Silencing the Green Engine: How Shareholder Voice Suppresses Innovation *

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Abstract

Using a fine-tuned large language model (LLM) to identify environment-related shareholder proposals, we examine how adversarial activism signaled by green proposal voting shapes firms' innovation policies. We document that the volume of proposals reaching a shareholder vote significantly suppresses corporate green innovation. Distorted managerial incentives and reputational risk serve as the potential channels for this decline in patenting. Cross-sectional analyses indicate that these "distraction" effects are more pronounced among firms with shorter innovation cycles and those exposed to symbolic proposals. In contrast, green activism activates innovation both for environmentally underperforming targets and during periods of peak climate concerns. This paper provides evidence that shareholder voice on environmental issues unintentionally engenders new agency costs of underinvestment, while such engagement disciplines firms' environmental conduct conditionally.

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 responsibility, does corporate America respond substantively or merely comply symbolically? The rapid expansion of environmental shareholder activism has generated an active and unresolved debate: does governance pressure discipline managerial myopia and accelerate the green transition, or does adversarial engagement impose costs that undermine the very practices it intends to promote?

Shareholder proposals represent a critical governance instrument through which investors exercise voice, monitor management, and coordinate collective action on corporate matters. [1] Under SEC Rule 14a-8, shareholders may force a company to include a resolution in its proxy materials, subject to eligibility requirements, though firms may also seek regulatory relief from the SEC to exclude proposals from the ballot. The process has become the primary channel of public environmental engagement, with proposal volumes surging sharply following the SEC's issuance of Staff Legal Bulletin No. 14L, which narrowed the scope for excluding proposals tied to significant social policy issues.

Agency theory offers competing hypothesis about the real effects of this pressure on corporate innovation. On one hand, suboptimal managerial effort, often characterized as shirking (Manso, 2011), managerial slack (Aguilera et al., 2008), or the pursuit of a quiet life (Bertrand and Mullainathan, 2003), may be corrected by external shareholder pressure, incentivizing longer-horizon investment. On the other hand, increasing environmental demands may divert managerial attention and cause management's resistance which crowd out strategic focus from the long-term investments. Managers may preemptively cut innovative spending to avoid earnings disappointments that could trigger large-scale institutional selling and lead to temporary stock undervaluation (Bushee, 1998). Because radical innovation requires the exploration of untested approaches with a high probability of failure, strong governance mechanisms that punish such early failures can heighten a manager's career concerns, making them less willing to "swing for the fences" (Manso, 2011; Aghion

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

et al., 2013). This external interference can induce defensive organizational "reactance," where managers engage in symbolic responses—demonstrating outward conformance through settlements or "window dressing" to satisfy salient shareholders—while diverting internal resources toward political activities to resist external pressure and preserve their discretion (David et al., 2007).

A shareholder proposal reaching to a public proxy vote signals a breakdown in private dialogue and exacerbates objective divergence and time-horizon mismatches between shareholders and management. In an incomplete contract situation, this friction is particularly pronounced in corporate green transition, which involves substantial uncertainty and makes it difficult to contract ex ante on environmental objectives (Grossman and Hart, 1986; Hart, 1995). As a result, short-term ESG accountability can overload the corporate agenda and shift focus away from long-term, explorative experimentation toward immediate and observable actions even management aware that those have limited social impact (Ocasio, 1997; Shapira et al., 2026). This strand of the literature suggest that "weak" governance may sometimes be a necessary evil to protect the innovation process (Manso, 2011; Keum, 2021).

Moreover, activist pressure generates a multi-task agency problem (Holmstrom and Milgrom, 1991), under which managers reallocate effort from complex, hard-to-measure innovation to more observable, symbolic actions that appease activists (Meyer and Rowan, 1977; Westphal and Zajac, 1994, 1998), while diverting resources toward defensive activities such as lobbying, legal resistance, and public relations at the expense of productive green innovation (David et al., 2007).

Whether discipline or distraction dominates remains an open question with direct implications for the efficacy of ESG-oriented shareholder engagement. We study the research question using a comprehensive sample of U.S. Russell 3000 firms from 2012 to 2023. To precisely identify environmental proposals, we classify all ISS shareholder resolutions using a fine-tuned large language model based on ClimateBERT (Bingler et al., 2024). Augmented with proposal- and firm-level contextual metadata, this approach identifies 46% more environmental proposals than the raw taxonomy and resolves systematic misclassifications between environmental and social mandates.

We focus on voted environmental proposals because they represent the failure of private negotiations and entail escalated public pressure on management. Our baseline results demonstrate that environmental proposals escalating to a formal proxy vote are associated with a significant and persistent decline in subsequent green patenting activity. In contrast, proposals resolved privately, either withdrawn through negotiation or omitted via SEC relief, exhibit no such effect. Furthermore, the stock market reaction to the announcement of a voted environmental proposal is significantly negative, consistent with investors pricing in expected transition costs and managerial distraction.

We identify two channels driving this decline in green innovation. First, using ISS executive compensation data, we find that voted green proposals significantly reduce the prevalence of environmental metrics in executive compensation, particularly quantitative and short-term incentive components. This "incentive decoupling" aims to shield managers from short-term activist pressures and to curtail the opportunism around scrutinized metrics, however, it inadvertently strips the long-horizon incentives required to sustain exploratory green innovation. Second, using RepRisk data, we document that voted proposals are significant leading indicators of subsequent high-severity, widely-reported negative environmental incidents. The realization of these environmental risks and the attendant reputational pressure divert managerial attention toward crisis management, reducing failure tolerance and depleting resources otherwise available for long-term projects.

The real effects of environmental activism exhibit significant cross-sectional heterogeneity. Decomposing proposals by content, the suppression is concentrated in disclosure-oriented resolutions, which afford managers substantial discretion to respond symbolically rather than substantively. Cross-sectional analysis reveals that environmental activism exerts a disciplinary effect for firms with weak environmental performance, where pressure redirects managerial focus toward substantive technological investment. Furthermore, when voted proposals coincide with unexpected shocks to aggregate climate sentiment, the baseline suppression reverses, as aligned market incentives transform adversarial pressure into an innovation catalyst. Consistent with stakeholder salience theory (David et al., 2007), we also find that the adverse effect is driven by individual activists and non-pecuniary advocacy organizations, while proposals from institutional shareholders are positively associated with green innovation.

