Biodiversity and Earnings News: When Nature Meets Numbers

Abstract

Biodiversity loss is increasingly recognized as a material financial risk, yet its capital market implications remain underexplored. We examine whether corporate biodiversity exposure (CBE)—the extent to which a firm's polluting facilities are located near conservation-priority areas—affects how investors price earnings news. We argue that CBE raises investors' information-processing costs when evaluating earnings announcements, dampening reactions to earnings news. Consistent with this prediction, firms with higher CBE exhibit weaker stock price responses to earnings. The effect is amplified under greater ecological and regulatory uncertainty and attenuated under stronger information environments and external monitoring, consistent with the information-processing-cost mechanism. To establish causality, we exploit staggered protected-area expansions in a stacked difference-in-differences design and find that newly exposed firms exhibit reduced earnings–return sensitivity. Overall, our findings reveal an informational channel through which ecological complexity constrains price discovery and underscore the importance of governance and disclosure in managing nature-related financial risks.

Keywords: Corporate Biodiversity Exposure; Earnings Announcements; Information Processing Costs; Corporate Governance; Biodiversity Conservation

JEL classification: M41, G14, G34, Q56, Q57

1. Introduction

The accelerating loss of biodiversity has emerged as a material financial risk with broad implications for firms, investors, and the global economy (Dasgupta, 2021; NGFS, 2022). Policymakers have responded with ambitious initiatives: the Kunming-Montreal Global Biodiversity Framework commits signatories to halt and reverse nature loss, while the European Union's Corporate Sustainability Reporting Directive expands environmental disclosure requirements. Standard setters are likewise embedding biodiversity into reporting frameworks, most prominently through the Taskforce on Nature-related Financial Disclosures (TNFD, 2023) and the European Sustainability Reporting Standards (ESRS).[1] Financial regulators and central banks, including the Network for Greening the Financial System (NGFS), warn that biodiversity loss threatens economic resilience and financial stability. Market surveys corroborate this concern,[2] with a growing majority of institutional investors identifying biodiversity as a material financial risk (Giglio et al., 2023; Garel et al., 2024). Large asset managers and stewardship coalitions are also pressing firms on biodiversity impacts, framing nature loss as both a portfolio risk and a fiduciary responsibility.

Translating ecological constraints into financial terms poses distinctive challenges for capital markets. These difficulties are most apparent when firms operate near protected or conservation-priority areas, which generate additional processing costs for investors interpreting earnings news. To map an earnings surprise into valuation, investors must consider ecological and regulatory contingencies such as land-use restrictions, enforcement actions, or reputational pressures, all of which blur the link between reported earnings and future cash flows. Conceptually, this aligns with the disclosure processing-cost framework of Blankespoor

[1]The International Sustainability Standards Board has committed to incorporating TNFD recommendations into future standards. ESRS E4, effective since January 2024 with phased implementation, mandates disclosures on biodiversity impacts, risks, and mitigation strategies, and explicitly references TNFD's LEAP framework.

[2]For example, the May-June 2025 Responsible Investor Nature and Investors Survey reports that 56% of global asset managers and owners were "seriously concerned" about the impact of nature loss on financial markets, while another 42% were "somewhat concerned." See Responsible Investor: Nature and Investors Survey 2025.

et al. (2020), which suggests that frictions arise through awareness, acquisition, and integration, thereby dampening stock price responses to disclosures. Because protected area data are observable and publicly available, the central obstacle lies less in awareness or acquisition and more in the integration costs of converting geospatial and regulatory information into financial terms. This perspective motivates our central question: does corporate biodiversity exposure reduce the market's responsiveness to earnings news?

Our framework builds on the literature on information frictions (Verrecchia, 1982; Diamond, 1985; Fischer and Verrecchia, 2000; Hirshleifer et al., 2009; Blankespoor et al., 2020), which shows that uncertainty and noise reduce the clarity of disclosures and raise investors' processing costs. We extend this perspective to biodiversity by arguing that proximity to protected areas generates ecological and regulatory uncertainty that complicates how markets process earnings news. While firms near conservation zones may not face immediate disruptions, the prospect of future regulation, litigation, activism, or ecological degradation further weakens the link between reported earnings and fundamentals. Consistent with this view, recent evidence shows that a growing number of U.S. firms mention biodiversity risks in their 10-K filings). These patterns suggest that corporate biodiversity exposure (CBE) heightens the costs of processing earnings information, with material consequences for capital markets. When processing costs are high, stock prices adjust less precisely to fundamentals, dampening the contemporaneous pricing of earnings news. We therefore hypothesize that firms with higher CBE exhibit weaker stock-price sensitivity to earnings news. We capture this sensitivity using earnings response coefficients (ERCs), defined as the slope coefficients from regressions of returns on earnings surprises (e.g., Easton and Zmijewski, 1989; Kothari, 2001; Francis et al., 2004), which serve as a standard measure of market responsiveness to earnings news.

A central requirement of our analysis is a reliable firm-level proxy for biodiversity exposure. We construct our CBE measure by linking polluting facilities to nearby legally protected areas using high-resolution geospatial data from the World Database on Protected

Areas (WDPA). For each facility, we calculate the cumulative area of protected land within a fixed radius, normalize this by the annual U.S. conservation footprint, and aggregate across facilities to derive a firm-level score. This approach improves on existing methods by providing a transparent and replicable alternative to proprietary footprint models or ad hoc textual classifications (Karolyi and Tobin-de la Puente, 2023; O'Dwyer, 2024), while aligning with recent calls from TNFD for location-specific risk assessment. An area-based metric, rather than simple site counts, captures variation in ecological sensitivity and regulatory salience while avoiding the conflation that arises when multiple protected areas are clustered around a facility. The resulting score offers a granular and policy-relevant tool for assessing permitting constraints, biodiversity offsets, and potential liabilities, and it serves as the basis for our empirical analysis. Importantly, because it reflects information that is observable yet costly for investors to incorporate when processing earnings announcements, the measure also proxies for information-processing frictions, positioning it as a bridge between ecological context and the market's response to earnings news.

We test our hypothesis using a panel of U.S. publicly traded firms from 1990 to 2021. Specifically, we estimate ERCs by regressing cumulative abnormal returns around earnings announcements on standardized earnings surprises, their interaction with our CBE measure, and firm-level controls. The interaction term is consistently negative and statistically significant, indicating that firms with greater biodiversity exposure experience weaker market reactions to earnings news. The effect is economically meaningful: a one percentage point increase in protected land near a firm's facilities corresponds to a 4.5 percent reduction in the return differential between firms in the top and bottom deciles of earnings surprises. The results remain robust to alternative constructions of CBE, including site-weighted, distance-weighted, and categorical measures. We also find that firms with high CBE exhibit lower abnormal trading volume and wider bid–ask spreads around earnings announcements, consistent with reduced investor participation and greater information risk when information-processing costs are high.

To establish causality, we implement a stacked difference-in-differences design that exploits the staggered expansion of protected areas. Firms that become newly exposed to conservation zones experience a significant decline in ERCs after designation, consistent with biodiversity exposure increasing information-processing costs and dampening the pricing of earnings news. Complementary falsification and timing placebo tests confirm that this effect does not reflect correlated firm traits or spurious return dynamics. Additional analyses show no evidence of anticipatory pricing or post-earnings-announcement drift, indicating that biodiversity exposure does not simply shift the timing of price discovery. Together, these tests validate a causal interpretation that biodiversity exposure weakens market responsiveness by raising the costs investors face in processing and integrating earnings information rather than through firm heterogeneity. Economically, higher information-processing costs reduce the clarity of the earnings signal, leading investors to demand higher expected returns and thereby raising firms' costs of capital (Easley and O'Hara, 2004; Lambert et al., 2007). As a result, biodiversity exposure may discourage investment in biodiversity-sensitive regions and redirect capital toward less exposed firms or industries, distorting both the cost of finance and the geography of corporate investment.

We further conduct a comprehensive series of robustness tests to assess the stability of these findings and address potential omitted variables. Specifically, we control for firms' geographic footprint, ESG orientation, earnings quality, and macro-level climate risks such as policy stringency, summit activity, warming trends, and natural disasters. Across all specifications, the negative impact of CBE on the pricing of earnings news remains strong and statistically robust. These results demonstrate that biodiversity exposure does not merely proxy for correlated sustainability characteristics or broader environmental shocks but instead represents a distinct source of information-processing cost that dampens contemporaneous price responsiveness to earnings news.

The attenuation in ERCs is not uniform across firms but instead varies systematically with institutional context and the quality of the information environment. From an institutional perspective, processing costs are higher in ecologically fragile states, in jurisdictions with stricter regulatory enforcement, and in counties with weaker stakeholder oversight. In these settings, uncertainty about potential liabilities, compliance costs, and reputational pressures complicates the processing of earnings news. From a firm-level perspective, however, stronger transparency and monitoring mitigate these frictions. Firms that disclose biodiversity information, attract greater analyst following, exhibit higher institutional ownership, or are subject to heightened media and NGO scrutiny experience less attenuation in the pricing of earnings news. These results indicate that biodiversity exposure impairs price discovery through its interaction with the broader information environment, such that the same ecological risk can yield very different capital market outcomes depending on institutional safeguards and disclosure infrastructures that either exacerbate or alleviate investors' information-processing costs.

Overall, the findings show that biodiversity exposure is not only an ecological or regulatory concern but also a structural challenge for capital markets. Rooted in spatial and ecological contexts that firms cannot fully diversify away or standardize through conventional reporting, biodiversity risk systematically weakens price discovery across industries and regions. Our evidence is consistent with higher processing costs: when ecological context is complex, investors place less contemporaneous weight on earnings surprises, reducing price responsiveness to earnings news. These mechanisms highlight the importance of initiatives such as the TNFD and ESRS, which aim to lower processing costs by making biodiversity exposures more interpretable to investors. While our analysis focuses on market responsiveness to earnings news, the broader implication is that incorporating biodiversity into financial reporting is essential both for accurate firm valuation and for sustaining the efficiency and resilience of capital markets as ecological constraints intensify.

Thus, our study makes three significant contributions. First, we introduce a new dimension to the earnings news literature by identifying biodiversity exposure as an ecologically grounded information friction that impairs investors' ability to process earnings news. Prior research has emphasized firm characteristics, governance, and institutional environments as key determinants of market reactions to earnings news (e.g., Bushman et al., 2004; Ferri et al., 2018; Tsang et al., 2025). However, the ecological context in which firms operate has received relatively little attention. We extend this literature by showing that proximity to conservation-priority areas weakens market responsiveness to earnings news, consistent with higher disclosure-processing frictions (Blankespoor et al., 2020). Specifically, firms with higher CBE exhibit lower contemporaneous ERCs and no evidence of post–earnings-announcement drift, indicating that investors rationally discount a costly-to-integrate earnings signal at the time of the announcement rather than gradually incorporating it over time.

Second, we demonstrate that biodiversity exposure is a distinct and underdisclosed source of financial risk. Unlike climate risks, which primarily affect firms through physical damages or transition costs (e.g., Engle et al., 2020; Ginglinger and Moreau, 2023), biodiversity exposure operates through an informational channel that distorts how earnings news is processed. This distinction matters because it reveals a risk channel that is location-specific, difficult to diversify, and largely overlooked in prevailing disclosure frameworks. By documenting this mechanism, we show that biodiversity loss generates informational externalities that undermine not only the valuation of exposed firms but also the efficiency of capital markets more broadly.

Third, we extend the disclosure and policy literatures by showing that the interaction between firms' ecological context and their information environment has significant consequences for market efficiency. We find that biodiversity-related frictions reduce the market's responsiveness to earnings news, while voluntary disclosure and external monitoring mitigate these effects by lowering processing costs. These results reveal how nature-related exposures and information infrastructures jointly shape the efficiency of price discovery and align with ongoing policy initiatives such as the TNFD and ESRS, which emphasize spatially explicit, nature-related reporting as a foundation for resilient financial systems. Collectively, our evidence suggests that biodiversity exposure is not only a firm-level risk but also a structural challenge for earnings information transmission, highlighting the importance of biodiversity reporting in sustaining efficient and resilient capital markets as ecological constraints intensify.

