts to Minimize Hydraulic Fracturing Impacts. It falls under a broader agenda class that may include items not directly relevant to this specific proposal: These proposals request greater disclosure of a companys (natural gas) hydraulic fracturing operations, including measures the company has taken to manage and mitigate the potential community and environmental impacts of those operations.	Green	0.99995
4	A Special Interest-type sponsor has filed a shareholder proposal to a(an) Petroleum & Coal Products-sector company. This proposal requests: Report on the Result of Efforts to Minimize Hydraulic Fracturing Impacts. It falls under a broader agenda class that may include items not directly relevant to this specific proposal: These proposals request greater disclosure of a companys (natural gas) hydraulic fracturing operations, including measures the company has taken to manage and mitigate the potential community and environmental impacts of those operations.	Green	0.99994
5	A Special Interest-type sponsor has filed a shareholder proposal to a(an) Food & Kindred Products-sector company. This proposal requests: Report on Supply Chain Land Rights Issues. It falls under a broader agenda class that may include items not directly relevant to this specific proposal: Typically requests that the company report on or take action to address the impact of its operations on the environment and surrounding communities. This includes resolutions on water use, palm oil production, deforestation, and mountaintop mining. Note: resolutions on the impact of hydraulic fracturing operations fall under a different code.	Green	0.99991

(Continued)

(Continued)

Order	Shareholder proposal text for LLM	Type	Score
6	A Individual-type sponsor has filed a shareholder proposal to a(an) Instruments & Related Products-sector company. This proposal requests: Provide Right to Act by Written Consent. It falls under a broader agenda class that may include items not directly relevant to this specific proposal: This code is used where a shareholder is seeking to amend company articles to provide for the right to act by written consent. A consent solicitation is similar to a proxy solicitation, except that no meeting occurs. Shareholders vote and sign their consents and deliver them to management. If enough consents are returned, the subject of the consent is deemed ratified.	Non-Green	0.99990
7	A public pension-type sponsor has filed a shareholder proposal to a(an) Non-Classifiable Establishments-sector company. This proposal requests: Report on Lobbying Payments and Policy. It falls under a broader agenda class that may include items not directly relevant to this specific proposal: Typically requests that the company prepare a report on its payments and policies related to direct and indirect lobbying expenditures, including payments made to trade associations.	Non-Green	0.99988
8	A Individual-type sponsor has filed a shareholder proposal to a(an) Wholesale Trade – Nondurable Goods-sector company. This proposal requests: Adopt Proxy Access Right. It falls under a broader agenda class that may include items not directly relevant to this specific proposal: Typically requests that the company allow shareholders access to the ballot.	Non-Green	0.99984
9	A company-type sponsor has filed a shareholder proposal to a(an) Insurance Agents, Brokers, & Service-sector company. This proposal requests: Adopt a Policy to Annualy Disclose EEO-1 Report. It falls under a broader agenda class that may include items not directly relevant to this specific proposal: Typically requests that the company prepare an updated diversity report identifying employees according to their gender and race in each of the nine EEOC-defined job categories.	Non-Green	0.99984
10	A Individual-type sponsor has filed a shareholder proposal to a(an) Automative Dealers & Service Stations-sector company. This proposal requests: Require Independent Board Chairman. It falls under a broader agenda class that may include items not directly relevant to this specific proposal: Separate the positions of CEO and Chairman such that two individuals hold these positions.	Non-Green	0.99984

This table reports a random sample of shareholder proposals classified by the LLM. "Green" proposals pertain to environmental issues, whereas "Non-Green" proposals capture other governance or social matters. Score denotes the LLM-implied probability associated with the classification outcome.

Table A3. List of top-10 activist of green proposals by overall types

Rank	Sponsor Name	Frequency	Freq. (%)
A. Top-10 Individuals			
1	Milloy, Steven	15	0.46
2	Ridenour, David	14	0.43
3	Taggart, Stewart	13	0.40
4	Behar, Andrew	11	0.34
5	McRitchie, James	11	0.34
6	Chevedden, John	10	0.31
7	Harrington, John C.	10	0.31
8	Young, Myra	7	0.22
9	Olson, Carl (State Dept. Watch)	6	0.18
10	Benta B.V.	5	0.15
B. Top-10 Institutions			
1	Calvert Asset Management Co.	209	6.42
2	New York State Common Retirement Fund	191	5.87
3	Walden Asset Management	160	4.92
4	New York City Pension Funds	148	4.55
5	Green Century Capital Management	113	3.47
6	Trillium Asset Management	98	3.01
7	California State Teachers' Retirement System	82	2.52
8	Mercy Investment Services	71	2.18
9	Domini Social Investments	48	1.48
10	Harrington Investments	33	1.01
C. Top 10 Other			
1	As You Sow Foundation	288	8.85
2	The Nathan Cummings Foundation	77	2.37
3	Unitarian Universalist Association	43	1.32
4	Presbyterian Church USA	40	1.23
5	Sisters of St. Dominic, Caldwell, NJ	37	1.14
6	General Board of Pension and Health Benefits of the United Methodist Church	36	1.11
7	Sierra Club Foundation	26	0.80
8	The Province of St. Joseph of the Capuchin Order	20	0.61
9	National Center for Public Policy Research	19	0.58
10	Episcopal Church	14	0.43
D. Sponsor Type Distribution of All Green Shareholder Proposals			
1	Institution	1795	55.18
2	Other	1129	34.71
3	Individual	329	10.11

This table lists the top 10 most frequent green shareholder proposal sponsors by their identities over the sample period: individuals (Panel A), institutions (Panel B), and other (Panel C). Freq. (%) is the percentage of times a specific sponsor appears among all sponsors of green shareholder proposals during the sample period. The listed activists jointly account for 56.19% of sponsor appearances in green activism, with individuals representing 3.14%, institutions 35.43%, and other sponsors 18.44%. Panel D reports the distribution of green proposals by shareholder type.