This paper contributes to the ongoing debate regarding the real effects of ESG shareholder engagement and the broader literature on agency conflicts and corporate innovation. Our findings yield important implications for the design of corporate governance mechanisms. Specifically, while highlighting the unintended consequences of adversarial environmental activism, the results demonstrate that governance interventions can effectively advance corporate social responsibility when appropriately timed and tailored.

The remainder of the paper is organized as follows. Section 2 describes the data, LLM-based classification procedure, and sample description. Section 3 presents the baseline results. Section 4 addresses causality and robustness. Section 5 and Section 6 investigates the underlying channels and cross-sectional heterogeneity. Section 7 draw 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 proposals from Institutional Shareholder Services (ISS), which covers the Russell 3000 firms. 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 precisely identify environmental shareholder 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-based text classification typically relies on raw text alone. However, shareholder resolutions in ISS data are often laconic, leading to semantic ambiguity when evaluated in isolation. To resolve these ambiguities and mitigate measurement errors inherent in polysemous language, 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 economically relevant priors that are often latent or omitted in the summary text.

While incorporating this contextual metadata, we intentionally mask specific entity identities (i.e., target firm and proponent names). This masking procedure is crucial for mitigating *pre-training bias*. Because LLMs embed extensive background knowledge regarding prominent firms, retaining specific corporate identifiers may cause predictions to reflect pre-existing reputational associations rather than the substantive text of the individual resolution.[2] Masking entity names forces the model to condition its classification strictly on the semantic content of the proxy material.

By simultaneously masking named entities and augmenting inputs with structural metadata, the model learns fundamental economic relationships rather than statistical artifacts. For instance,

2. 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.

it captures the underlying association between methane-related vocabulary and the energy sector, thereby enhancing out-of-sample generalizability. More importantly, layering proposal text with metadata systematically resolves semantic ambiguities that confound traditional keyword-based or zero-shot classifications. For example, an isolated 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). Similarly, 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 employ a training strategy involving stratified sampling and human supervision. Because of the scarcity of green proposals, it would yield an unbalanced training set dominated by obvious non-environmental proposals if we random sample proposal data for training set, which provides little information for the model to learn decision boundaries. Instead, we apply stratified sampling approach based on the model's confidence probability. Specifically, we run an initial version of the model on the full sample and select observations for manual labeling from two specific strata. We partition observations into score-based quartiles. From the first and second quartiles, we randomly draw 750 observations each, resulting in a balanced training set of 1,500 samples concentrated in the lower half of the score distribution.

We verify and correct each label of the stratified samples, thus formulate our training set and further fine-tune the downstream classification layer of ClimateBERT. In this way, over-sampling the "hard-to-classify" cases can help maximize the marginal information gain from manual labeling and improve the model's ability to distinguish between environmental and social proposals rather than superficial keyword overlap. The fine-tuning performance of the LLM is reported in Appendix

Table A1. [3]

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. 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.

To ensure robustness, we evaluate the model's predictions across the full sample and perform targeted manual audits. Specifically, we check for proposals containing keywords that are inherently associated with social issues and have been shown to systematically generate false positives. These include terms such as "Net neutrality," "Human right to water," "Food waste," and "Pig gestation."

A known limitation of encoder-only LLMs is their tendency to generate false positives when encountering high-frequency "buzzwords" that appear across multiple ESG contexts (e.g., *Safety*, *Water*, or *Waste*). A central objective of our fine-tuning and refinement process is to achieve high discriminant validity—distinguishing strictly environmental mandates from social or governance interventions that utilize similar language. We compare two proposals regarding supply chain management, which are both submitted to firms in the Food & Kindred Products industry:

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 this as a product safety and consumer health issue for a food supplier rather than a systemic climate or environmental risk. This avoids the conflation of public health concerns with environmental targets.an a systemic climate or

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

environmental risk, thereby avoiding the conflation of public health concerns with environmental targets.

2.1.3 Classification results and stylized facts

Table A2 provides validation examples drawn from random sampling following the LLM-based classification. The LLM framework deconstructs aggregated ESG classifications to identify 2,840 unique environmental resolutions, representing 14.85% of the total sample. This approach yields substantial improvements over legacy commercial taxonomies. A benchmark classification based solely on the ISS "Environmental" tag identifies only 1,943 proposals (10.16% of the total sample). By recovering environmental resolutions latent within the ISS "E&S Blend" category, our framework expands the identified green set by 46.17%. Conversely, an overly broad definition that includes the entire "E&S Blend" category inflates the count to 3,727 (19.49%), introducing significant measurement error through the inclusion of non-environmental social and governance issues.

Figure 1 plots the evolution of green proposal volume and average voting support from 2012 to 2023. Green proposal volume was relatively stable throughout the pre-2021 period,

as firms frequently invoked the Rule 14a-8 exception to omit environmental resolutions from their proxy statements. This regulatory regime shifted in November 2021 with the SEC's issuance of Staff Legal Bulletin No. 14L (SLB 14L), which narrowed the scope for excluding proposals tied to significant social policy issues. After the announcement, total volume surges to approximately 200 green proposals during the 2022 and 2023 proxy seasons, accompanying with a contraction in omitted resolutions and a surge in green proposals reaching a vote.

Despite the surge in volume, average shareholder support experienced a stark reversal. Support rates climbed steadily to a peak of approximately 40% in 2021, only to plummet to roughly 20% following the implementation 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. Rather than merely requesting climate-risk disclosures, these resolutions increasingly seek to mandate specific emissions-reduction strategies and operational milestones. In sum, while regulatory easing empowers environmental activism, it simultaneously facilitates the entry of marginal, highly prescriptive proposals that lack broad investor consensus and may encroach on managerial discretion.

2.2 Innovation data and truncation bias adjustment

This paper focuses on green innovation to distinguish substantive technological progress from symbolic actions or "cheap talk". While emission reductions can often be achieved through static abatement activities, green innovation represents a forward-looking, albeit risky, commitment to solving environmental and climate challenges and hedging against transition shocks.

Innovation entails long development horizons and a tolerance for early failure, a trait often at odds with the pressures from investors embracing shorter horizons. This trade-off is critical because if shareholder pressure induces managers to prioritize immediate, visible compliance targets, such as emissions reductions or ESG rating improvements, it may compete with other corporate agendas, inadvertently crowd out the internal resources and divert managerial attention required for breakthrough technologies. Thus, understanding the relationship between shareholder activism and green innovation is essential to determine whether engagement strategies genuinely advance the green transition or merely encourage superficial "greenwashing" at the expense of long-term solutions.