2. Institutional Context and Hypothesis Development

Protected areas are legally designated lands established to conserve biodiversity, safeguard ecosystems, and preserve sites of ecological or cultural significance. Unlike environmental regulations that respond after degradation occurs, protected areas are proactive, place-based measures designed to prevent biodiversity loss within defined boundaries. Empirical evidence shows that well-managed protected areas can slow species declines and sustain higher species richness than comparable unprotected sites (e.g., Coetzee et al., 2014; Gray et al., 2016). By restricting land use and enforcing conservation rules, they preserve habitats, restore endangered populations, and maintain ecological balance.

The United States maintains one of the world's largest and most diverse networks of protected areas. As of 2025, they cover more than 1.2 million square kilometers, representing about 13% of the U.S. landmass and nearly 9% of the world's protected terrestrial areas (UNEP-WCMC, 2025). This conservation tradition traces back to Yellowstone National Park, established in 1872 as the world's first national park, which set a precedent for modern conservation globally. Today, U.S. protected areas are governed by a multilayered framework. Federal lands are regulated by the National Park Service Organic Act, the Wilderness Act, and the Federal Land Policy and Management Act, while broader statutes such as the Endangered Species Act (ESA) and the National Environmental Policy Act (NEPA) provide nationwide protections. Regulatory influence also reaches beyond designated boundaries: the Environmental Protection Agency's Prevention of Significant Deterioration program imposes stricter pollution controls near protected areas, and ESA-designated critical habitats can constrain development even outside park limits. These spillovers raise compliance costs, constrain operational flexibility, and increase reputational risks for firms in land-intensive or extractive industries (Pfaff and Robalino, 2017). For investors, protected areas also create informational complexity: evaluating a firm's exposure requires combining geospatial proximity, ecological sensitivity, and overlapping regulatory constraints into forward-looking assessments of value. This integration of diverse and non-standardized signals is costly, positioning protected areas as a salient source of information-processing frictions in financial markets.

As of September 2022, the U.S. contained 42,824 protected areas spanning federal, state, local, private, and Indigenous governance structures (UNEP-WCMC, 2025). Since 1990, more than 13,000 new sites have been designated, reflecting an expanding and heterogeneous conservation landscape. The IUCN classification system further distinguishes sites by conservation intensity: strict nature reserves (Categories Ia–Ib) prohibit nearly all human activity, national parks (Category II) permit limited recreation, Categories III–IV emphasize species- or habitat-specific protection, and Categories V–VI allow sustainable resource use. Figure 1 illustrates the geography of U.S. protected areas, shading stricter categories in dark green and multi-use zones in lighter tones. This variation means that firms' biodiversity exposure depends not only on geographic proximity but also on the ecological and regulatory salience of nearby areas. For investors, accounting for such heterogeneity requires integrating geospatial data with nuanced legal classifications, a process that amplifies information-processing costs and complicates how earnings signals are interpreted in capital markets.

Despite their scale and economic importance, protected areas remain largely absent from corporate disclosure standards and underexplored in finance and accounting research. Most disclosure frameworks and ESG metrics focus on climate-related risks, often summarized by scalar measures such as greenhouse gas emissions or carbon intensity. In contrast, biodiversity exposure is inherently spatial, varying with proximity to ecologically sensitive sites, the fragility of local ecosystems, and the overlapping regulatory regimes that govern them. This complexity creates significant challenges for measurement and comparability: two firms with similar emissions profiles may face very different biodiversity-related risks depending on the geographic location of their operations. Moreover, the consequences of exposure extend beyond direct regulatory costs. Firms located near protected areas are more vulnerable to reputational scrutiny from environmental groups, heightened monitoring by regulators, and operational constraints tied to permitting or land-use restrictions. Yet these risks are rarely disclosed in financial reports or investor communications (Giglio et al., 2023), leaving investors to piece together incomplete or non-standardized information. The need to integrate heterogeneous geospatial, ecological, and regulatory signals into forward-looking assessments of firm value imposes substantial processing costs. In Blankespoor et al.'s (2020) taxonomy, biodiversity risks are not difficult to recognize (awareness) or to access (acquisition), but they are costly to combine and interpret within valuation models. This integration challenge weakens the clarity of earnings announcements as performance signals.

To theorize this link, we draw on the literature on information frictions. Theoretical models emphasize that the market's response to public disclosures depends not only on the amount of new information conveyed but also on the costs investors incur in processing it (Verrecchia, 1982; Diamond, 1985; Hirshleifer and Teoh, 2003; see Blankespoor et al., 2020 for a review). When processing costs are high, for example because information is complex, ambiguous, or difficult to integrate, earnings announcements lose clarity as signals of firm performance. Investors therefore place less contemporaneous weight on earnings surprises, weakening the price response even without invoking behavioral bias. Empirical evidence supports this mechanism: Ferri et al. (2018) show that reducing uncertainty about managerial motives through mandatory executive compensation disclosure increases stock price responsiveness to earnings news. Building on this framework, we argue that biodiversity exposure raises the costs of processing earnings news, since investors must account for geospatial, ecological, and regulatory contingencies in valuation. These added costs impair the market's ability to incorporate earnings information efficiently into prices.

Biodiversity exposure exemplifies this mechanism. Firms operating near protected areas face localized risks ranging from regulatory interventions and land-use restrictions to reputational scrutiny from environmental groups (TNFD, 2023; OECD, 2020). These risks are spatially heterogeneous and extend beyond administrative boundaries, making them difficult for investors to forecast and value (Pfaff and Robalino, 2017). Even compliant firms remain vulnerable, since ecological sensitivity can amplify regulatory or public responses to incidents. Because these exposures are rarely standardized or systematically disclosed (Giglio et al., 2023), investors bear additional processing costs when incorporating geospatial, ecological, and regulatory context into their valuation. Blankespoor et al. (2020) conceptualize disclosure processing costs as encompassing awareness, acquisition, and integration. Their framework highlights that processing frictions arise not only from whether information is available, but also from the challenges of assembling and interpreting disparate signals. We argue that such processing frictions reduce the clarity of earnings news as performance signals for exposed firms, weakening the market's responsiveness to earnings news.

H1: The market response to earnings news is lower for firms with greater biodiversity exposure.

3. Data, Measurement, and Research Design

The data for our main analysis are drawn from multiple sources covering the period 1990-2021: (1) Spatial data on U.S. protected areas are obtained from the World Database on Protected Areas (WDPA), which provides detailed geospatial boundaries, designation years, and conservation classifications for all formally designated lands; (2) Facility-level information comes from the National Establishment Time-Series (NETS) database compiled by Walls & Associates, merged with pollution data from the EPA's Toxic Release Inventory (TRI) and Pollution Prevention (P2) databases; and (3) Firm-level accounting data are from

Compustat, stock return data from CRSP, analyst earnings forecasts and reported earnings from the I/B/E/S Summary History file, and institutional ownership data from FactSet.

3.1. Constructing Corporate Biodiversity Exposure (CBE)

To construct firm-level measures of corporate biodiversity exposure (CBE), we link geospatial information on protected areas to the locations of polluting facilities and aggregate these exposures to their publicly listed parent firms. Facilities are drawn from the NETS database and restricted to facilities subject to the EPA's TRI, which covers sites with non-trivial pollution footprints. Historical Duns & Bradstreet (DUNS) numbers reported in TRI are matched to facilities in NETS and reconciled with Compustat identifiers (gvkeys). Because parent names and identifiers change over time, we employ a two-stage procedure: fuzzy string matching of historical names across NETS, TRI, and Compustat, followed by manual verification of ambiguous cases. This yields a high-confidence linkage between facilities, pollution reporters, and their parents.

For each facility-year, we calculate the cumulative surface area of protected areas within a 30-kilometer radius using WDPA geospatial boundaries, normalize by the total U.S. protected area in that year, and aggregate across all TRI facilities of a parent company. We adopt a 30-kilometer buffer as a conservative benchmark: narrow enough to capture concentrated ecological impacts documented in environmental science, yet broad enough to align with regulatory practice while limiting noise from more distant exposures.[3] Anchoring our measure in this benchmark provides a conceptually grounded, empirically supported, and policy-relevant definition of localized ecological risk that captures the spatial channel most likely to shape investor interpretation of financial signals.

To illustrate the construction, Figure 2 presents Toyota's U.S. operations in 1990. Pro-

[3] Atmospheric dispersion models show that concentrations from large stationary sources decline sharply within the first tens of kilometers downwind (Hinds, 1999; Seinfeld and Pandis, 2016). Ecological research similarly finds that deposition effects on soils, water, and vegetation are strongest near emission sources, typically within a few tens of kilometers (e.g., Likens et al., 1979; Driscoll et al., 2001; Greaver et al., 2012). Consistent with this evidence, EPA's 2024 modeling guidance specifies that Gaussian plume dispersion models apply only up to 50 kilometers from a source (EPA, 2024).

tected areas within a 30-kilometer radius are shaded in dark green, while the two TRI-reporting facilities are shown with red stars. The Long Beach, California, plant was proximate to roughly 146 km^2 of protected lands, while the Columbus, Indiana, facility was near about 910 km^2. Aggregating across both sites yields a total exposure of 1,056 km^2. Dividing this by the nationwide surface area of protected lands in 1990 (1,453,580 km^2) gives Toyota's firm-level CBE score: 1,056/1,453,580 = 0.00073, or 0.073%. This calculation illustrates three design features of our measure: it avoids overweighting from clusters of small reserves, assigns proportionally greater weight to larger protected areas, and restricts attention to TRI-reporting facilities where proximity to sensitive ecosystems heightens regulatory, operational, and reputational risks. The construction yields a transparent and replicable firm-year measure of biodiversity exposure, which we integrate with quarterly financial and market data to form the firm-quarter panel used in our empirical analysis.

3.2. Measuring Market Responses to Earnings News

Our hypotheses suggest that corporate biodiversity exposure may weaken the market response to earnings news by increasing processing costs for investors. To evaluate this possibility, we examine the earnings response coefficient (ERC), defined as the stock market's reaction to unexpected earnings news. ERC has long served as a core measure of earnings informativeness in the accounting and finance literatures(e.g., Ball and Brown, 1968; Collins and Kothari, 1989; Gelb and Zarowin, 2002; Bhattacharya et al., 2020; Gipper et al., 2020; Tsang et al., 2025). It captures how investors revise expectations of firm value in response to new earnings information, providing a forward-looking, market-based proxy for disclosure effectiveness.

ERC is particularly well suited to our setting because it reflects investors' actual interpretation of reported earnings rather than properties of the earnings series itself. Following convention, we estimate ERC by regressing firms' short-window abnormal returns around earnings announcements on measures of earnings surprise. Abnormal returns are calculated as the firm's raw return minus the return on a benchmark portfolio matched on size and book-to-market characteristics, and earnings surprise is measured using standardized unexpected earnings from I/B/E/S analyst forecasts. In this framework, the slope coefficient on earnings surprise reflects the ERC, and the interaction between earnings surprise and biodiversity exposure captures whether proximity to sensitive ecological areas dampens investors' responsiveness to earnings news. Unlike accounting-based proxies such as persistence, smoothness, or accrual quality, which assess statistical attributes of earnings, ERC directly measures how news is incorporated into prices. This distinction matters because proximity to biodiversity-sensitive areas does not change the accounting content of earnings but may alter how those earnings are perceived and priced in capital markets.

3.3. Other Variables

To isolate the effect of biodiversity exposure on ERC, we control for firm fundamentals known to influence the earnings-returns relation. Firm size (log of market equity) captures differences in visibility and analyst following, which can dampen the marginal value of earnings news. Book-to-market (book equity over market equity) distinguishes value firms, often more sensitive to new information, from growth firms. Leverage (total liabilities over total assets) reflects financial risk and creditor scrutiny, which may shape how earnings are priced. Earnings volatility, measured as the standard deviation of quarterly earnings over the prior four years, is also included since less predictable earnings histories tend to make current announcements more informative.