Table A4. Alternative model specifications

	(1)	(2)	(3)
Dep't var = Adj. Counts	OLS	Poisson	Poisson
#GVoted	-0.106***	-0.105*	-0.188***
	[0.038]	[0.061]	[0.073]
#GUnvoted	0.012	0.021	0.063
	[0.016]	[0.032]	[0.045]
Observations	7,442	3,392	2,965
Pseudo/R-squared	0.732	0.409	0.411
Controls	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes
Ind x Year FE	Yes	No	Yes
Wald test ($\beta_1 = \beta_2$)	-2.849	-2.167	-3.454
Wald p-val	0.004	0.030	0.001

This table presents robustness tests examining the relationship between voted environmental shareholder proposals and adjusted green patent counts. Column (1) adds industry-year interaction fixed effect to the baseline OLS model. Column (2) adopt Poisson regression to account for count-based nature of patent data, and Column (3) additionally control for industry-year fixed effect. Statistical significance at the 10%, 5%, and 1% levels is denoted by *, **, and ***, respectively.

Table A5. Alternative measures on the number of green patents

	(1)	(2)	(3)
Dep't var =	Log(1 + Adj. Counts)	Climate Adj. Counts	Log(1 + Climate Adj. Counts)
#GVoted	-0.046**	-0.119***	-0.058***
	[0.020]	[0.041]	[0.022]
#GUnvoted	0.005	-0.010	-0.005
	[0.007]	[0.012]	[0.006]
Observations	7,530	7,530	7,530
R-squared	0.704	0.657	0.662
Year FE	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes
Control Variables	Yes	Yes	Yes
Wald test ($\beta_1 = \beta_2$)	-2.510	-2.548	-2.340
Wald p-val	0.012	0.011	0.020

This table presents robustness tests examining the relationship between voted environmental shareholder proposals and adjusted green patent counts. Column 1 replaces the adjusted number of green patent counts with its natural logarithm. Column 2 uses the adjusted number of climate-change-specific patents as the dependent variable, with the same truncation adjustment method as the baseline. Column 3 applies a log transformation to climate patents. Statistical significance at the 10%, 5%, and 1% levels is denoted by *, **, and ***, respectively.

Table A6. Other robustness tests on baseline results

Dep't var = Adj. Counts	(1) Winsor	(2) Dummy	(3) Median 5y	(4) Mean 5y	(5) High vs. Low Support	(6) E control
#GVoted_w	-0.091**					
	[0.040]					
#GUnvoted_w	0.023					
	[0.024]					
I(GVoted)		-0.078*				
		[0.042]				
GVoted ratio(med 5yr)			-0.154*			
			[0.085]			
GVoted ratio(mean 5yr)				-0.270*		
				[0.143]		
Support over 55th					-0.143***	
					[0.045]	
Support below 45th					-0.025	
					[0.056]	
#GVoted						-0.087**
						[0.040]
#GUnvoted						0.044*
						[0.023]
E Score						0.003***
						[0.001]
Observations	7,530	7,530	7,530	7,530	7,530	4,469
R-squared	0.703	0.703	0.703	0.703	0.703	0.726
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Control Variables	Yes	Yes	Yes	Yes	Yes	Yes
Wald test ($\beta_1 = \beta_2$)	-2.403				-1.702	-3.200
Wald p-val	0.017				0.089	0.001

This table presents robustness tests for the relationship between voted green shareholder proposals and truncation-adjusted green patent counts. Column (1) reports estimates where the number of voted green proposals is winsorized at the 1st and 99th levels. Column (2) utilizes an indicator variable equal to one if the firm had at least one green proposal reaching a proxy vote. Columns (3) and (4) use ratios of voted green proposals relative to five-year index-level means and medians, respectively. Column (5) partitions the number of voted proposals into high-support (above the 55th percentile) and low-support (below the 45th percentile) categories based on index-year distributions. Column (6) controls for firm-level environmental performance scores. Statistical significance at the 10%, 5%, and 1% levels is denoted by *, **, and ***, respectively.

Table A7. Robustness tests on results of support level of green proposals and innovation

	3 year			Ever GPROP		
Dep't var =	(1) Adj. Counts	(2) Adj. Cites	(3) Log(1+Value)	(4) Adj. Counts	(5) Adj. Cites	(6) Log(1+Value)
GPROP voting	0.182	0.353*	0.427**	0.019	0.134*	0.388**
	[0.188]	[0.204]	[0.188]	[0.075]	[0.072]	[0.176]
GPROP voting ×	-1.266	-1.733**	-1.816**	-0.351	-0.562**	-1.401**
Support for	[0.781]	[0.792]	[0.708]	[0.292]	[0.274]	[0.589]
Observations	7,530	7,530	7,530	3,459	3,459	3,459
R-squared	0.774	0.634	0.735	0.724	0.596	0.689
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes	Yes	Yes

This table presents firm-level regressions examining the relation between support level of environmental shareholder proposals and innovation outcomes. Dependent variables include the truncation-adjusted number and citations of green patents, and the logarithm of one plus their economic value. Columns (1)–(3) use the cumulative innovation outputs over a three-year forward-looking window, and Columns (4)–(6) limit the sample to firms that are targeted by at least one environmental proposal during the sample period. All regressions include firm and year fixed effects. Standard errors, clustered at the firm level, are reported in brackets. Statistical significance at the 10%, 5%, and 1% levels is denoted by *, **, and ***, respectively.