We use green patents to proxy the level of corporate green innovation because patents are the most natural and readily observable outputs from innovation activities. We obtain patent data from the extended version of Kogan et al. (2017) (KPSS hereafter). Similar to the matching methods of previous studies (Cohen et al., 2026; Sautner et al., 2023; Li et al., 2024), our identification on green patents relies on their Cooperative Patent Classification (CPC). Green patents generally include patents on pollution and emission abatement, water-related adaptation, renewable energy, energy storage, carbon capture and storage, and climate change mitigation technologies. In the universe of KPSS patents, we map CPC with the OECD algorithm provided by Haščič and Migotto (2015), and we can match 175,968 or 5.32% of 3,282,234 patents in environment-related technology domains.

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, which is pioneered by Hall et al. (2005) and Seru (2014). 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. 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.

The comparison between unadjusted and adjusted green patent data (including patent counts and forward citations) is presented in Figure 2. Both unadjusted counts and citations exhibit a sharp decline over time, and become notably sparse toward the sample-end, which indicates patent applications are underrepresented and justifies adjustment solution. Our 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 the patent data.

In this study, we measure a firm's green innovation quantity using the total adjusted number of green patents, aggregated by patent application year. We capture green innovation quality using two proxies. First, we use the total adjusted forward citations received by these patents, also aggregated by application year. Second, we employ the economic value of patents, following Kogan et al. (2017). This measure is defined as 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. [4]

2.3 Other data

SEC no-Action letter data. We examine managerial responses to green shareholder activism prior to proposals reaching the shareholder meeting. This dataset serves two primary purposes. First, it allows us to verify the concentration of shareholder proposals. Second, it enables us to track early managerial resistance to shareholder activism.

In particular, we trace firms' no-action requests submitted to the SEC, which seek regulatory relief to exclude specific shareholder proposals from proxy materials. We hand-collect and parse all no-action letters issued by the SEC's Division of Corporation Finance since 2006. No-action letters document the regulatory process through which SEC staff act as intermediaries in disputes between management and shareholders, and they contain three key components: the original shareholder proposal, the firm's request for exclusion, and the SEC's final determination. Our parsed no-action letter dataset comprises approximately 3,523 records, which can be successfully matched to the ISS dataset through fuzzy match method based on the information of proponents, companies, and dates.

There are other datasets used for analysis. ESG data comes from S&P Global ESG Score. Environmental incidents data comes from RepRisk. Executive compensation metrics data comes

4. 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.

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.

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. [5] 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 A4 presents summary statistics for the primary variables used in our analysis, and Table A5 discloses variable definitions. All continuous 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

5. 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.

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.

3 Baseline results

3.1 Firm value implications of voted green proposals

We first 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 1.

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 proposals voting and green innovation

3.2.1 Voting of green shareholder 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 the following sections.

We first focus on the *depth* of green activism and investigate whether proposals that proceed to a shareholder vote elicit changes in environmental innovation strategies. 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. 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 ballot via SEC no-action relief. Consequently, this decomposition provides a proxy for the salience of the shareholder demand and the extent of divergence between shareholders and management. 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 2 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. Conversely, the coefficients on withdrawn and omitted proposals are economically small and statistically insignificant.

Column (3) aggregates the unvoted categories into a single component (#GUnvoted). Consistent with the findings in Column (2), the coefficient on #GVoted remains negative and highly significant, whereas the coefficient on #GUnvoted is positive and insignificant. These findings suggest that the voting status of environmental proposals is a critical determinant of their impact. Specifically, voted proposals are associated with a subsequent reduction in the volume of green patents generated by targeted firms. Furthermore, the estimated effect of voted proposals differs significantly from that of their unvoted counterparts; a Wald test of the equality of coefficients ($\beta_1 = \beta_2$) strongly rejects the null hypothesis (p-value = 0.005).

In Columns (4) and (5), we investigate whether this reduction in patenting quantity is accompanied by a deterioration in patent quality. Utilizing aggregate forward citations and the natural logarithm of estimated patent value as the dependent variables, we find no evidence that environmental proposals—regardless of their voting status—adversely affect the quality or economic value of the firm's green innovation output. 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 (p-values of 0.830 and 0.518, respectively). Collectively, these results imply that while environmental activism that reaches a proxy vote may reduce the overall quantity of green patents, it does not appear to compromise the average quality or economic value of the innovations produced.

Panel B of Table 2 conducts a series of robustness tests to validate our baseline findings regarding the reduction in green patent quantity. To address concerns about the temporal dynamics of innovation output, Columns (1) and (2) extend the measurement window, utilizing the adjusted patent counts over two- and three-year forward-looking horizons, respectively. The coefficients on #GVoted remain negative and statistically significant, indicating a persistent decline in green patenting activity following a voted proposal.

Furthermore, Columns (3) and (4) alter the sample. Column (3) restricts the sample exclusively to firms targeted by at least one green proposal during the sample period, and Column (4) focuses on firm-year 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 four Columns (p-values ranging from 0.001 to 0.057), reinforcing the robust structural divergence driven by the voting status of the resolutions.

3.2.2 Support level of green shareholder proposals

Shareholder proposals serve not only as a mechanism to communicate discontent to management, but also a public channel to reveal the aggregate preferences of broad shareholder base. Unlike the initial submission, which reflects the specific agenda of a few active shareholders, voting outcomes aggregate the views of the wider investor community, including passive institutional investors who may otherwise be reticent to engage (Kastiel and Nili, 2020; Nili and Kastiel, 2016).

We condition on green proposals that have been brought to a shareholder vote, the similar setting as He et al. (2023), and then examine whether the degree of voting consensus among shareholders conveys differential information about firms' 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 3 presents the regression results. In Panel A, we employ an interaction specification. 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.

The results in Panel A reveal a nuanced relationship. 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 prompt management to enhance green patent quality. For the quantity measure in Column (1), the interaction coefficient is negative but insignificant ($t = 1.23, -0.366/0.298$). However, the coefficient on the interaction terms ($GPROP\ voting \times Support\ for$) are significantly negative for patent citations and value at the 5% level. The results of robustness test are similar when we re-run the regressions using innovation outputs over longer window and using subsample, as shown in Table A9. This implies that the quality of green patent decreases as shareholder support on green proposals intensifies.