We further account for factors related to the information environment and investor attention. Institutional ownership and analyst coverage proxy for monitoring and information flow, which can either reduce or amplify the value of earnings news. A loss indicator controls for asymmetric market reactions to bad versus good news, while a Friday-announcement dummy addresses investor inattention around weekend disclosures (DellaVigna and Pollet, 2009; Hirshleifer et al., 2009). Investor attention is also proxied by cumulative abnormal returns over the 30 days preceding the announcement (Li et al., 2011), capturing whether pre-event trading activity crowds out attention to new information. Each control enters the specification both directly and interacted with unexpected earnings, ensuring flexible adjustment for confounding variation. Appendix A details variable definitions and construction.

3.4. Descriptive statistics

Table **1** presents summary statistics for the variables used in the main analysis, based on 104,181 firm–quarter observations spanning 1990–2021. The mean value of CBE is 0.126, with a median of 0.007 and an interquartile range of 0.000 to 0.068. This distribution indicates that while most firms have little or no proximity to protected areas, a nontrivial subset operates in more ecologically sensitive regions. The skewness reflects the spatial clustering of conservation zones, which are concentrated in certain geographic areas, as well as patterns in industrial site selection that lead some firms to locate near such zones. These features highlight the heterogeneity in firms' exposure to biodiversity risk.

The distribution of returns around earnings announcements is also consistent with prior evidence. The average value of *AbRetn[0,1]* is close to zero (0.002), with an interquartile range of –0.025 to 0.029, which is in line with the symmetric return distributions reported in earlier ERC studies (e.g., Kothari et al., 2005; Chi and Shanthikumar, 2017). In terms of firm fundamentals, the average market capitalization of sample firms is approximately $1.9 billion, the average book-to-market ratio is 0.522, and average institutional ownership is 45.4%. Other firm characteristics, including analyst coverage and earnings volatility, display wide cross-sectional variation, consistent with patterns documented in prior research (e.g., DellaVigna and Pollet, 2009; Hirshleifer et al., 2009). This variation ensures that the sample represents a broad spectrum of firm sizes, valuation profiles, and information environments.

3.5. Empirical Specification

We test whether corporate biodiversity exposure impairs the market's response to earnings news by estimating regressions of firms' short-window abnormal returns on earnings surprises, biodiversity exposure, and their interaction. The unit of observation is the firm-quarter earnings announcement. Abnormal returns are measured over a two-day window around the announcement date, denoted $\mathit{AbRetn[0,1]}_{it}$, and computed as the firm's raw return minus the return on a benchmark portfolio matched on size and book-to-market using a 5×5 double-sort procedure (Chi and Shanthikumar, 2017). Earnings news is captured by standardized unexpected earnings (SUE), defined as the difference between reported EPS and the I/B/E/S median analyst forecast, scaled by beginning-of-quarter stock price. To ensure comparability across firms and time, we rank SUE into deciles within each quarter, yielding the variable $RSUE$.

Our baseline regression is:

$$\begin{aligned} \mathit{AbRetn[0,1]}_{it} \quad = \quad & \alpha_0 + \beta_1 \mathit{CBE}_{it} \times \mathit{RSUE}_{it} + \beta_2 \mathit{CBE}_{it} + \beta_3 \mathit{RSUE}_{it} + \sum_k \beta_k \text{Controls}_{it} \qquad (1) \\ & + \sum_j \beta_j \text{RSUE}_{it} \times \text{Controls}_{it} + \phi_t + \gamma_i + \text{RSUE}_{it} \times \phi_t + \text{RSUE}_{it} \times \gamma_i + \varepsilon_{it}, \end{aligned}$$

where i indexes firms and t denotes fiscal quarter-years. The dependent variable is the two-day cumulative abnormal return around the earnings announcement, $\mathit{AbRetn[0,1]}_{it}$. ERCs correspond to the slope on $RSUE_{it}$. Our coefficient of interest is β_1, which indicates whether biodiversity exposure alters this slope, specifically, whether proximity to protected areas dampens the market's responsiveness to earnings news. We include firm (γ_i) and time (ϕ_t) fixed effects, as well as their interactions with $RSUE_{it}$, to absorb unobserved heterogeneity in earnings responsiveness. Control variables described in Section **3.3** are included both directly and interacted with $RSUE_{it}$ to ensure that the estimated effect of CBE is not confounded by other determinants of the earnings-returns relation. Standard errors are clustered at the firm level.

4. Empirical results

4.1. Baseline Evidence

Table 2 reports the baseline regressions testing whether corporate biodiversity exposure (CBE) attenuates the market's response to earnings news. The dependent variable is the two-day cumulative abnormal return around the earnings announcement date, and the key regressor is the interaction between *CBE* and the firm's standardized unexpected earnings (*RSUE*). The coefficient on this interaction term captures whether proximity to biodiversity-sensitive areas impairs market response to earnings news, as measured by the earnings response coefficient (ERC).

We begin in Column (1) with a parsimonious specification including only *RSUE*, *CBE*, and their interaction. This model provides a simple benchmark for the directional relationship between biodiversity exposure and earnings responsiveness. In Column (2), we add firm and quarter-year fixed effects to absorb persistent cross-sectional heterogeneity and common time shocks, so that identification comes from within-firm, within-period variation in exposure. Column (3) introduces standard firm-level controls such as size, leverage, profitability, and analyst coverage, accounting for observable characteristics known to affect the ERC. In Column (4), we further interact *RSUE* with each of these controls, allowing the earnings-returns relation to vary systematically with firm characteristics. Finally, Column (5), the fully specified model, interacts *RSUE* with both firm and quarter-year fixed effects, permitting the ERC to flexibly vary across firms and over time.[4]

Across all specifications, the coefficient on $CBE \times RSUE$ is negative and statistically significant at the one percent level. In Columns (1)-(4), the estimates range from -0.007

[4] In Column (5), the main *RSUE* term is absorbed by the fixed-effect interactions. The estimated coefficient on $CBE \times RSUE$ therefore reflects within-firm, within-period variation in biodiversity exposure, net of firm- and time-specific differences in earnings responsiveness.

to -0.008 with standard errors below 0.002. In our main specification (Column 5), which includes firm and quarter-year fixed effects as well as their interactions with *RSUE*, the coefficient is -0.005 ($p = 0.002$). Interpreted in economic terms, because *CBE* is measured in percentage points, a one-point increase in exposure reduces the return differential between the top and bottom RSUE deciles by approximately 4.5 percent ($-0.005 \times (10 - 1) = -0.045$). This magnitude indicates that biodiversity exposure dampens the market's sensitivity to earnings surprises, weakening the link between firm performance and stock price reactions. The evidence that CBE lowers the earnings–return relation suggests that investors face greater difficulty interpreting and incorporating earnings information for firms operating near protected areas. Biodiversity exposure therefore increases information processing costs, reducing the strength of market reactions to firm-specific news.

The control variables behave as expected and lend further credibility to the specification. Larger firms, firms reporting losses, and those releasing earnings on Fridays exhibit significantly weaker announcement returns, consistent with prior evidence that these settings reduce the salience or credibility of earnings news (e.g., Hirshleifer et al., 2009). Interaction terms between *RSUE* and firm characteristics also align with existing research. For example, the negative and significant coefficient on $RSUE \times Size$ indicates that earnings surprises elicit weaker market responses in larger firms, perhaps reflecting greater information availability or more diversified operations. In contrast, the positive and significant coefficient on $RSUE \times LAnalyst$ suggests that greater analyst coverage amplifies the market's reaction to earnings, consistent with improved signal clarity and credibility. Together, these results confirm that the baseline design reproduces established patterns in the ERC literature while isolating a novel role for biodiversity exposure.

Having established the robustness of the baseline specification, we next examine the sensitivity of our results to alternative definitions of biodiversity exposure. Because the *CBE* measure is constructed using a 30-kilometer buffer, we assess robustness to alternative spatial definitions by estimating models with radii of 20, 40, and 50 kilometers. This range follows ecological deposition studies and EPA regulatory modeling guidance (see Footnote 3). Across these alternative definitions, the untabulated coefficients on $CBE \times RSUE$ remain negative and statistically significant. The effect is strongest at 20 kilometers (β_1 = –0.009, p = 0.009), greater in magnitude than our 30-kilometer benchmark (β_1 = –0.005, p = 0.002), and gradually attenuates as the buffer expands to 40 kilometers (β_1 = –0.003, p = 0.025) and 50 kilometers (β_1 = –0.002, p = 0.014). These results confirm that the dampening of ERCs is primarily driven by localized exposure to biodiversity-sensitive areas. Guided by ecological and regulatory considerations, the 30-kilometer buffer offers a theoretically grounded and empirically stable benchmark that balances signal and noise, aligns with plausible ecological and stakeholder footprints, and yields consistent results across the 20–50 kilometer range.

4.2. Alternative Constructions of CBE

To further assess the robustness of our main results, we construct and evaluate several alternative firm-level measures of corporate biodiversity exposure that capture distinct dimensions of ecological significance and institutional context.

The first measure, *CBE_IUCN*, emphasizes the ecological importance of nearby protected areas by weighting each site's surface area within 30 kilometers according to its IUCN protection category (Category I = 6; Category VI = 1; see Appendix B). The IUCN framework reflects a hierarchy of ecological and regulatory significance: strict nature reserves and wilderness areas (Category I) receive the strongest legal protection and safeguard the most fragile ecosystems, whereas multiple-use areas (Category VI) permit broader economic activity and provide weaker conservation oversight. For each facility, we calculate the weighted surface area of all protected sites within the buffer, multiplying each site's land area by its category weight, and then aggregate these weighted areas across all domestic facilities owned by the firm in a given year. The firm-level *CBE_IUCN* is defined as this aggregated weighted surface area scaled by the total weighted surface area of all designated protected areas in the U.S. in that year. This construction ensures that exposure to large, strictly protected areas carries greater ecological salience than exposure to smaller or less restrictive sites, enabling us to test whether proximity to ecologically critical zones amplifies information frictions in how investors process earnings news.

The second and third measures distinguish protected areas by governance authority. *CBE_Gov_Exposed* captures the surface area of government-managed protected lands, including federally designated sites (such as national parks, wilderness areas, and wildlife refuges) as well as state or local jurisdictions (such as state parks or conservation reserves). These areas typically benefit from statutory mandates, formal enforcement structures, and higher regulatory visibility, which may elevate their salience to firms and investors. In contrast, *CBE_Non_Gov_Exposed* measures the surface area of protected lands managed by non-governmental entities, such as private land trusts, community-based conservation initiatives, and NGO-administered reserves. Although these sites lack the same statutory enforcement mechanisms, they can nonetheless exert substantial influence through reputational pressures, local community mobilization, or targeted NGO campaigns. For each facility, we calculate the cumulative surface area of protected lands within 30 kilometers separately for government- and non-government–managed sites, and then aggregate these exposures across all facilities owned by the firm in a given year. Each firm-level measure is defined as the natural logarithm of one plus this aggregated area. By distinguishing governance regimes, these measures allow us to test whether the frictions associated with biodiversity exposure arise primarily from formal regulatory oversight or from reputational and community-based pressures.

Table **3** reports the results for the three alternative constructions of CBE, estimated using the specification in Column (5) of Table **2**. Across all definitions, the interaction between *RSUE* and the exposure measure is negative and statistically significant, indicating that biodiversity exposure dampens the market's response to earnings news regardless of how it is measured. The effect is weakest when exposure is defined using IUCN-weighted categories, somewhat stronger for government-managed lands, and most pronounced for non-government-managed lands. This pattern suggests that formal regulation and strict conservation designations provide clearer signals and reduce ambiguity, whereas exposure to NGO- or community-managed areas introduces greater reputational uncertainty and thereby stronger information frictions for investors. Overall, these results reinforce the robustness of our main finding while highlighting the particular importance of reputational and community-based oversight in shaping how biodiversity exposure conditions the market's interpretation of earnings news.