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. The interaction with $Low\ support$ yields positive and significant coefficients for innovation quality (e.g., 0.540 for patent value in Column (5), indicating that proposals receiving mild shareholder endorsement are associated with improved innovation quality. In contrast, the interaction with $High\ support$ is negative and statistically significant across all specifications.

Collectively, these findings suggest that while "nudges" from activists that receive low-to-moderate support may encourage firms to generate higher-quality patents, overwhelming shareholder pressure in the form of high consensus appears to act as a constraint, potentially forcing firms to prioritize short-term compliance or other defensive measures over long-term, high-value exploratory innovation.

We 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%). Consequently, 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.

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

The RDD estimates are reported in Table 4. 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%. For comparison, the Column (5) only includes the sample of non-close-calls, which lie far from the passing threshold. We observe that the point estimates remain are generally statistically indistinguishable from zero, except for non-close proposals.

In aggregate, our findings based on shareholder proposal passage indicate that the deterioration of green innovation post activism is less attributable to the direct consequence of governance mechanism than to preemptive managerial responses triggered by escalating shareholder sentiment on environment issues.

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. [6] We explore CHMD subsample and its complement to distinguish the impact of proposal intervention 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 5 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). [7] The evidence in short-lag

6. 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.

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

industries support that pushing green proposals to a formal vote exerts a distinct intervention effect that suppresses corporate green innovation.

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 shareholder activism, highlighting the role of shareholder proposals as a complementary external governance mechanism (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 6 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 6 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 7 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 trajectory 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 green 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 sample-period time-series means of the firm-level controls, $\bar{X}_i$, 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 explicitly 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 procedure corrects for the error propagation between the two stages, addresses potential serial correlation and clustering effects in the panel structure, and ensures the statistical robustness of our identification strategy.

Table 8 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 quantity 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 subject the baseline results to a battery of robustness checks:

(1) For the 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.

(2) For model specifications, we add industry $\times$ 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 interaction fixed effects in the Poisson model.

(3) For 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).

Across all these specifications, our baseline findings remain qualitatively unchanged and statistically significant. Details of the robustness tests are reported in the Appendix. All relevant results are presented in Tables A6, A7, and A8.

5 How green activism influence innovation?

5.1 Underlying channels

5.1.1 Internal managerial incentives

Executive compensation metrics align corporate strategy with shareholder expectations, and their effective disclosure fosters consensus on management's strategic direction (Gantchev et al., 2025). 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. Crucially, 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, as green innovation inherently requires long-term investment horizons and sustained environmental commitment.

However, the presence of a voted green shareholder proposal usually indicates a controversial resolution resulting from the failure of private, "behind-the-scenes" engagements between shareholders and management. This can inherently transform environmental objectives into highly politicized events, drawing intense public scrutiny driven by investors seeking to align managerial outcomes with the environmental preferences (Cohen et al., 2023; Jensen and Murphy, 1990).

Under the heightened scrutiny following the public pressures from proposal voting, boards must also account for the distortionary effects of 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).

Consequently, elevated CSR sentiment reduces corporate reliance on explicit environmental compensation. To shield managers from short-term activist pressures and to curtail the opportunistic gaming of highly scrutinized metrics, we posit that boards optimally choose to reduce the sensitivity of executive pay to explicit environmental targets. This rational contracting response, however, yields unintended real consequences. By stripping away these 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 revert to myopic goals and symbolic compliance.

Motivated by these contracting frictions, we test the "incentive decoupling" hypothesis, which posits that green activism drives the dilution of environmental criteria from executive contracts. 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.” Table 10 presents the empirical 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 formally 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 withdrawn or excluded.

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. Facing elevated shareholder pressure and external noise, boards systematically de-emphasize quantifiable and short-term environmental targets to insulate performance evaluation from market sentiment and curb managerial opportunism. Such defensive contracting undermines the managerial incentives required for sustained green innovation.

5.1.2 External reputational risk

Corporate irresponsible behavior is a well-documented catalyst for institutional engagement (McCahery et al., 2016). When latent ESG vulnerabilities materialize into salient negative incidents, they act as powerful triggers that heighten reputational accountability for investors and reveal critical new information about hidden ESG weaknesses of the company (Liang et al., 2025). The materialization of environmental risks thus creates urgent operational and financial imperatives for the firm. Indeed, negative ESG news induces analysts to significantly downgrade their earnings forecasts, which negatively affects firm value (Derrien et al., 2025).

Within this framework, we investigate whether green proposals act as early-warning signals that precede these severe reputational shocks. While He et al. (2023) document that the support levels of environmental and social votes aggregate private shareholder information regarding future risks, we posit a distinct signaling mechanism based on the mere *presence* of such votes. Because shareholders and management typically resolve disputes through private, behind-the-scenes engagements, a green proposal that formally reaches the proxy ballot exposes a failure in internal governance. It publicly signals severe divergences in environmental practices and managerial resistance to accountability. Hence, the voting event itself pre-emptively reveals these latent governance hazards, serving as a leading indicator of subsequent negative coverage and the realization of environmental risks.

Activism subjects the firm to intense external scrutiny and media agenda-setting, amplifying the severity and reach of these environmental issues (Dyck et al., 2008). This ensuing reputational crisis can stifle green innovation via three frictions. First, attention diversion. Because managerial attention is scarce, concentrated negative coverage forces managers to prioritize immediate crisis communication and regulatory compliance over highly uncertain, long-term green technology development (Ocasio, 1997). Moreover, recent paper suggest that information fatigue and agenda overload externally sourced from broader societal concerns can impair the board's monitoring capacity hinder its ability to triage business priorities (Shapira et al., 2026). Second, financing frictions. Negative coverage erodes reputational capital and increases the risk premiums demanded by investors (Vasi and King, 2012). Facing high cost of capital, managers are likely to hold a precautionary savings motive and a preference for conservative liquidity management policies. Since firms cautiously build internal cushions and fund short-term compliance, financial resources could be crowded out that might otherwise have been allocated on riskier and longer-horizon green investments. Third, heightened risk aversion. External scrutiny creates an asymmetric payoff structure... outweighed by the career risks associated with potential project failure (Stein, 1989). Consequently, managers eschew exploratory R&D in favor of low-risk, symbolic compliance to appease concerned stakeholders.

In sum, the reputational pressure triggered by green proposal votes prompts defensive reallocations of attention, capital, and risk appetite, ultimately crowding out green innovation. We test this logic using RepRisk data, which captures substantive ESG controversies and norm violations independently of voluntary corporate disclosures. Table 11 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 strongly 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 and boundary conditions

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 innovation, since they easily attract short-termism managerial response.

Rule 14a-8 introduces tension between management functions and relevance on shareholder proposals. Under the Rule 14a-8 screening, shareholders must trade-off to maker sure that their proposals carry important implications to the company but are not too specific to micromanage on ordinary business. [8] Such structural limitations on shareholder proposals afford managers considerable discretion to appease activist interventions with immediate response and deprioritize long-term projects.

In Table 9, we further investigate the heterogeneity of shareholder interventions by decomposing the voted green proposals based on their underlying content. Specifically, we partition the count of voted proposals into disclosure-oriented proposals ($\#GVoted\_Disc$) and those targeting operational practices or internal governance ($\#GVoted\_Nondisc$)[9].

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. Conversely, proposals addressing non-disclosure (or say operational) issues exhibit a positive and statistically significant relationship with both the patent citations in Column (2) and economic value in Column (3). Importantly, the Wald tests reported in the lower panel formally 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 adverse impact on corporate innovation is primarily driven by the disclosure-oriented proposals. This evidence is consistent with the notion that proposals demanding enhanced reporting may compel managers to prioritize immediate, symbolic compliance at the expense of substantive, 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 12 reports the results.

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

9. At the proposal level, 67.51% of the voted green proposals are disclosure-oriented, with the remainder addressing non-disclosure 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 [10] and re-estimate the model.

Table 13 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 aggregate climate sentiment

This section examines how exogenous variation 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 introduce 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.

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

10. 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.

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 conditioning vector $\mathbf{z}_{t-1}$ comprises seven variables spanning five dimensions. [11] 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,

11. 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. [12].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 14 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 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,

12. For firm-year observations with missing AGM dates, we impute May 15 of the corresponding calendar year as the default AGM date.

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 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 examine shareholder proposals from the perspective of their sponsors to better elucidate how activism evolves and influences corporate innovation. We distinguish between sponsor types because their characteristics 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.

Based on submission activity, we identify *Top Activists* as those shareholders who (co-)file a volume of green proposals falling within the top quartile of all sponsors in a given proxy season. Table A3 lists the top-10 activists based on submission frequency.

Then, we differentiate sponsors by their engagement patterns. We define a *Newcomer* as a shareholder who (co-)files a green proposal in the current proxy season but has not participated in any green proposal filings over the preceding three years. Drawing on the concept of institutional ownership breadth (Chen et al., 2002; Lehavy and Sloan, 2008), a proposal from a *Newcomer* represents a "fresh" signal of concern, suggesting that the investor has recently scrutinized the firm's environmental profile and is willing to incur the costs of engagement. In contrast, we classify a shareholder as a *Persister* if they have participated in green proposal filings in at least one prior proxy season over the past three years, which are characterized by their recurrent engagement with the target firm. This type of engagement may reflect persistent concerns regarding its environmental performance of the firm and signal unresolved disagreement with managers.

Beyond submission history, 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 final dataset comprises 1,531 distinct sponsors, categorized into individuals, institutions, and others.[13]

To better understand the drivers of activism, we provide a granular classification of sponsors based on their organizational structures and underlying objectives. We begin by distinguishing institutional sponsors, which we subdivide into public pension funds, unions, and investment firms. This latter group, comprising mutual funds, socially responsible investment (SRI) funds, and other asset managers, is defined by fiduciary duties that prioritize the maximization of shareholder value. This value-driven orientation stands in contrast to the motives of special interest groups, the *Other* category in which we include advocacy and advisory organizations such as As You Sow. These groups differ significantly from traditional institutional investors because they are primarily advocacy-oriented and possess a distinct set of operational advantages. Unlike individual proponents who typically act alone and lack resources, special interest groups are highly professionalized organizations that maintain dedicated legal teams, sophisticated media strategies, and a deep technical familiarity with SEC Rule 14a-8.

Furthermore, their economic incentives distinguish them from institutional owners. As nonprofit advocacy organizations that submit proposals on behalf of beneficial owners, they typically do not hold equity stakes themselves. Lacking the cash-flow exposure and ownership-linked governance channels that motivate traditional institutional investors, their engagement is primarily advocacy-oriented rather than value-driven. Consequently, proposals submitted by these groups operate largely through reputational pressure and agenda-setting rather than conventional governance channels.

13. Mostly are special interest groups, religious group, and NGOs, who usually hold non-pecuniary purpose.

6.2 Pre-vote and vote results

Predicting the outcomes of green shareholder proposals is empirically challenging because of the selection processes that precede a formal vote. Several factors prevent a proposal from reaching the corporate ballot. First, the submission of a green proposal is endogenous, driven by diverse sponsor motives ranging from risk mitigation to ethical considerations and public agenda-setting. For instance, activists primarily seeking public visibility may be less likely to reach a settlement with management, irrespective of the negotiation. In other cases, proposals may proceed to a vote simply because management's concessions fail to meet shareholder expectations. Second, the absence of a vote typically results from either a formal managerial challenge under SEC Rule 14a-8 to exclude the proposal or a private agreement that resolves the underlying issue. Thus, the final voting outcome represents a residual and lagging result of sequential interactions between shareholders and management (Couvert, 2025; Gantchev, 2013). Analyzing these pre-vote dynamics is therefore informative for understanding how environmental activism operates in a proxy season.

Table 15 summarizes the pre-vote outcomes [14] for filed environmental proposals. Panel A reports the results of SEC no-action challenges, while Panel B focuses on negotiated withdrawals. The 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

14. 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.

($p < 0.01$). 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 16 summarizes 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).[15]

We find favorable recommendations from management and ISS are statistically significant determinants of shareholder support. Notably, 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 differentiates its response by utilizing SEC challenges to exclude proposals with higher expected viability, such as those from *Persisters*, while prioritizing private negotiation for proposals with lower expected support.

6.3 Green innovation influence

We next aggregate proposal and sponsor features to the firm level to examine their overall influence on corporate green innovation. By counting the number of environmental proposals and the specific types of sponsors initiating or co-filing them, we capture the intensity of shareholder activism along the *breadth* dimension. A larger coalition of shareholders expressing environmental discontent likely amplifies a broader scope of external pressure on management.