Having established that our main result is robust across alternative constructions of biodiversity exposure, we next examine whether its influence extends beyond announcement returns to other dimensions of market responsiveness.

4.3. Alternative Dimensions of Market Responsiveness

To examine whether the impact of biodiversity exposure extends beyond announcement returns, we re-estimate the baseline specification using abnormal trading volume and abnormal bid-ask spreads as alternative outcomes. variables capture distinct dimensions of market responsiveness to earnings news (e.g., Atiase et al., 1994; Bamber et al., 2011; Tsang et al., 2025). Specifically, *AbVolume[0,1]* is defined as the change in average log dollar trading volume over the two-day announcement window relative to the prior 30-day average, while *AbSpread[0,1]* is defined as the change in average bid-ask spreads over the same window, scaled by the midquote and expressed in percentage terms. Dollar volume is calculated as price multiplied by shares traded. Higher values of *AbVolume[0,1]* and lower values of *AbSpread[0,1]* indicate stronger market responsiveness. The regression specification mirrors Eq. 1, with firm and quarter-year fixed effects and standard controls, but replaces the earnings surprise term with its absolute value ($AbsSUE$) because both outcomes are unsigned.

Table 4 reports the results. In Column (1), the coefficient on CBE is negative and statistically significant, indicating that firms with greater biodiversity exposure exhibit smaller abnormal increases in trading volume around earnings announcements. In Column (2), the coefficient on *CBE* is positive and significant, showing that these firms experience widening bid-ask spreads during the announcement window. Together, the results indicate that biodiversity exposure dampens investor trading responses and reduces liquidity at the time of disclosure. Both outcomes reinforce the return-based evidence: proximity to biodiversity-sensitive areas not only weakens price reactions to earnings news but also suppresses trading activity and raises transaction costs. These complementary patterns suggest that biodiversity exposure introduces frictions into the information environment that operate across multiple market dimensions. By lowering trading volume and impairing liquidity, such frictions limit the efficiency with which earnings announcements are incorporated into prices, underscoring the broader impact of ecological factors on capital market functioning.

4.4. Validating Identification

4.4.1 Difference-in-Differences

To strengthen the causal interpretation of our findings, we implement a difference-in-differences (DiD) design that exploits the staggered timing of firms' initial exposure to biodiversity conservation areas. The design compares changes in market responsiveness to earnings news before and after a firm's facilities are first exposed to protected areas, defined as the year in which land within 30 kilometers of an existing facility receives legal conservation status, with contemporaneous changes for control firms whose facilities remain unexposed during the sample window. By leveraging within-firm variation and using untreated firms as a counterfactual, the DiD framework mitigates concerns about time-invariant firm characteristics and common shocks that might otherwise confound the relationship between biodiversity exposure and earnings responsiveness. If biodiversity exposure dampens responsiveness, we would expect treated firms to exhibit a decline in ERCs relative to control firms following the designation of nearby protected areas.

Our empirical strategy follows a stacked DiD specification that accommodates staggered treatment timing while preserving a clean control group and a consistent event-time window. For each firm, the year of initial exposure to a protected area is defined as the event year ($t = 0$), and we construct a symmetric seven-year window ($[-3, +3]$) around it. Each exposure event defines a cohort in which treated firms are those newly exposed in that year, and control firms are those that remain unexposed throughout the same window. By aligning firms within this uniform event-time structure, the stacked DiD specification provides a transparent estimate of how initial exposure to conservation areas affects the market's responsiveness to earnings announcements. The specification includes cohort-by-firm and cohort-by-quarter fixed effects, which absorb time-invariant firm characteristics and time-varying cohort shocks. Standard errors are clustered at the firm level.

$$\begin{aligned} AbRetn[0,1]_{it} &= \alpha_0 + \beta_1 Treat_i \times Post_{it} + \beta_2 RSUE_{it} \times Treat_i \times Post_{it} \\ &\quad + \sum_k \beta_k \text{Controls}_{ict} + \sum_j \beta_j (RSUE_{it} \times Controls_{ict}) + \phi_{ct} + \gamma_{ci} \\ &\quad + (RSUE_{it} \times \phi_{ct}) + (RSUE_{it} \times \gamma_{ci}) + \varepsilon_{it}, \end{aligned} \tag{2}$$

where i, t, and c denote firms, fiscal quarter-years, and event-time cohorts, respectively. $Post_{it}$ equals one for all quarters after a firm first becomes exposed to a protected area. Treated firms are assigned to cohort c based on the year of initial exposure. Firms whose first exposure occurs outside the seven-year event window remain coded as untreated ($Treat_i = 0$) and serve as controls within the corresponding window.

Column (1) of Table 5 reports the baseline stacked DiD results. The coefficient of interest is the triple interaction term, $RSUE_{it} \times Treat_i \times Post_{it}$. The estimate is negative and statistically significant (-0.009, $p = 0.024$), indicating that earnings announcements elicit weaker market responses after firms are first exposed to biodiversity-sensitive areas. This effect is consistent with the idea that new exposure creates localized risks, such as heightened regulatory scrutiny, litigation threats, or reputational concerns, that complicate how investors process earnings signals. Importantly, the coefficient on $Treat_i \times Post_{it}$ is statistically insignificant, showing that the effect is not driven by general valuation shifts but specifically by changes in the earnings-returns relation.

To assess timing and persistence, we estimate a dynamic DiD specification by replacing $Post_{it}$ with a full set of event-year indicators. Column (2) of Table **5** reports the results. The coefficients on the triple interaction terms, $RSUE_{it} \times Treat_i \times EventYear_t$, trace the evolution of the ERC around the time of first exposure. The pre-treatment coefficients ($t = -2$ and $t = -1$) are statistically insignificant, supporting the parallel-trends assumption and ruling out anticipatory effects. The decline in market responsiveness to earnings news emerges in the year of initial exposure ($t = 0$), intensifies in the following year ($t = +1$, coefficient -0.017, $p = 0.005$), and dissipates thereafter. Post-treatment coefficients at $t = +2$ and $t = +3$ are small and statistically insignificant. This temporal pattern indicates that biodiversity exposure dampens market responsiveness to earnings news primarily in the short run, as investors face heightened processing costs immediately after nearby land receives protected status.

The fade-out at $t \geq 2$ is consistent with learning or disclosure adjustments that gradually reduce processing costs over time. Framing this within the disclosure cost taxonomy of Blankespoor et al. (2020), biodiversity exposure may initially increase awareness costs (investors may not notice conservation designations near facilities), acquisition costs (linking geospatial exposure data requires effort), and especially integration costs (assessing how ecological proximity affects future cash flows is complex). The short-run decline in market responsiveness to earnings news at $t = 0$ and $t = +1$ aligns with heightened processing costs when firms are first exposed, while the subsequent fade-out suggests that awareness spreads, data become more accessible, and intermediaries such as analysts and ESG data providers help mitigate these frictions over time.

In summary, the DiD results corroborate our baseline evidence by showing that the attenuation of market responsiveness to earnings news is not explained by firm heterogeneity or common shocks. Instead, it emerges when firms become newly exposed to protected areas, with the effect concentrated in the first two years after exposure. The evidence supports a causal interpretation: proximity to biodiversity-sensitive areas introduces localized risks that heighten uncertainty and reduce the clarity of earnings signals in capital markets.

4.4.2 Falsification, Placebo, and Timing Tests

While the attenuation of ERCs among biodiversity-exposed firms is consistent with weaker market responsiveness, it is essential to verify that this finding does not reflect spurious associations or timing-related return dynamics. We therefore conduct a unified set of falsification, placebo, and timing tests to validate our interpretation. A falsification test examines whether the estimated effect appears in settings where it should theoretically be absent, thereby confirming that the result is not driven by correlated firm characteristics. In contrast, a placebo test evaluates whether the relationship arises at random or at the wrong time, ensuring that it is tied to genuine earnings events rather than spurious return patterns. Complementary timing tests, focusing on anticipatory pricing before announcements and post-earnings-announcement drift (PEAD) after announcements, further assess whether biodiversity exposure alters the temporal dynamics of price adjustment. Together, these analyses provide a comprehensive validation of both identification and timing, strengthening the causal interpretation of our results.

The first test addresses location-based confounding. If the observed attenuation merely reflects firm characteristics correlated with proximity to protected areas rather than the pollution-linked exposure that makes biodiversity proximity economically relevant, then similar patterns should appear for non-polluting establishments. To evaluate this possibility, we re-estimate Eq. 1 using a sample of non-polluting facilities located near protected areas, replacing CBE with $CBE\_Nonpolluting$. A significant negative coefficient on $RSUE \times CBE\_Nonpolluting$ would indicate that the weaker ERCs are not unique to polluting firms. As reported in Column (1) of Table **6**, the interaction term is statistically insignificant, suggesting that the attenuation effect is absent among non-polluting firms.

This pattern reinforces that the ERC attenuation is specific to environmentally impactful firms, consistent with biodiversity exposure increasing information-processing costs tied to polluting activities.

The second test evaluates spurious correlations in return dynamics. If the documented attenuation were driven by general patterns in stock returns or correlated firm traits rather than earnings-specific reactions, similar effects should appear around randomly chosen non-event dates. To assess this, we conduct a placebo test by re-estimating Eq. 1 using cumulative abnormal returns over the two-day window following randomly assigned pseudo earnings announcement dates within the same fiscal quarter. Because no earnings information is released on these pseudo dates, a significant $RSUE \times CBE$ coefficient would indicate that the attenuation arises from confounding return behavior unrelated to earnings announcements. As shown in Column (2) of Table **6**, the interaction term is small and statistically insignificant, confirming that biodiversity exposure does not predict abnormal returns outside the true announcement window.

The third test considers anticipatory pricing. Sophisticated investors or ESG-focused institutions might process biodiversity-related information before earnings announcements and adjust expectations in advance. If so, the weaker contemporaneous reaction could reflect earlier assimilation of relevant signals rather than reduced responsiveness. To evaluate this, we re-estimate Eq. 1 using cumulative abnormal returns over the 60 trading days preceding the announcement window ($[-60, -1]$). If anticipatory pricing were present, the coefficient on $RSUE \times CBE$ would be positive and significant in this pre-event period. As reported in Column (3) of Table **6**, the coefficient is statistically insignificant, indicating that biodiversity-exposed firms' earnings surprises are not systematically priced before announcements.

Finally, we test for delayed adjustment consistent with the PEAD anomaly. If biodiversity exposure increases disclosure complexity or amplifies uncertainty, investors may require additional time to interpret earnings signals, causing post-announcement adjustments that unfold gradually. We therefore re-estimate Eq. 1 using cumulative abnormal returns over the [2, 60] trading-day window. As shown in Column (4) of Table **6**, the coefficient on $RSUE \times CBE$ is again statistically insignificant, suggesting that biodiversity exposure does not lead to stronger drift or slower assimilation of information.

Taken together, these cross-sectional and timing-based validity checks confirm that the weaker ERCs of biodiversity-exposed firms are not driven by correlated firm characteristics, spurious return patterns, anticipatory trading, or gradual post-announcement adjustment. Instead, they reflect a genuine reduction in contemporaneous market responsiveness to earnings news, consistent with biodiversity exposure heightening information-processing costs and complicating investors' ability to interpret financial disclosures promptly.

5. Mechanisms and Additional Analyses

5.1. Mechanism Tests

Our results indicate that proximity to biodiversity conservation areas introduces information frictions that weaken the pricing of earnings news. These frictions arise not from missing information but from the complexity and costs of interpreting financial signals under ecological uncertainty. To examine this mechanism more directly, we assess whether the effect of CBE varies systematically with two contextual dimensions: the institutional environment and the firm-level information environment. The institutional environment captures ecological safeguards, regulatory enforcement, and local stakeholder oversight—factors that shape the salience and uncertainty of biodiversity-related exposures. The firm-level environment reflects disclosure quality, analyst coverage, institutional ownership, and external monitoring, all of which can mitigate information-processing costs. We expect the effect of CBE to be stronger in weaker institutional settings and attenuated where transparency and monitoring improve investors' ability to interpret spatial exposures.

5.1.1 Institutional Environment

Institutional settings play a central role in shaping how biodiversity exposure affects capital markets. Prior research on information frictions predicts that uncertainty and context-specific risks raise investors' costs of processing disclosures (Verrecchia, 1982; Diamond, 1985). Building on this framework, we examine three dimensions of the institutional environment: ecological fragility, regulatory salience, and stakeholder oversight. In each case, we expect the adverse effect of CBE on the market response to earnings news to be stronger where ecological protections are weak, enforcement is uncertain, or stakeholder oversight is limited.

We begin with ecological fragility. Fragile ecosystems and weak biodiversity protection frameworks heighten uncertainty about prospective liabilities and regulatory responses (TNFD, 2023; Giglio et al., 2023). In such contexts, investors anticipate greater risks of regulatory intervention, reputational costs, and operational restrictions, but the scale and timing of these exposures remain difficult to quantify. This uncertainty increases information-processing costs and amplifies the frictions induced by biodiversity exposure. To capture ecological fragility, we construct two indicators. The first, *Low_SpeciesProtect*, equals one for firms headquartered in states with below-median values of the Species Protection Index. The second, *Low_BioRating*, equals one for firms in states classified as facing "major challenges" in biodiversity outcomes. Both measures are drawn from the Map of Life project at Yale University.[5]

We next consider regulatory salience. Firms headquartered in jurisdictions subject to heightened environmental enforcement face binding compliance obligations and greater ambiguity about the cost and persistence of earnings. Such contexts highlight ecological risks but also complicate investors' assessment of future liabilities. We measure regulatory salience using county-level non-attainment status under the U.S. National Ambient Air Quality Standards (NAAQS). Non-attainment counties fail to meet federal thresholds for pollutants such

[5] Map of Life, Yale University: https://bgc.yale.edu/map-of-life.

as ozone or particulate matter and are subject to enhanced scrutiny, mandatory compliance plans, and potential penalties. Following Choy et al. (2024) and Dai et al. (2025), we define *Nonattainment* equal to one for firms headquartered in such counties. We expect the adverse effect of CBE on the market response to earnings news to be stronger in these jurisdictions.

Finally, we examine stakeholder oversight. In the absence of direct regulatory intervention, information frictions are likely greater where local monitoring of ecological risks is weak and potential liabilities are less visible. We proxy oversight using two county-level measures. The first, *Low_BioMedia*, relies on biodiversity-related newspaper coverage. Using the dictionary developed by Giglio et al. (2023) and applied to ProQuest newspaper articles between 1990 and 2021, we classify an article as biodiversity-related if it contains at least one keyword and assign local newspapers to counties following Gentzkow and Shapiro (2010). We then count articles by county-year and set *Low_BioMedia* equal to one if coverage falls below the sample median. The second measure, *Low_PopDensity*, is based on county-level population density from the U.S. Census Bureau. Since public scrutiny tends to be stronger in densely populated regions, we define *Low_PopDensity* equal to one for counties with below-median population density. Together, these measures capture local visibility and community-based monitoring, allowing us to test whether weaker stakeholder oversight heightens the information-processing costs associated with biodiversity exposure.

Table **7** presents the results. Across all five specifications, the triple interaction term ($RSUE \times CBE \times Indicator$) is consistently negative and statistically significant, indicating that the effect of biodiversity exposure on the market response to earnings news varies systematically with institutional context. The impact is stronger in states with weak species protection or low biodiversity ratings, consistent with fragile ecosystems and limited safeguards amplifying investor uncertainty and heightening information-processing costs. It is also more pronounced in non-attainment counties under federal air quality standards, where uncertainty about compliance obligations and exposure to potential liabilities raise the costs investors face in processing earnings information. Finally, the effect is largest in counties with limited biodiversity-related media coverage or low population density, where weak visibility and community monitoring restrict the flow of local information and increase the difficulty investors face in evaluating the implications of earnings news. Overall, these results show that institutional context conditions earnings responsiveness: fragile ecosystems, uncertain enforcement, and weak oversight all increase the costs of processing financial information.

5.1.2 Firm-Level Information Environment

Firm-level transparency and external monitoring also shape how biodiversity exposure is reflected in capital markets. The literature on information frictions suggests that clearer disclosures and the presence of sophisticated intermediaries reduce the costs investors face in processing complex information (Verrecchia, 1982; Diamond, 1985). We examine three dimensions of the firm-level information environment: disclosure, financial intermediation, and societal oversight.

The first dimension is disclosure. Explicit recognition of biodiversity-related risks in 10-K filings provides a credible signal of managerial awareness and helps investors assess the materiality of exposures that are otherwise spatially diffuse and complex. When firms identify biodiversity as a source of operational or regulatory risk, they lower investors' information-processing costs by reducing asymmetry and clarifying the channels through which exposure may affect future performance. To capture this dimension, we construct an indicator variable, *Biodiversity_Disc*, equal to one if a firm's 10-K filing contains biodiversity-related language, using the text-based classification of Giglio et al. (2023). This measure allows us to test whether transparency about ecological risks mitigates the adverse effect of CBE on the market response to earnings news.

The second dimension is financial intermediation by institutional investors, sell-side analysts, and the media. Institutional investors possess specialized expertise and portfolio-level incentives to evaluate environmental exposures and hold firms accountable through monitoring and engagement. Sell-side analysts translate complex or non-standard information into forecasts and recommendations, enabling dispersed investors to incorporate ecological risks into valuations. The news media plays a complementary watchdog role by amplifying the visibility of firms' environmental exposures and shaping public and investor attention, thereby increasing accountability pressures. Together, these groups lower information-processing costs by clarifying complex firm-level exposures. We measure this dimension using three indicators: *High_IO*, equal to one if institutional ownership is above the sample median; *High_Analyst*, equal to one if analyst coverage is above the median; and *High_Media*, equal to one if the firm's media coverage is above the median. These measures capture settings where sophisticated financial intermediaries are most likely to enhance the clarity of earnings signals.

The third dimension is societal oversight. Unlike disclosure or financial intermediaries, societal monitors operate outside financial markets but nonetheless influence how investors perceive firm behavior. NGOs, in particular, act as activist monitors by highlighting ecological risks, pressuring firms to adopt best practices, and providing independent verification of corporate claims. To capture this dimension, we construct *High_NGO*, equal to one if the firm is covered by the SigWatch database. This measure captures contexts where external scrutiny enhances the visibility of biodiversity exposure and helps reduce the opacity that would otherwise complicate investors' processing of earnings news.

Table 8 reports the results. Across all five indicators, disclosure, institutional ownership, analyst coverage, media coverage, and NGO monitoring, the triple interaction term ($RSUE \times CBE \times Indicator$) is positive and statistically significant, indicating that stronger information environments systematically mitigate the adverse effect of biodiversity exposure on the market response to earnings news. The dampening effect of CBE is especially evident for firms that explicitly disclose biodiversity risks, those with higher institutional ownership or broader analyst coverage, and those subject to greater media or NGO scrutiny. Overall, the results highlight that the effect of biodiversity exposure is not uniform across firms. The quality of the information environment conditions earnings responsiveness: where disclosure, financial intermediation, and societal oversight are stronger, information-processing costs are lower and market reactions are more efficient.

5.2. Additional Analyses

We perform a series of additional analyses to ensure that the observed attenuation in ERCs among biodiversity-exposed firms is not driven by omitted variables or correlated firm characteristics. These tests evaluate whether the documented effect of CBE on market responsiveness persists after accounting for firm-level, sustainability-related, and macro-environmental factors. Table **9** reports the results.

Column (1) adds a control for the geographic scope of operations, measured as the natural logarithm of one plus the number of polluting facilities. This addresses the concern that the CBE effect may simply proxy for firm size or operational breadth. Larger firms with broader operations are often more diversified and attract greater analyst coverage, which could mechanically weaken earnings responsiveness. By holding operational scope constant, we ensure that the CBE effect is not capturing scale-driven dynamics. Column (2) introduces the firm's overall ESG score to control for general sustainability performance. Firms with stronger ESG profiles may already face more scrutiny, attract ESG-oriented investors, and provide higher-quality non-financial disclosure. If this were driving the weaker ERCs, the CBE effect would disappear once ESG orientation is included. The persistence of the result after controlling for ESG suggests that biodiversity exposure represents a distinct information-processing channel, separate from broader sustainability performance.

Column (3) incorporates earnings quality, proxied by discretionary accruals estimated under the modified Jones model (Dechow et al., 1995). Because lower earnings quality can reduce reporting credibility and dampen ERCs, controlling for discretionary accruals helps disentangle biodiversity-related information-processing costs from frictions arising from accounting noise. Columns (4)–(7) introduce climate-related risk factors to ensure that biodiversity exposure does not simply proxy for broader environmental or policy risks. Following

Faccini et al. (2023), we include monthly indices capturing U.S. climate policy stringency, international climate summit activity, global warming trends, and natural disaster incidence. These macro-level variables reflect environmental and policy conditions that could influence firm performance or investor attention.

Across all seven specifications, the coefficient on $RSUE \times CBE$ remains negative and highly significant, with magnitudes close to those in the baseline model. This consistency indicates that the attenuation in earnings responsiveness is not driven by operational scale, ESG orientation, financial reporting quality, or correlated climate risks. Instead, the results confirm that proximity to protected areas introduces a distinct form of ecological complexity that increases investors' information-processing costs and weakens market reactions to earnings news.

6. Conclusion and Implications

This study investigates how corporate biodiversity exposure (CBE), defined as the spatial proximity of polluting facilities to conservation-priority areas, affects the market response to earnings news. We find that firms with higher CBE exhibit significantly weaker pricing of earnings surprises, consistent with biodiversity-related frictions that complicate how investors process earnings disclosures. These frictions are plausibly rooted in ecological uncertainty, regulatory and legal risks, and reputational pressures, which are compounded by the absence of standardized disclosure on biodiversity exposures. Beyond price reactions, we also document muted abnormal trading volume and wider bid-ask spreads for high-CBE firms around earnings announcements, consistent with reduced participation and heightened information risk. A stacked difference-in-differences design shows that this attenuation arises when firms become newly exposed to biodiversity-sensitive areas, confirming that the effect reflects exposure shocks rather than persistent firm traits. Complementary falsification, placebo, and timing tests further rule out correlated characteristics and spurious return dynamics, reinforcing a causal interpretation that biodiversity exposure weakens market responsiveness through informational channels. Together, the evidence indicates that CBE raises information-processing costs and dampens the capital market's responsiveness to core corporate disclosures.

Economically, weaker market response to earnings news reduces the precision of price discovery, with potential implications for firms' costs of capital and the allocation of capital across industries and regions. While we do not directly test long-run financing outcomes, prior research suggests that when investors face greater uncertainty in interpreting earnings signals, they demand higher risk premia, which raises the cost of capital and distorts capital allocation (Easley and O'Hara, 2004; Lambert et al., 2007). This implies that biodiversity exposure could deter investment in biodiversity-sensitive regions, redirect capital toward less-exposed firms or industries, and alter both the pricing of corporate securities and the geography of economic activity. Over time, such reallocations may depress growth in affected sectors, entrench financing disadvantages for exposed firms, and generate systemic distortions in how capital markets fund production. Investigating these longer-term consequences remains an important direction for future research. Our results therefore position biodiversity risk not merely as an ecological or regulatory concern but as a structural challenge for financial markets, given its potential to impede price discovery and capital allocation in ways that extend well beyond directly exposed firms.