Table 17 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 whether *there is safety in numbers*, that is, whether a higher aggregate volume of environmental proposals forces management to alter innovation policies. We posit that activism comes in a coordinated fashion may be more likely to divert managerial attention and elicit short-termism and

15. 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.

underinvestment in environmental technologies. In Panel A, we document a significant, 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 point 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 significant 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 indicate that while environmental proposals are associated with a subsequent decline in the economic value of a firm's green innovation, this decline is a generalized response to the volume of sponsor pressure. Engagement of "fresh" and less experienced activist are associated with the decline in innovation. Crucially, however, we must interpret these subsample significances with caution. Across both Panel B and Panel C, formal 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 the sponsor count by investor identity to determine which classes of shareholders drive the aggregate negative effect on green innovation. Individual investors and the *Other* category—comprising special interest groups, religious organizations, and NGOs—emerge as 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 indicates that, compared with other sponsors, professional investors adept to using green shareholder proposals to exert a meaningful disciplinary effect. In line with stakeholder salience theory, such engagement effectively curbs managerial short-termism, redirecting corporate focus and resources toward long-term, high-value green innovation.

In sum, cross-sectional decomposition reveals that individual activist and non-pecuniary advocacy groups are likely to depress green innovation, whereas professional investing firms enhance it. The real effects of environmental activism therefore also depend on 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 sample selection concerns.

The distorted managerial incentives and increasing reputational pressure serve as underlying channels for such effect. However, the efficacy of shareholder intervention is highly conditional. We show that activism successfully disciplines management and fosters innovation only when targeting firms with substantial room for environmental improvement or during periods of high environmental sentiment. We also explore sponsor features that are associated with pre-vote and vote results of green proposals, and activist coordination also indicate the decline in innovation. Collectively, our findings highlight that while escalating shareholder voice aims to promote environmental responsibility, its real effects depend on target fundamentals, the broader information environment, and sponsoring shareholders.

However, 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. Consequently, we cannot exclude the possibility of a substitution effect, wherein firms respond to green activism by acquiring external patents rather than developing indigenous technologies. Second, our analysis utilizes a conditional sample of firms targeted by activists. Therefore, the findings should be generalized to the broader population of firms with caution.

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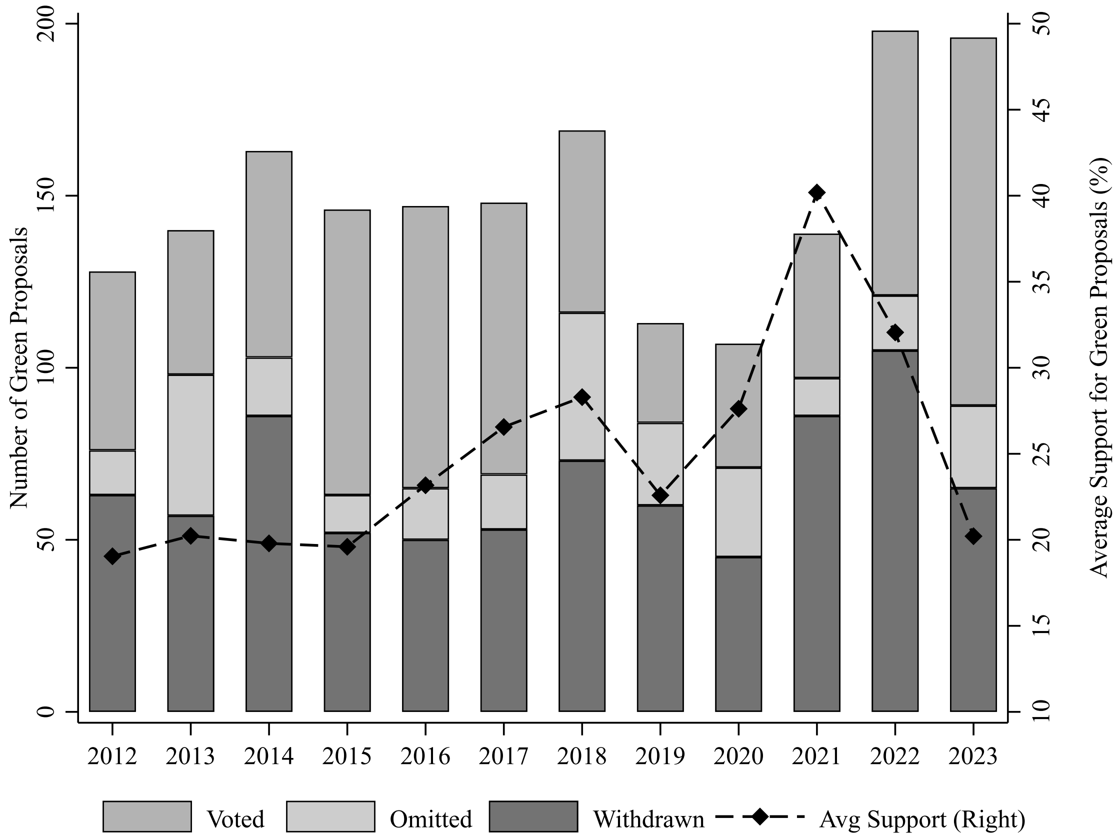
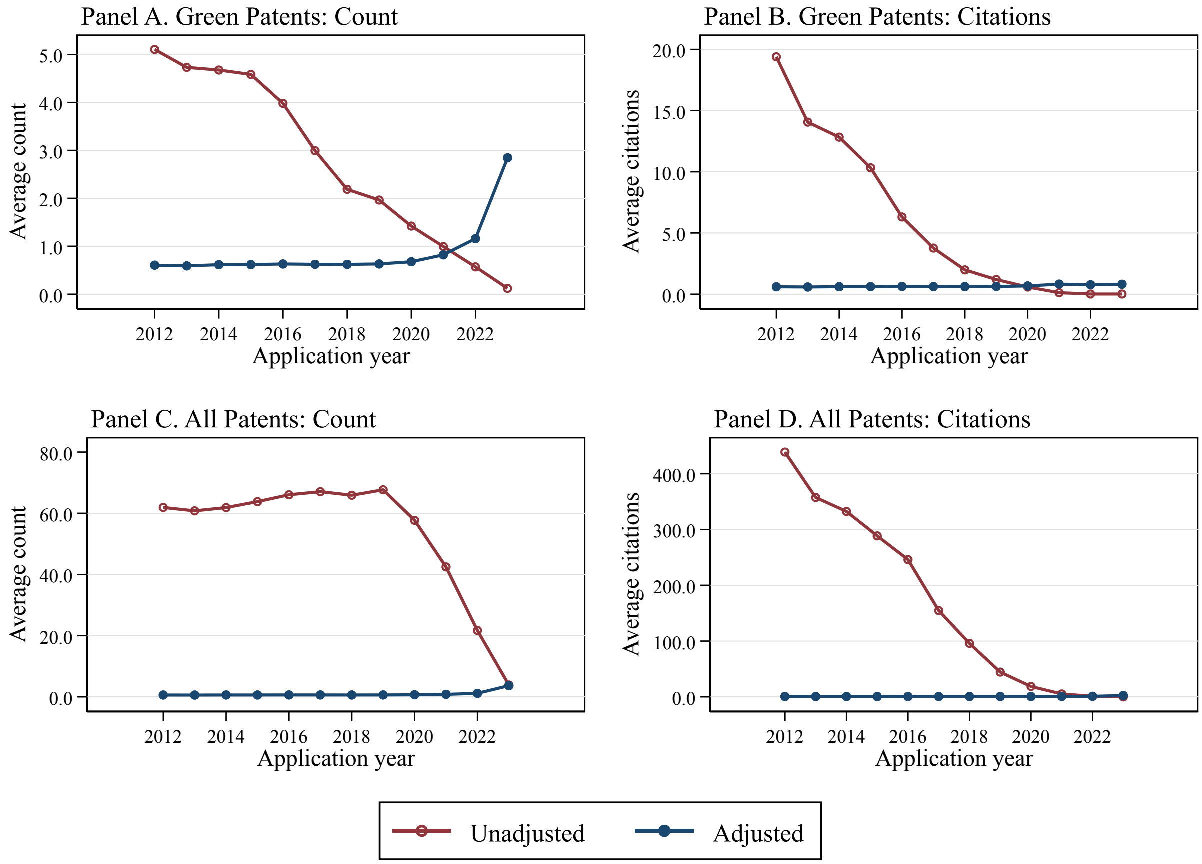
Figures and tables