For firms, the findings highlight the strategic value of contextualized biodiversity reporting in mitigating information frictions. Specifically, voluntary biodiversity disclosure, coupled with monitoring from analysts and institutional investors and external scrutiny from media and NGOs, attenuates the dampening effect of CBE on earnings responsiveness. These results suggest that strengthening the surrounding information environment can lower processing costs and improve how markets interpret earnings signals for biodiversity-exposed firms. For investors, the evidence underscores the importance of evaluating not only the degree of exposure to biodiversity risk but also the quality of the surrounding information and institutional environment. Assessing both dimensions is essential for accurately pricing risks and avoiding systematic misallocation of capital.

At the policy level, our findings support the growing emphasis on spatially explicit, standardized disclosure frameworks, such as the Taskforce on Nature-related Financial Disclosures (TNFD) and the European Sustainability Reporting Standards (ESRS). Such frameworks make biodiversity exposures more comparable, interpretable, and decision-useful. Incorporating biodiversity into financial reporting is therefore essential not only for improving valuation accuracy but also for sustaining the efficiency and resilience of capital markets as ecological constraints intensify.

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Figure 1. The Geography of Protected Areas in the United States

The figure maps all protected areas in the contiguous United States, excluding Alaska and Hawaii. The underlying data are obtained from the World Database on Protected Areas (WDPA). The horizontal and vertical axes represent geographic coordinates (longitude and latitude), allowing the spatial distribution of protected areas to be visualized across the continental U.S. Following the IUCN protected area management categories, strictly protected reserves and wilderness areas (Categories Ia and Ib) are shown in dark green, while categories II–VI (ranging from national parks to managed resource areas) are displayed in progressively lighter shades of green. This gradation highlights the variation in management objectives across protected lands, from strict biodiversity preservation to landscapes allowing sustainable use of natural resources.

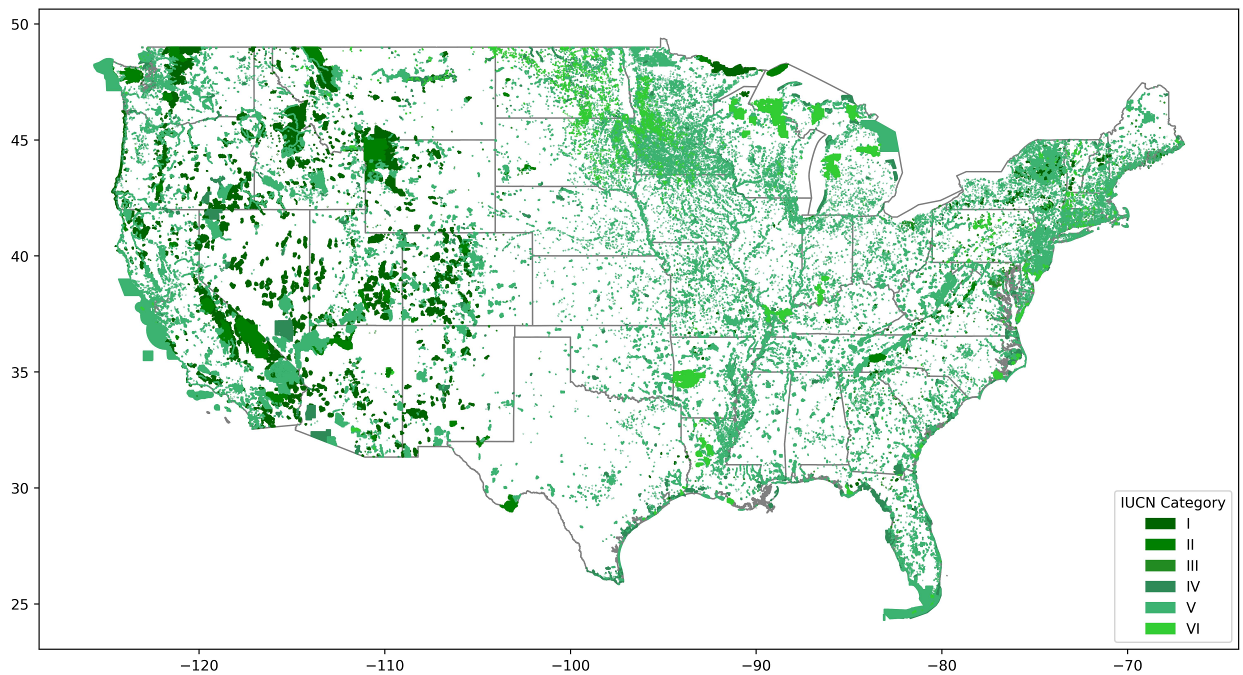

Figure 2. Toyota Motor Corporation's Production Facilities

The figure illustrates Toyota's two U.S. facilities that reported to the Toxics Release Inventory (TRI) in 1990, one in Long Beach, California (left image), and the other in Columbus, Indiana (right image), highlighted with red stars. Protected areas within a 30-kilometer radius are shaded in dark green. Our corporate biodiversity exposure (CBE) metric is defined as the total surface area of these proximate protected areas, expressed relative to the nationwide conservation footprint. This spatial overlay captures the extent to which a firm's operations are situated near ecologically sensitive zones, quantifying potential regulatory and reputational risks.

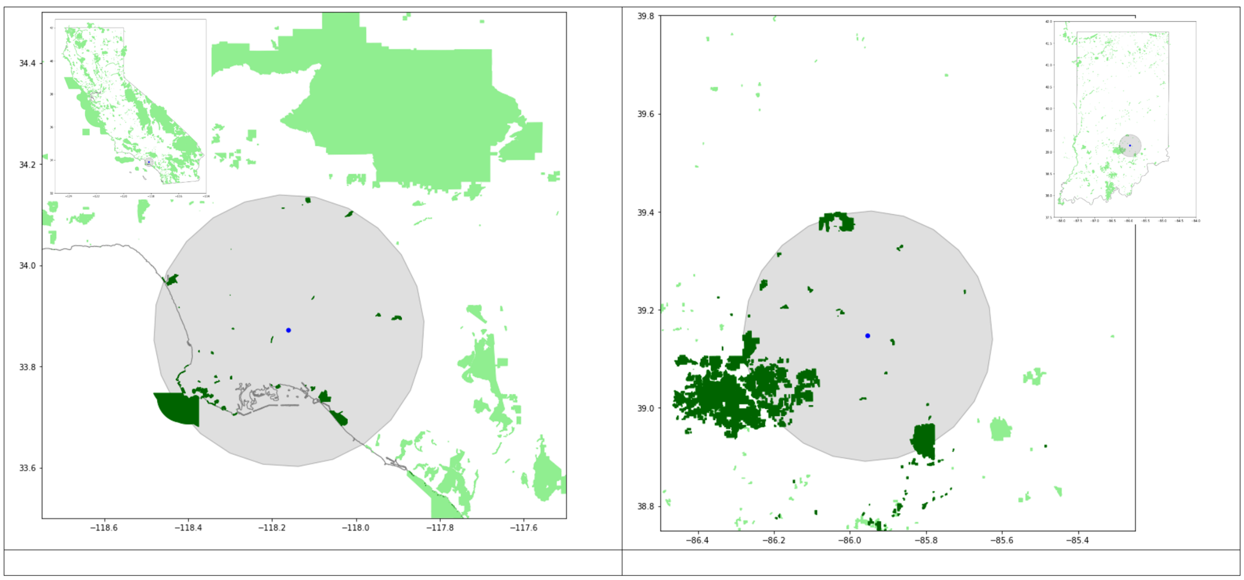

Table 1
Summary Statistics

This table reports descriptive statistics for the main variables used in our empirical analysis, including the number of observations (Observations), mean (Mean), standard deviation (Stdev), 25th percentile (25th), median (50th), and 75th percentile (75th) over the 1990–2020 period. Variable definitions are provided in Appendix A. All continuous variables are winsorized at the 1st and 99th percentiles, except for $AbRetn[0, 1]$.

	Observations	Mean	Stdev	25th	Median	75th
CBE	104181	0.126	0.408	0.000	0.007	0.068
$AbRetn[0, 1]$	104181	0.002	0.044	-0.025	0.001	0.029
$RSUE$	104181	-0.003	0.069	-0.001	0.000	0.002
$Size$	104181	7.540	1.878	6.216	7.484	8.841
$Leverage$	104181	0.564	0.212	0.430	0.569	0.694
BTM	104181	0.522	0.415	0.282	0.455	0.678
IO	104181	0.454	0.365	0.000	0.529	0.783
$LAnalyst$	104181	1.772	0.692	1.099	1.792	2.303
$EarnVol$	104181	0.442	0.599	0.120	0.239	0.494
$BadNews$	104181	0.419	0.494	0.000	0.000	1.000
$Loss$	104181	0.149	0.357	0.000	0.000	0.000
$Friday$	104181	0.093	0.291	0.000	0.000	0.000
$Prior\_AbRetn$	104181	-0.002	0.135	-0.068	-0.003	0.062

Table 2
Biodiversity Exposure and Earnings Response Coefficients (ERCs)

This table reports the effects of corporate biodiversity exposure (CBE) on the market's response to earnings news, proxied by earnings response coefficients (ERCs) estimated from cumulative abnormal returns $AbRetn[0,1]$. We estimate OLS regressions using test variables alone and in combination with alternative fixed effects (FE) specifications, including interactions between $RSUE$ and both firm and year-quarter FE. Variable definitions are provided in Appendix A. p-values, shown in parentheses, are based on heteroskedasticity-consistent standard errors clustered at the firm level. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively. The sample period spans 1990-2021.

	(1)	(2)	(3)	(4)	(5)
Dependent Variable			*AbRetn[0,1]*		
$CBE \times RSUE$	-0.007***	-0.007***	-0.008***	-0.007***	-0.005***
	(0.000)	(0.000)	(0.000)	(0.002)	(0.002)
CBE	0.004***	0.004***	0.005***	0.004***	0.004***
	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)
$RSUE$	0.039***	0.039***	0.034***	0.047***	
	(0.000)	(0.000)	(0.000)	(0.000)	
$Size$			-0.003***	-0.001***	-0.001
			(0.000)	(0.000)	(0.292)
$Leverage$			0.004***	0.008***	0.002
			(0.003)	(0.000)	(0.575)
BTM			0.007***	0.009***	0.008***
			(0.000)	(0.000)	(0.000)
IO			0.003***	-0.009***	-0.000
			(0.000)	(0.000)	(0.949)
$LAnalyst$			0.002***	-0.000	0.000
			(0.000)	(0.701)	(0.627)
$EarnVol$			0.000	-0.000	0.000
			(0.148)	(0.916)	(0.463)
$BadNews$			-0.003***	0.001	0.001
			(0.000)	(0.286)	(0.300)
$Loss$			-0.009***	-0.008***	-0.006***
			(0.000)	(0.000)	(0.000)
$Friday$			-0.001**	0.004***	0.002**
			(0.014)	(0.000)	(0.040)
$Prior\_AbRetn$			-0.007***	-0.006***	-0.007***
			(0.000)	(0.003)	(0.002)
$RSUE \times Size$				-0.002***	-0.004***
				(0.000)	(0.002)
$RSUE \times Leverage$				-0.009***	0.003
				(0.006)	(0.497)
$RSUE \times BTM$				-0.005***	-0.003*
				(0.000)	(0.070)
$RSUE \times IO$				0.022***	0.005*
				(0.000)	(0.096)
$RSUE \times LAnalyst$				0.005***	0.003**
				(0.000)	(0.029)
$RSUE \times EarnVol$				0.001	-0.000
				(0.383)	(0.714)
$RSUE \times BadNews$				-0.009***	-0.007***
				(0.000)	(0.005)
$RSUE \times Loss$				-0.003*	-0.007***
				(0.083)	(0.000)
$RSUE \times Friday$				-0.010***	-0.006***
				(0.000)	(0.000)
$RSUE \times Prior\_AbRetn$				-0.003	-0.004
				(0.464)	(0.324)
Constant	-0.018***	-0.018***	-0.004	-0.011***	0.012***
	(0.000)	(0.000)	(0.193)	(0.001)	(0.000)
Quarter-Year FE	No	Yes	Yes	Yes	Yes
Firm FE	No	Yes	Yes	Yes	Yes
$RSUE\times$ Quarter-Year FE	No	No	No	No	Yes
$RSUE\times$ Firm FE	No	No	No	No	Yes
Observations	104,231	104,181	104,181	104,181	104,181
Adjusted R^2	0.060	0.067	0.074	0.078	0.098

Table 3
Alternative CBE Measures and ERCs

This table revisits the baseline regression results by testing alternative measures of corporate biodiversity exposure (CBE), focusing on the market's responsiveness to earnings news as proxied by earnings response coefficients (ERCs). We test three alternative CBE dimensions: (i) ecological proximity (CBE_IUCN), (ii) exposure to governmental biodiversity regulations ($CBE\_Gov\_Exposed$), and (iii) exposure to nongovernmental scrutiny ($CBE\_Non\_Gov\_Exposed$). Variable definitions are provided in Appendix A. p-values, reported in parentheses, are based on heteroskedasticity-consistent standard errors clustered at the firm level. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

	(1)	(2)	(3)
Dependent Variable		$AbRetn[0,1]$	
$RSUE \times CBE\_IUCN$	-0.002***		
	(0.003)		
CBE_IUCN	0.001***		
	(0.000)		
$RSUE \times CBE\_Gov\_Exposed$		-0.005***	
		(0.002)	
$CBE\_Gov\_Exposed$		0.004***	
		(0.000)	
$RSUE \times CBE\_Non\_Gov\_Exposed$			-0.016*
			(0.050)
$CBE\_Non\_Gov\_Exposed$			0.009**
			(0.013)
Controls	Yes	Yes	Yes
$RSUE\times$ Controls	Yes	Yes	Yes
Quarter-Year FE	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes
$RSUE\times$ Quarter-Year FE	Yes	Yes	Yes
$RSUE\times$ Firm FE	Yes	Yes	Yes
Observations	104,181	104,181	104,181
Adjusted R^2	0.098	0.098	0.098

Table 4
CBE and Market Microstructure Responses

This table reports the effects of corporate biodiversity exposure (CBE) on alternative measures of market responsiveness to earnings news, proxied by abnormal trading volume ($AbVolume[0,1]$) and abnormal bid–ask spreads ($AbSpread[0,1]$). Columns (1) and (2) use abnormal volume and abnormal spread, respectively. Both measures are calculated over the two-day earnings announcement window. Variable definitions are provided in Appendix A. p-values, reported in parentheses, are based on heteroskedasticity-consistent standard errors clustered at the firm level. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

	(1)	(2)
Dependent Variable	$AbVolume[0,1]$	$AbSpread[0,1]$
CBE	-0.018**	0.011**
	(0.020)	(0.018)
$AbsSUE$	0.007	0.006
	(0.390)	(0.661)
$Size$	-0.043***	0.009***
	(0.000)	(0.009)
$Leverage$	0.008	0.042**
	(0.596)	(0.013)
BTM	-0.071***	0.018*
	(0.000)	(0.061)
IO	0.014	-0.011
	(0.119)	(0.110)
$LAnalyst$	0.066***	-0.006
	(0.000)	(0.160)
$EarnVol$	0.023***	-0.004
	(0.000)	(0.148)
$BadNews$	-0.044***	0.016***
	(0.000)	(0.000)
$Loss$	-0.063***	0.028***
	(0.000)	(0.000)
$Friday$	-0.036***	-0.010
	(0.000)	(0.133)
$Prior\_AbRet$	0.210***	-0.241***
	(0.000)	(0.000)
Constant	0.825***	-0.081**
	(0.000)	(0.015)
Quarter-Year FE	Yes	Yes
Firm FE	Yes	Yes
Observations	100,208	92,334
Adjusted R^2	0.200	0.048

Table 5
Stacked Difference-in-Differences (DiD) Estimates of CBE on ERCs

This table reports the effects of corporate biodiversity exposure (CBE) on earnings response coefficients (ERCs) using a stacked DiD design. The estimation sample is restricted to a symmetric seven-year event window [–3,+3], centered on the first year of exposure (Year 0). Firms whose first exposure occurs outside this window are assigned $Treat = 0$ and serve as within-window controls. The specification includes cohort-by-firm and cohort-by-quarter-year fixed effects. Variable definitions are provided in Appendix A. p-values, shown in parentheses, are based on heteroskedasticity-consistent standard errors clustered at the firm level. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

	(1)	(2)
Dependent Variable	$AbRetn[0,1]$	
$Treat \times Post$	0.002	
	(0.295)	
$RSUE \times Treat \times Post$	-0.009**	
	(0.024)	
$RSUE \times Treat \times t = -2$		0.003
		(0.700)
$RSUE \times Treat \times t = -1$		-0.004
		(0.504)
$RSUE \times Treat \times t = 0$		-0.012**
		(0.043)
$RSUE \times Treat \times t = 1$		-0.017***
		(0.005)
$RSUE \times Treat \times t = 2$		-0.007
		(0.250)
$RSUE \times Treat \times t = 3$		-0.003
		(0.687)
$Treat \times t = -2$		0.001
		(0.909)
$Treat \times t = -1$		0.002
		(0.658)
$Treat \times t = 0$		0.004
		(0.280)
$Treat \times t = 1$		0.007**
		(0.043)
$Treat \times t = 2$		0.000
		(0.930)
$Treat \times t = 3$		0.001
		(0.768)
Controls	Yes	Yes
$RSUE \times$ Controls	Yes	Yes
Cohort-Quarter-Year FE	Yes	Yes
Cohort-Firm FE	Yes	Yes
$RSUE \times$ Cohort-Quarter-Year FE	Yes	Yes
$RSUE \times$ Cohort-Firm FE	Yes	Yes
Observations	253,608	253,608
Adjusted R^2	0.122	0.122

Table 6
Falsification, Placebo, and Timing Tests for Reduced ERCs

This table reports regression results validating that the reduced earnings response coefficients (ERCs) observed among firms with high corporate biodiversity exposure (CBE) are not driven by correlated firm traits, spurious return dynamics, or timing-related mechanisms. Columns (1) and (2) present location and timing placebo tests designed to verify that the observed ERC attenuation is specific to polluting facilities and true earnings announcement windows, respectively. Columns (3) and (4) evaluate pre- and post-announcement timing mechanisms, anticipatory pricing and post–earnings-announcement drift (PEAD), to ensure that biodiversity exposure does not alter the temporal dynamics of price adjustment. The dependent variables are cumulative abnormal returns adjusted for size and book-to-market factors: $AbRetn[0,1]$ for the actual two-day earnings announcement window; $Random\_AbRetn[0,1]$ for pseudo-announcement dates; $AbRetn[-60,-1]$ for the 60-day pre-announcement window; and $AbRetn[2,60]$ for the 60-day post-announcement window. Variable definitions are provided in Appendix A. p-values, reported in parentheses, are based on heteroskedasticity-consistent standard errors clustered at the firm level. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

	(1)	(2)	(3)	(4)
Dependent Variable	$AbRetn[0,1]$	$Random\_AbRetn[0,1]$	$AbRetn[-60,-1]$	$AbRetn[2,60]$
$RSUE \times CBE\_Nonpolluting$	-0.008			
	(0.651)			
$CBE\_Nonpolluting$	0.023**			
	(0.026)			
$RSUE \times CBE$		-0.001	0.003	-0.003
		(0.502)	(0.591)	(0.736)
CBE		0.000	-0.002	0.005
		(0.537)	(0.489)	(0.304)
Controls	Yes	Yes	Yes	Yes
Quarter-Year FE	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes
$RSUE\times$ Quarter-Year FE	Yes	Yes	Yes	Yes
$RSUE\times$ Firm FE	Yes	Yes	Yes	Yes
Observations	152,167	104,181	104,181	104,181
Adjusted R^2	0.085	0.046	0.097	0.145

Table 7
Cross-Sectional Variation in CBE Effects by Institutional Environment

This table reports cross-sectional regression results analyzing how the association between corporate biodiversity exposure (CBE) and earnings response coefficients (ERCs) varies with institutional environment. We estimate interaction terms between $RSUE$, CBE, and indicator variables defined as follows: (i) *Low_SpeciesProtect*, equal to one if the firm's headquarters is located in a state whose Species Protection Index is below the sample median and zero otherwise; (ii) *Low_BioRating*, equal to one if the firm's headquarters is located in a state whose biodiversity rating is classified as "major challenges" and zero otherwise; (iii) *Non_attainment*, equal to one for firms headquartered in counties designated as non-attainment areas under the U.S. National Ambient Air Quality Standards; (iv) *Low_BioMedia*, equal to one for firms headquartered in counties with biodiversity-related media coverage below the sample median; and (v) *Low_PopDensity*, equal to one for firms headquartered in counties with population density below the sample median. The number of observations varies across columns due to data limitations in constructing the respective cross-sectional variables. Variable definitions are provided in Appendix A. p-values, reported in parentheses, are based on heteroskedasticity-consistent standard errors clustered at the firm level. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

	(1)	(2)	(3)	(4)	(5)
	Definition of *Indicator*				
	Low_SpeciesProtect	*Low_BioRating*	*Non_attainment*	*Low_BioMedia*	*Low_PopDensity*
Dependent Variable	*AbRetn*[0, 1]				
$RSUE \times CBE \times Indicator$	-0.015**	-0.012*	-0.011**	-0.016*	-0.012**
	(0.024)	(0.064)	(0.033)	(0.059)	(0.049)
$RSUE \times CBE$	0.003	0.003	-0.003	0.004	0.004
	(0.438)	(0.539)	(0.329)	(0.196)	(0.381)
$RSUE \times Indicator$	0.007*	0.005	0.008**	-0.008	0.007**
	(0.067)	(0.183)	(0.019)	(0.126)	(0.031)
CBE	-0.001	0.001	0.001	0.002	-0.002
	(0.678)	(0.945)	(0.562)	(0.139)	(0.312)
Controls	Yes	Yes	Yes	Yes	Yes
Quarter-Year FE	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes
Firm FE × *Indicator*	Yes	Yes	Yes	Yes	Yes
$RSUE$ × Controls	Yes	Yes	Yes	Yes	Yes
$RSUE$ × Quarter-Year FE	Yes	Yes	Yes	Yes	Yes
$RSUE$ × Firm FE	Yes	Yes	Yes	Yes	Yes
Controls × *Indicator*	Yes	Yes	Yes	Yes	Yes
Quarter-Year FE × *Indicator*	Yes	Yes	Yes	Yes	Yes
$RSUE$ × Controls × *Indicator*	Yes	Yes	Yes	Yes	Yes
$RSUE$ × Quarter-Year FE × *Indicator*	Yes	Yes	Yes	Yes	Yes
$RSUE$ × Firm FE × *Indicator*	Yes	Yes	Yes	Yes	Yes
Observations	68,092	68092	49,599	70,099	62,089
Adjusted R^2	0.178	0.177	0.208	0.118	0.130

Table 8
Cross-Sectional Variation in CBE Effects by Informational Environment

This table reports cross-sectional regression results analyzing how the association between corporate biodiversity exposure (CBE) and earnings response coefficients (ERCs) varies with disclosure and external monitoring. We estimate interaction terms between $RSUE$, CBE, and indicator variables defined as follows: (i) *Biodiversity_Disc*, equal to one if the firm discloses biodiversity exposure in its 10-K filings and zero otherwise; (ii) *High_IO*, equal to one if the firm's institutional ownership is above the sample median and zero otherwise; (iii) *High_Analyst*, equal to one if the firm's analyst coverage exceeds the sample median and zero otherwise; (iv) *High_Media*, equal to one if the firm's media coverage is above the sample median and zero otherwise; and (v) *High_NGO*, equal to one if the firm is covered by the SigWatch database and zero otherwise. The number of observations varies across Columns (1), (4), and (5) due to data limitations in constructing the respective cross-sectional variables. Variable definitions are provided in Appendix A. p-values, reported in parentheses, are based on heteroskedasticity-consistent standard errors clustered at the firm level. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