Figure 1. Volume and support rate of green shareholder proposals



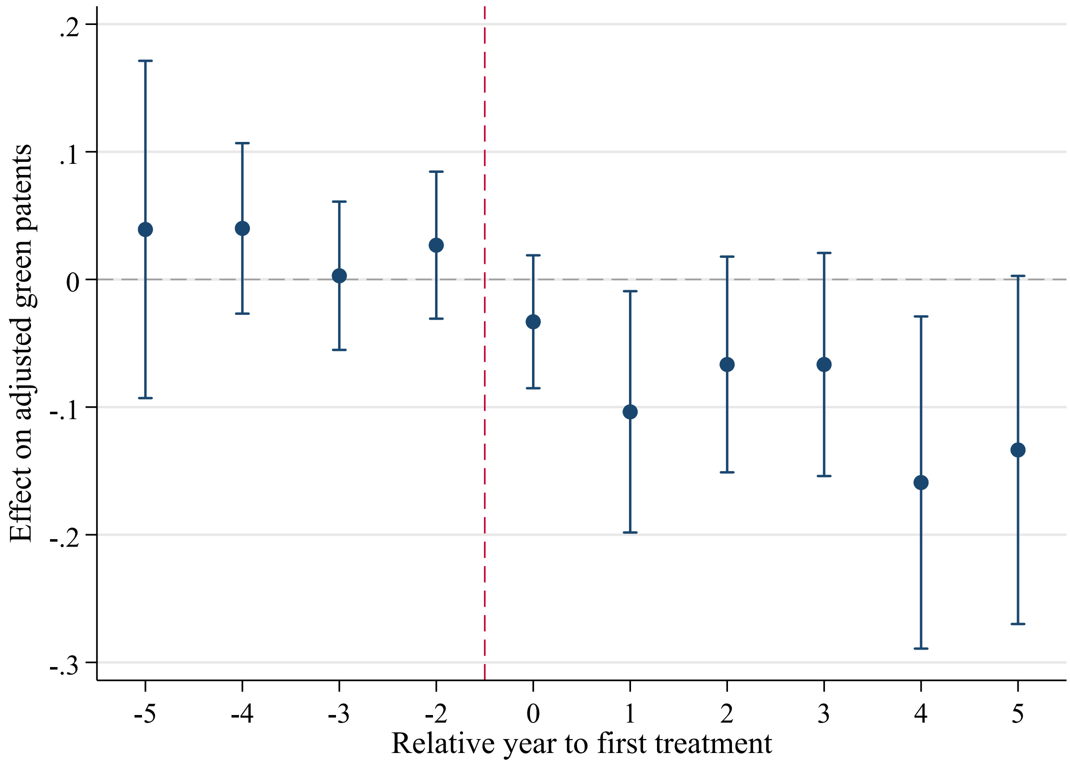
This figure illustrates the volume of green shareholder proposals and the associated level of shareholder support over the sample period. The left y-axis reports the annual total number of green proposals by final status, while the right y-axis indicates the annual support rate for proposals that reach 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