	(1)	(2)	(3)	(4)	(5)
	Definition of $Indicator$				
	Biodiversity_Disc	*High_IO*	*High_Analyst*	*High_Media*	*High_NGO*
Dependent Variable	*AbRetn*[0, 1]				
$RSUE\times$ $CBE\times$ $Indicator$	0.051***	0.009**	0.007*	0.009*	0.006*
	(0.001)	(0.025)	(0.076)	(0.070)	(0.078)
$RSUE\times$ CBE	-0.007	-0.005**	-0.007***	-0.008***	-0.006***
	(0.137)	(0.021)	(0.008)	(0.000)	(0.005)
$RSUE\times$ $Indicator$	-0.025***	-0.004*	-0.005**	-0.004	-0.003*
	(0.006)	(0.064)	(0.014)	(0.118)	(0.075)
CBE	0.003	0.003**	0.005***	0.004***	0.004***
	(0.327)	(0.013)	(0.000)	(0.000)	(0.009)
Controls	Yes	Yes	Yes	Yes	Yes
Quarter-Year FE	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes
Firm FE × $Indicator$	Yes	Yes	Yes	Yes	Yes
$RSUE$ × Controls	Yes	Yes	Yes	Yes	Yes
$RSUE$ × Quarter-Year FE	Yes	Yes	Yes	Yes	Yes
$RSUE$ × Firm FE	Yes	Yes	Yes	Yes	Yes
Controls × $Indicator$	Yes	Yes	Yes	Yes	Yes
Quarter-Year FE × $Indicator$	Yes	Yes	Yes	Yes	Yes
$RSUE$ × Controls × $Indicator$	Yes	Yes	Yes	Yes	Yes
$RSUE$ × Quarter-Year FE × $Indicator$	Yes	Yes	Yes	Yes	Yes
$RSUE$ × Firm FE × $Indicator$	Yes	Yes	Yes	Yes	Yes
Observations	47,654	104,181	104,181	65,022	104,181
Adjusted R^2	0.129	0.116	0.115	0.125	0.120

Table 9
Robustness Tests with Additional Controls

This table reports regression results evaluating the robustness of the main finding that corporate biodiversity exposure (CBE) weakens the market's responsiveness to earnings announcements, measured by earnings response coefficients (ERCs). "Columns (1)–(7) report results using additional firm- and macro-level controls. Columns (1)-(3) introduce additional firm-level controls. Column (1) includes the total number of plants operated by the firm (log-transformed); Column (2) adds the firm's ESG score; and Column (3) incorporates earnings quality, proxied by discretionary accruals estimated using the modified Jones model (Dechow et al., 1995). Columns (4)–(7) incorporate additional climate-related risk controls from Faccini et al. (2023): the U.S. Climate Policy Index, International Climate Summit Index, Global Warming Index, and Natural Disaster Index, all aggregated to the monthly level by averaging daily values. Variable definitions are provided in Appendix A. p-values, reported in parentheses, are based on heteroskedasticity-consistent standard errors clustered at the firm level. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Definition of *AddControl*						
	Total Plants	*ESG Score*	*Earn_Quality*	*Climate Policy*	*ClimateSummit*	*Global Warming*	*Natural Disaster*
Dependent Variable	$AbRetn[0,1]$						
$RSUE \times CBE$	-0.004***	-0.008***	-0.005***	-0.007***	-0.007***	-0.007***	-0.007***
	(0.009)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
CBE	0.003***	0.004***	0.004***	0.004***	0.004***	0.004***	0.004***
	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
$CBE \times AddControl$	-0.004*	-0.003	-0.005	0.002	0.002**	0.004	0.002
	(0.591)	(0.736)	(0.470)	(0.252)	(0.035)	(0.149)	(0.347)
$AddControl$	-0.002	0.001	-0.001	-0.003	-0.003*	-0.006	-0.005
	(0.178)	(0.894)	(0.928)	(0.412)	(0.099)	(0.217)	(0.254)
Other Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Quarter-Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
$RSUE$ × Other Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes
$RSUE$ × Quarter-Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
$RSUE$ × Firm Fixed	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	104,181	62,230	95770	68,743	68,743	68,743	68,743
Adjusted R-squared	0.136	0.166	0.140	0.116	0.116	0.116	0.116

Appendix A
Variables and their Definitions

Variable	Definition
Variables Used in the Main Analysis	
CBE	Firm-level exposure to protected areas is defined as the total surface area of protected areas (PAs) located within a 30-kilometer radius of each of the firm's polluting facilities, aggregated across all polluting facilities and scaled by the total area of designated PAs in the U.S. in the corresponding year.
$AbRetn[0,1]$	The size and book-to-market ratio-adjusted cumulative abnormal returns over the two-day trading window following the earnings announcement.
$RSUE$	The decile rank of standardized unexpected earnings (SUE), where SUE is calculated as the difference between the announced earnings per share (EPS) from I/B/E/S and the median of the most recent analyst earnings forecasts, scaled by the stock price per share at the beginning of the quarter.
$Size$	The natural logarithm of a firm's market value of equity at the end of the quarter.
$Leverage$	The leverage ratio, defined as long-term debt plus debt in current liabilities, divided by total assets.
BTM	Book value of equity divided by market value of equity at the end of the quarter.
IO	Proportion of shares held by institutional investors at the end of the quarter
$LAnalyst$	The natural logarithm of one plus the number of analysts who provide quarterly forecasts for a firm.
$EarnVol$	Earnings volatility, defined as the standard deviation of quarterly earnings over the past four years.
$BadNews$	Indicator variable equal to one if the earnings surprise is less than zero and zero otherwise.
$Loss$	Indicator variable equal to one if the firm's net income before extraordinary items is less than zero and zero otherwise.
$Friday$	Indicator variable equal to one if the earnings announcement is released on a Friday and zero otherwise.
$Prior\_AbRetn$	The size- and book-to-market ratio-adjusted cumulative abnormal returns over the 30 days before the test window.
Variables Used in Other Analyses	
CBE_IUCN	The weighted surface area of protected areas (PAs), where each PA's land area is multiplied by its IUCN protection category weight, located within a 30-kilometer radius of each of the firm's polluting facilities, aggregated across all polluting facilities and scaled by the total surface area of designated PAs in the U.S. in the corresponding year.

$CBE\_Gov_{E}xposed$	The total surface area of protected areas (PAs) located within a 30-kilometer radius of all firm-operated polluting facilities, conditional on at least one PA within the radius managed by a federal or local government agency. In case there are no government-managed PAs in this radius in a given year, the variable takes the value of 0 in that year. This metric is scaled by the total area of designated PAs in the U.S., in the corresponding year.
$CBE\_Non\_Gov\_Exposed$	The total surface area of protected areas (PAs) located within a 30-kilometer radius of all firm-operated polluting facilities, conditional on no government-managed PA, within the radius. In case all PAs are there are managed by a federal or local government agency within this radius in a given year, the variable takes the value of 0 in that year. This metric is scaled by the total area of designated PAs in the US, in the corresponding year.
$AbVolume[0,1]$	The difference between the average log dollar trading volume over the two-day window following the earnings announcement date and the average log dollar trading volume over the prior month. Daily dollar trading volume is calculated as the product of the daily closing price and the number of shares traded.
$AbSpread[0,1]$	The difference between the average daily bid-ask spread over the two-day trading window following the earnings announcement date and the average daily bid-ask spread over the prior month. The bid-ask spread is calculated as the difference between the offer price and the bid price, scaled by the midpoint of the two prices and multiplied by 100.
$AbsSUE$	The absolute value of earnings surprises.
$Treat$	Indicator variable equal to 1 if the firm is observed in a given quarter within a symmetric seven-year event window [-3,+3] surrounding its first exposure to protected areas located within a 30-kilometer radius of any of its facilities, and zero otherwise.
$Post$	Indicator variable equal to one for all quarters beginning with the first quarter in which the firm is first exposed to protected areas located within a 30-kilometer radius of any of its facilities, and zero otherwise.
$CBE\_Nonpolluting$	Firm-level exposure to protected areas is defined as the total surface area of protected areas (PAs) located within a 30-kilometer radius of each of the firm's nonpolluting facilities, aggregated across all polluting facilities and scaled by the total area of designated PAs in the U.S. in the corresponding year.
Random_AbRetn[0,1]	The size and book-to-market ratio-adjusted cumulative abnormal returns over the two-day trading window following a randomly assigned pseudo earnings announcement date within the same fiscal quarter.
AbRetn[-60,-1]	The size and book-to-market ratio-adjusted cumulative abnormal returns over the pre-announcement window.
AbRetn[2,60]	The size and book-to-market ratio-adjusted cumulative abnormal returns over the post-announcement window.
Low_SpeciesProtect	Indicator variable equal to one if the firm's headquarters is located in a state whose Species Protection Index is below the sample median, and zero otherwise.

Low_BioRating	Indicator variable equal to one if the firm's headquarters is located in a state whose biodiversity rating is classified as "major challenges," and zero otherwise.
Non-attainment	Indicator variable equal to one for firms headquartered in counties designated as non-attainment areas under the U.S. National Ambient Air Quality Standards.
Low_BioMedia	Indicator variable equal to one for firms headquartered in counties with biodiversity-related media coverage below the sample median.
Low_PopDensity	Indicator variable equal to one for firms headquartered in counties with population density below the sample median.
Biodiversity_Disc	Indicator variable equal to one if the firm discloses biodiversity exposure in 10-K filings and zero otherwise.
High_IO	Indicator variable equal to one if the firm's institutional ownership is above the sample median, and zero otherwise.
High_Analyst	Indicator variable equal to one if the firm's analyst coverage exceeds the sample median and zero otherwise.
High_Media	Indicator variable equal to one if the firm's media coverage is above the sample median.
High_NGO	Indicator variable equal to one if the firm is covered by the SigWatch database and zero otherwise.
Total_Plants	The natural logarithm of the total number of polluting plants operated by the firm in a given year.
ESG_Score	The combined ESG score of a firm in a given year.
EarnQuality	Discretionary accruals estimated using the modified Jones model (Dechow et al., 1995).
Climate Policy	US Climate Policy Index, obtained from Faccini et al. (2023), captures policy-related climate risk based on news coverage of U.S. climate policy actions and debates.
Climate Summit	International Climate Summit Index, obtained from Faccini et al. (2023), captures policy-related climate risk reflected in international climate negotiations and summits.
Global Warming	Global Warming Index, obtained from Faccini et al. (2023), measures physical climate risk related to global warming, proxied by news coverage of rising temperatures and long-term climate change trends.
Natural Disaster	Natural Disaster Index, obtained from Faccini et al. (2023), this index measures physical climate risk associated with extreme weather and natural disasters.

Appendix B
IUCN Protected Area Management Categories and Definitions

Category	Title	Definition / Management Objective
Ia	Strict Nature Reserve	Areas strictly set aside to protect biodiversity and/or geological features; human access and use are highly restricted, primarily for scientific research and monitoring purposes.
Ib	Wilderness Area	Large unmodified or slightly modified areas retaining natural character and influence; without permanent habitation and managed to preserve natural conditions.
II	National Park	Large natural areas set aside to protect ecological processes, species, and ecosystems; provide for spiritual, educational, scientific, and recreational uses.
III	Natural Monument	Areas set aside to protect a specific natural monument (e.g., landform, sea mount, cave, ancient grove); usually relatively small but of high conservation value.
IV	Habitat/Species Management Area	Areas aimed at protecting particular species or habitats, with management reflecting this priority; may require active interventions (e.g., habitat restoration, invasive species control).
V	Protected Landscape/Seascape	Areas where the interaction of people and nature has created a distinct landscape/seascape with ecological, cultural, and scenic value; management focuses on conservation and sustainable uses.
VI	Protected Area with Sustainable Use	Areas that conserve ecosystems and habitats together with cultural values and allow sustainable, low-level, non-industrial natural resource use.