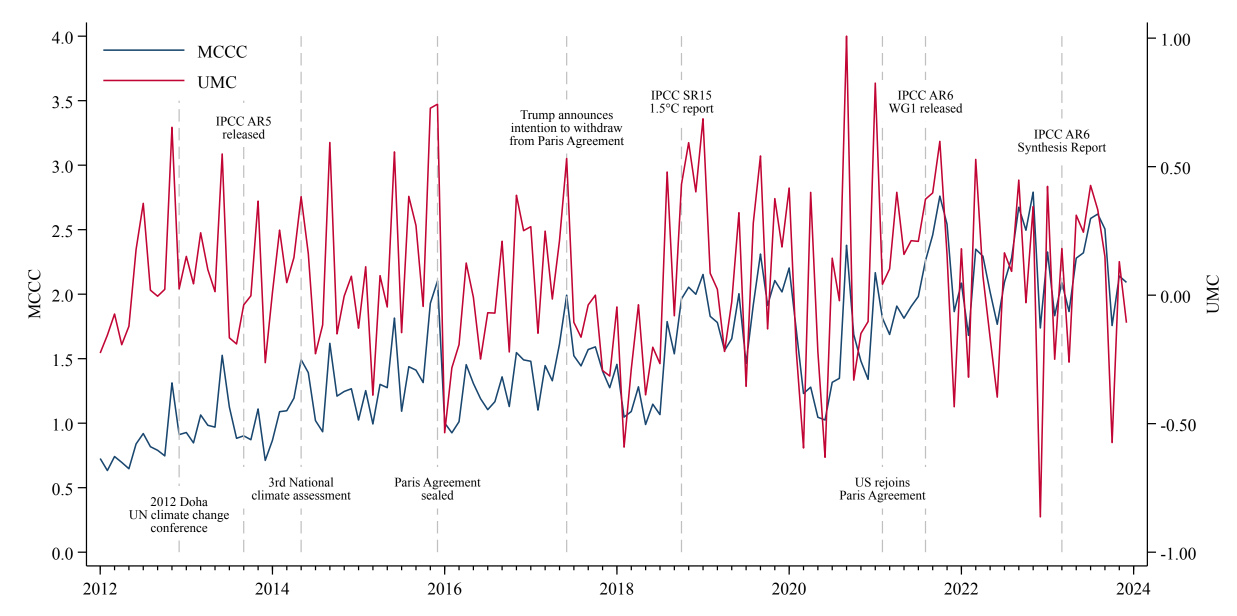
This figure compares trends in unadjusted and adjusted average patent data by application year. The upper panels focus on green patents, while the lower panels focus on all patents. The left panels compare unadjusted and adjusted patent counts, and the right panels compare forward patent citations.

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. 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 2. 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 2. (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 3. 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 4. 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 5. 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 6. 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 7. 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 8. 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 9. 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 10. 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 11. Voted green proposals and environmental incidents

	(1)	(2)	(3)	(4)	(5)	(6)
Dep't var =	All E-incidents		UN Env.	Med/High Sev.	Med/High Reach	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 12. 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 13. Test on energy sector

Dep't var = Adj. Counts	(1) Energy	(2) 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 14. Climate coverage shocks, voted green proposals, and innovation

	Shock of UMC			Shock of MCCC		
	(1)	(2)	(3)	(4)	(5)	(6)
Dep't var =	Adj. Counts	Adj. Cites	Log(1+Value)	Adj. Counts	Adj. Cites	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 × UMC Spike	0.159**	0.134**	0.342***			
	[0.068]	[0.062]	[0.111]			
MCCC Spike				-0.045**	-0.016	-0.070
				[0.018]	[0.016]	[0.044]
#GVoted × MCCC Spike				-0.014	-0.001	-0.127
				[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 15. 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 16. Support level and sponsor features

Dep't var = Sup. lev.	(1) Activist	(2) Newcomer	(3) Persister	(4) Indiv.	(5) Instit.	(6) 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 15, 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 17. 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 17. (Continued)

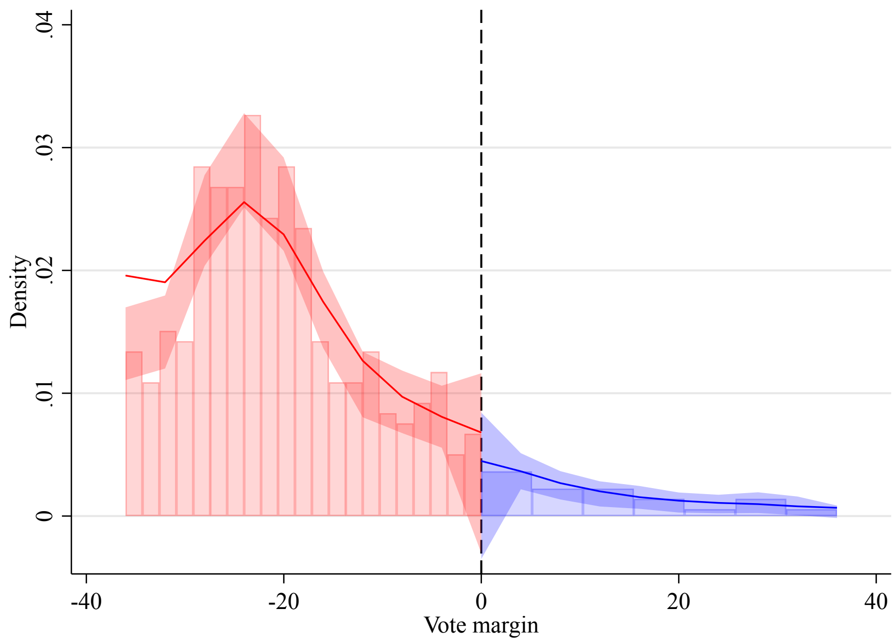
Panel D. Sponsor identity

Dep't var =	(1) Adj. Counts	(2) Adj. Cites	(3) 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 2, 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 2, 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 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 A5. 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 A5. 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 A5. 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 ≥ 2 in RepRisk).
Log(1+#EReach)	Natural logarithm of one plus the number of negative environmental incidents with medium to high reach (Reach ≥ 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 A5. 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 A6. Alternative measures on the number of green patents

Dep't var =	(1) Log(1 + Adj. Counts)	(2) Climate Adj. Counts	(3) 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. Statistical significance at the 10%, 5%, and 1% levels is denoted by *, **, and ***, respectively.

Table A7. Alternative model specifications

Dep't var = Adj. Counts	(1) OLS	(2) Poisson	(3) 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. Statistical significance at the 10%, 5%, and 1% levels is denoted by *, **, and ***, respectively.

Table A8. Other robustness tests on baseline results

	(1)	(2)	(3)	(4)	(5)	(6)
Dep't var = Adj. Counts	Winsor	Dummy	Median 5y	Mean 5y	High vs. Low Support	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 examining the relationship between voted environmental shareholder proposals and adjusted green patent counts. Statistical significance at the 10%, 5%, and 1% levels is denoted by *, **, and ***, respectively.

Table A9. Robustness tests on results of support level of green proposals and innovation

	(1)	(2)	(3)	(4)	(5)	(6)
Dep't var =	Adj. Counts	Adj. Cites	Log(1+Value)	Adj. Counts	Adj. Cites	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.